SECTION 02010
DEMOLITION

PART 1 GENERAL

1.01 SUBMITTALS

A. At least 5 working days in advance of cutting operations, the Contractor shall submit a proposed schedule and methods for the demolition and cutting work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall perform the demolition required for joining and tying in new work to existing work. Items removed temporarily for the convenience of the Contractor shall be replaced to the satisfaction of the Owner's Representative.

1. Existing HDPE culverts and weir boxes identified for salvage shall be removed and transported to the storage area shown on plans or designated by the Owner's Representative.

2. Existing utilities, piping systems, telephone, communications, and data systems, and electrical and mechanical equipment to remain in place shall be adequately supported, protected, and maintained until work is complete.

3. Features or items that are damaged by the Contractor during the course of the work shall be repaired and restored to a state equal or superior to that which existed before the beginning of the work, as judged by the Owner's Representative.

3.02 WORK TO BE ACCOMPLISHED BEFORE DEMOLITION

A. The Contractor shall not begin demolition until the Owner's Representative has reviewed and accepted the Contractor's proposed schedule and methods of performing the demolition work.

B. The Contractor shall obtain and verify measurements for modification work and shall establish exact layouts, locations, lines, and elevations of work in relation to existing conditions.

C. Prior to commencing cutting operations in an area, the Contractor shall verify that:

1. All utilities and piping in the area are located.

2. Piping and utilities to remain in service are rerouted, or supported and protected.

3. Affected electrical equipment and circuits are deenergized and locked out.

4. Affected telephone, communications, and data lines are disconnected.

5. Affected piping is isolated, drained, flushed, or purged, and all valving to the lines is locked out.

3.03 DEMOLITION, SALVAGE, AND DISPOSAL

A. Piping, electrical and mechanical equipment and other items obstructing the new construction shall be carefully removed. Items designated as being salvageable in the contract documents shall be provided to Owner. The Contractor shall transport and store salvageable items on the premises as shown on plans or as directed by the Owner's Representative. Items that are not designated to be salvaged, or designated salvageable items in damaged and non-functioning condition, shall be immediately disposed of off the site in a lawful manner.

B. Unless otherwise shown on the drawings, piping that will be disconnected as a part of the work shall be removed if it is aboveground and abandoned in place if it is buried. Aboveground lines that enter the ground shall be cut off a minimum of 30 inches below grade and removed. The ends of abandoned-in-place lines shall be closed with welded or threaded caps, flanges, or concrete plugs. The supports for aboveground lines that are no longer required shall be removed. Lines that enter structures and are designated to be removed shall be flanged at both ends of the penetration through the structure.

1. Removal and lawful disposal of residual chemicals and piping containing chemical residues shall be the responsibility of the Contractor.

C. The Owner shall be immediately advised if utilities that are not shown on the drawings are encountered during demolition operations. Utilities shall not be disturbed until specific instructions are received from the Owner.

D. New work shall be joined to existing work as seamlessly as practicable.

E. Material that has been removed or demolished shall be immediately disposed of off the site in a lawful manner. While being handled and loaded, debris shall be moistened with water to settle dust. Upon completion of demolition work, the premises shall be left neat, clean, and in a condition to receive subsequent work.

END OF SECTION

SECTION 02110
CLEARING, GRUBBING, AND STRIPPING

PART 1 GENERAL

1.01 SUBMITTALS

1.02 Tree sealant: The proposed tree sealant shall be submitted for approval 30 days prior to the removal of branches from trees that are designated to remain in place.

A. Contractor shall provide submittals for removal of trees and shrubs within the limits of the trimming requirements. Submittals shall document the tree and shrub types, and the number and size of trees and shrubs.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SCHEDULING

A. Clearing, grubbing, and stripping shall be completed as a separate item of work before the beginning of excavation, stockpiling, trenching, or fill operations. The completed cleared areas must be approved by the Owner's Representative before the Contractor begins subsequent earthwork items.

B. Areas within the limits of excavation, embankment, shall be cleared, grubbed, and stripped as immediately prior to beginning earthwork as is practicable.

C. Borrow areas shall be cleared, grubbed, and stripped prior to use. These areas shall be cleared, grubbed, and stripped in stages, as necessary, to ensure that the borrow areas are not contaminated.

D. Areas to be used for temporary stockpiling of material shall not be cleared, grubbed, and stripped prior to stockpiling. Areas to be used for permanent stockpiling of material shall be cleared, grubbed, and stripped prior to stockpiling.

E. Clearing, grubbing, and stripping of the length of trench to be excavated each day shall be completed, and material from these operations shall be stockpiled away from the trench area, before the start of trenching.

3.02 PRESERVATION OF EXISTING CONDITIONS

A. Existing trees, shrubbery, other vegetation, wetlands and other areas of concern, structures, pavements, or utilities designated to remain in place shall be protected from damage resulting from the work.

B. Special protection shall be provided at wetlands noted on plans or indicated by the Owner's Representative.

C. Tree branches shall be cut and removed only where, in the opinion of the Owner's Representative, such cutting is necessary to effect construction operations. Tree branches other than those that must be removed to perform the work shall be trimmed to provide a balanced appearance.

3.03 CLEARING, GRUBBING, AND STRIPPING

A. General

1. Clearing, grubbing, and stripping shall extend not more than five feet beyond the limits of clearing, or excavations and fill slopes, and at no time beyond the limits of work.

2. Temporary surface, storm water, and erosion control in conformance with the storm water pollution prevention plan (SWPPP) shall be implemented concurrent with the clearing, stripping, and grubbing operations.

3. Waste-disposal areas shall be cleared, grubbed, and stripped only as necessary for the disposal of waste material.

4. Areas that have been cleared, grubbed, and stripped shall be maintained free of objectionable growth until the work has been completed.

B. Clearing

1. Clearing shall consist of cutting, removing, and disposing of objectionable material from the ground surface, such as trash, trees, brush, logs, stumps, weeds, grasses, fences, structures, and natural or artificial obstructions of any kind.
2. During the clearing process, trees shall be cut so that they fall into the area to be cleared. Trees and stumps requiring removal shall be cut to ground level where their root structures do not interfere with construction. If roots interfere with construction, they shall be removed up to 10 ft from the tree trunk, but as minimally as needed to proceed with construction.
3. Clearing shall also include the removal and disposal from the jobsite of trash piles and rubbish created prior to and during the construction work.

C. Grubbing

1. Grubbing shall consist of digging up, removing, and disposing of objectionable material found at or below the ground surface such as trash, trees, brush, logs, stumps, roots, and natural or artificial obstructions of any kind that will interfere with the required excavations and construction.

D. Stripping

1. Stripping shall consist of the removal of organic materials, sod, topsoil, grass, and grass roots from the areas designated to be stripped.
2. Except under previously existing paving or structures, or when otherwise shown on the drawings, existing soil materials shall be stripped to a depth of 6 inches below the original ground surface.
3. Stripped materials and topsoil shall be stored in accordance with Section 02200 and shall not be mixed with borrow materials.
4. The Contractor shall ensure that stripped materials and stockpiled topsoil are identified and marked so that they are not incorporated into fill or embankment.

3.04 DISPOSAL OF CLEARING, GRUBBING, AND STRIPPING DEBRIS

A. Burning of combustible materials will not be permitted.

B. Material removed from the jobsite shall be disposed of legally.

END OF SECTION

SECTION 02140
DEWATERING

PART 1 GENERAL

1.01 APPLICATION

A. Control of subsurface groundwater shall conform to this section. Control of site-surface water is specified in Section 02200.

1.02 SUBMITTALS

A. 10 working days prior to the start of the work, the Contractor shall submit to the Owner's Representative, for approval, a complete and detailed plan and description of the dewatering system he proposes to use for dewatering.

1. The Temporary Dewatering Plan shall consist of a drawing, or drawings, as necessary, showing the temporary drainage pipe and dewatering plan, including best management practices and any other measures proposed to be used to limit sediment and other sources of pollution from entering the adjacent waterways or disturbing adjacent activities on the property.

B. All decisions in regard to acceptability of groundwater exclusion methods will be made by the Owner's Representative and all such decisions shall be final.

1.03 QUALITY ASSURANCE

A. The discharge of water or drilling waste products shall be in accordance with the requirements of the federal, state, or local agencies having jurisdiction. The Contractor shall be responsible for determining the responsible authority and complying with its regulations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall maintain safe and stable excavations. Further, the Contractor shall be prepared to work with and in perched water conditions in localized areas.

B. Except for shutdowns for maintenance of dewatering equipment, no interruption in the approved dewatering procedures will be permitted during excavation and construction operations. Full time surveillance (24 hours a day) and maintenance of the equipment shall be provided by the Contractor to avoid breakdowns.

C. The system installed to lower the groundwater shall be capable of providing continuous and reliable draw throughout the construction period. The Contractor shall be responsible for the design, construction and maintenance of the dewatering system.

D. The Contractor shall keep a daily log of the flow rate. The information shall be transmitted to Owner's Representative on a weekly basis.

3.02 EARTHWORK

A. Dewatering shall not affect the bearing capacity of the subgrade soils at the proposed bottom of excavation.

B. Flotation of pipelines and structures shall be prevented by maintaining a positive and continuous removal of water until the construction is completed to the design grades.

END OF SECTION

SECTION 02200
EARTHWORK

PART 1 GENERAL

1.01 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.
2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. American Institute of Steel Construction (AISC)

C. American Society for Testing and Materials (ASTM)

1. ASTM D422, Standard Test Method for Particle-Size Analysis of Soils
2. ASTM D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
3. ASTM D1557, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/cu.ft. (2,700 kN-m/cu.m.))
4. ASTM D2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
5. ASTM D2487, Standard Practice for Classification of Soils for Owner's Representativeing Purposes (Unified Soil Classification System)
6. ASTM D4253, Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
7. ASTM D4829, Standard Test Method for Expansion Index of Soils
8. ASTM D4914, Standard Test Method for Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit
9. ASTM D5030, Standard Test Method for Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit

D. California Department of Transportation (Caltrans)

1. Caltrans Standard Specifications, 2006 Edition
2. Caltrans Standard Plans, 2006 Edition
3. Caltrans Trenching and Shoring Manual
4. California Well Standards: DWR Bulletin 74-81 and Supplemental Bulletin 74-90.

E. Standard Specifications for Public Works Construction (SSPWC)

F. United States Bureau of Reclamation (USBR), Earth Manual

1. USBR 7205, Procedure for Determining Unit Weight of Soils In-Place by the Sand-Cone Method
2. USBR 7230, Procedure for Determining Unit Weight and Moisture Content of Soils In-Place—Nuclear Moisture-Density Gauge

G. United States Naval Facilities Owner's Representativeing Command (NAVFAC)

1. NAVFAC Design Manual 7.01-Soil Mechanics
2. NAVFAC Design Manual 7.02-Foundations & Earth Structures

1.02 SUBMITTALS

A. Material Samples: Representative samples of materials to be imported shall be submitted as 100-pound bulk packages. The Contractor shall certify their compliance with these specifications.

B. Test Reports and Certifications: The following test reports and certifications shall be submitted.

1. Certifications that all materials used are in accordance with these specifications. Certifications of compliance shall be submitted for each material and shall contain the following:

a. Name of supplier

b. Type of material being supplied and available quantity

c. A statement that the material complies with these specifications

d. Copies of test results from a qualified testing laboratory

C. Permits: Copies of permits required to perform the work shall be submitted.

D. Plans, Calculations, and Procedures: The following plans, calculations, and procedures shall be submitted at least 10 working days prior to the start of the work.

1. A drawing and method statement for control and disposal of surface water, including storm runoff and construction water, from the works.

a. Control Of Water In The Work**:** If water is present, or anticipated in the work area, the Contractor shall prepare and submit to the Owner's Representative for review and approval a Temporary Dewatering Plan, per Section 02140.

2. Proposed excavation plans, schedule and sequence of earthwork operations, including phasing and staging, and stockpiling plans.

3. Detailed plans for the protection and the safety of workers when trenches and excavations are equal to or greater than 5 feet in depth. The plans shall include supporting design calculations and shall cite all references used to substantiate the calculations. If a support of excavation system is included in the plans, detailed procedures for the installation and removal of the support of excavation system shall be provided.

1.03 DEFINITIONS

A. Percent Compaction—The ratio of the field in-place dry density to the laboratory maximum dry density, expressed as a percentage.

B. Fill—For the purposes of this section, the words “fill,” “backfill,” and “embankment” are synonymous and refer to soils, rock, or soil-rock combinations that are conditioned, placed or replaced, and compacted to the percent compaction specified.

C. Geotextile—The words “geotextile” and “filter fabric” are synonymous.

1.04 QUALITY ASSURANCE

A. Imported materials shall match the initial samples

B. Certificates of Compliance

1. A certificate of compliance will not relieve the Contractor of responsibility for incorporating material into the work which is in accordance with the drawings and these specifications.

C. Submittals and supporting calculations for excavation plans, including, but not limited to, temporary sloped excavations, slope stabilization, and/or slope reinforcement, shall be prepared, signed, and stamped by a civil or geotechnical engineer currently registered in the State of California.

D. Submittals and supporting calculations for support of excavation systems, including, but not limited to, shoring, bracing, and/or sheeting, shall be prepared, signed, and stamped by a civil or structural engineer currently registered in the State of California.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill

1. Unless determined to be unsuitable by the Owner's Representative, or specified on plans, soils and earth materials obtained from required excavations may be used for fill.

   a. Soils from borrow sites outside of the Yolo Bypass are not allowed.

2. Fill materials shall be naturally occurring, well-graded soil or soil-rock combinations, free of wood, trash, construction debris, and organic, contaminated, or deleterious material. Fill materials shall have an expansion index of not more than 40 when tested in accordance with ASTM D4829.

3. Fill for trenches shall be free from unbroken masses of earthy materials that might arch or bridge and leave unfilled pockets.

4. Particle-Size Limitations

   a. The maximum particle size shall be 3 inches. Materials that are in excess of 3 inches in size may be placed in fill only with the approval of and under the direction of the Owner's Representative.

   b. The maximum particle size of fill materials placed within 3 feet of structures or pipelines shall be 3 inches.

5. The type of material used in the bedding, pipe-zone and backfill of trenches shall be as shown on the drawings.

B. Sand backfill and sand bedding shall have a minimum sand equivalent of 30 when tested in accordance with ASTM D2419. Gradation of the material shall be in accordance with the following:

U.S. Standard Sieve Size	Percentage Passing by weight
½-inch	100
No. 4	70-100
No. 16	50-90
No. 50	10-40
No. 200	0-10

C. Crushed aggregate base shall be in accordance with SSPWC Section 200-2.2, adhering to the gradation of SSPWC Section 200-2.2.2.

D. Crushed miscellaneous base shall be in accordance with SSPWC Section 200-2.4 fine gradation.

E. Permeable material shall be in accordance with Caltrans Standard Specifications, Section 68-1.025, Class 2 Grading.

F. Crushed rock shall be of the nominal size indicated on plans, in accordance with SSPWC Section 200-1.1 and Section 200-1.2 unless otherwise shown on the drawings or directed by the Owner's Representative.

G. Structural fill and backfill for precast concrete bridges shall be as specified on bridge specifications on the plans.

H. Pea gravel shall be primary aggregate size No. 4, in accordance with SSPWC Section 200-1.4.

I. CLSM (Controlled Low Strength Material) shall be in accordance with SSPWC Section 201-6.

J. Rip-rap.

1. Rock for rip-rap courses shall be Caltrans Backing 2.

2.02 EROSION CONTROL BLANKET

A. The ECB applied at elevations above 7.7 ft elevation shall be Excel R-1 All Natural as manufactured by Western Excelsior, 901 Grand Ave, Mancos CO 81328 (1-866-540-9810, www.westernexcelsior.com). Excel R-1 All Natural temporary Erosion Control Blanket is composed of a 100% High Altitude Rocky Mountain Aspen Excelsior matrix mechanically (stitch) bonded on two inch centers to a single biodegradable, jute/scrim net. The excelsior matrix consists of curled, machine produced fibers with greater than eighty percent longer than six inches. Stiching is comprised of cotton thread. Excel R-1 All Natural blanket is available in natural color or dyed green.

B. The ECB applied at elevations below 7.7 ft shall be Tackmatx All Natural as manufactured by Western Excelsior, 901 Grand Ave, Mancos CO 81328 (1-866-540-9810, www.westernexcelsior.com). Tackmatx consists of an extended term Rolled Erosion Control Product comprised of an excelsior matrix mechanically (stitch) bound to a single, natural 100% biodegradable net (top) and infused with polyacrylamide (PAM).

C. Contractor shall obtain approval of Owner's Representative prior to installing erosion-control matting. Duration of installation shall be approved by the Owner's Representative.

D. The ECB shall be identified by the following properties:

Property	Test Method	Value	Unit
Tensile Strength	ASTM D6818	6.3 (MD), 6.3 (TD)	lb/in
Elongation	ASTM D6818	5.0 (MD), 5.0 (TD)	%
Mass per Unit Area	ASTM D6566	11.5	oz/yd^2
Thickness	ASTM D1777	10.0	mm
Light Penetration	ECTC TASC 00197	50	% open
Water Absorption	ASTM D1117	375	%

E. The ECB may be furnished any of the following dimensions:

Roll Width	4 ft	4 ft	8 ft	8 ft
Roll Length	90 ft	180 ft	90 ft	450 ft
Coverage	40 yd^2	80 yd^2	80 yd^2	400 yd^2
Roll Weight	32 lbs	65 lbs	65 lbs	325 lbs
**Note: Roll weight measured at the time of manufacture.				

2.03 STAKES

A. Stakes shall be tapered Douglas fir of dimensions shown on the plans and conform to fabric manufacturer's specification. Installation of stakes, their location and number shall be according to manufacturer's recommendations and as shown on the plans.

2.04 SILT FENCE

A. Wire Supported and Self Supporting Silt Fence:

1. Geotextile Fabric

a. Fibers used in geotextiles shall consist of longchain synthetic polymers, composed of at least 85 percent by weight polyolefins, polyesters, or polyamides. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvages.

b. The geotextile shall be free of any treatment or coating which might adversely alter its physical properties after installation.
c. Geotextile shall be furnished in 36" width rolls.
d. Geotextile rolls shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure.
e. Each roll shall be labeled or tagged to provide product identification sufficient for inventory.
f. Rolls shall be stored in a manner, which protects them from the elements.
g. Geotextile shall conform to the following:

TABLE 1

PHYSICAL REQUIREMENTS[1] FOR

TEMPORARY SILT FENCE GEOTEXTILES

Property	Test Method	Wire Fence Supported Requirements	Self Supported Requirements
Tensile Strength, Lbs.	ASTM D4632	90 Minimum[2]	90 Minimum[2]
Elongation at 50% Minimum			
Tensile Strength (45 Lbs.)	ASTM D4632	N/A	50 Maximum
Filtering Efficiency, %	VTM-51[3]	75	75
Flow Rate gal/ft/min	VTM-51[3]	0.3	0.3
Ultraviolet Degradation at 500 hrs.	ASTM D4355	Minimum 70% Strength Retained	Minimum 70% Strength Retained

Notes: 1. All numerical values represent minimum average roll value.

A. When tested in any principal direction.

B. Virginia DOT test method.

2. Posts: Wood, steel or synthetic posts may be used. Posts shall have a minimum length of 36" plus embedment depth (24" min.). Posts shall have sufficient strength to resist damage during installation and to support applied loads.
3. Support Fence: Wire or other support fence shall be at least 24" high and strong enough to support applied loads.
4. Prefabricated Fence: Prefabricated fence systems may be used provided they meet all of the above material requirements.

PART 3 EXECUTION

3.01 PREPARATION

A. Underground Utilities and Substructures

1. Contractor shall arrange for utilities and substructures within the work areas to be located prior to sitework and identified with aboveground markers over their locations.
2. Underground Service Alert of Northern California and Nevada (USA North; telephone: 1-800-227-2600 or 811; website: www.usanorth.org) shall be given 2 working days, minimum, advanced notification of excavation.

3. Department of Oil, Gas, and Geothermal Resources (DOGGR; District 6 telephone: 1-916-322-1110 website: www.conservation.ca.gov/dog) shall be consulted on the location and condition of abandoned and active oil and gas wells onsite and the general vicinity. In the event a leaking well or pipeline is encountered, call 1-916-322-1110.
4. Utility and substructure installations and their general locations shown on the drawings may not be a complete listing.
5. Utilities and substructures that are encountered in work areas and that are not shown on the drawings shall be reported to the Owner's Representative immediately.
6. Where unidentified existing utilities are encountered and determined to be abandoned, only the interfering portions shall be removed, unless indicated otherwise on the plans. Work shall not be performed on an active utility without obtaining prior approval of the Owner's Representative and the utility owner. The Contractor shall not proceed without instructions, except to correct an immediate hazard or emergency condition. Work performed by the Contractor in the absence of written instructions will be entirely at Contractor's own risk.

B. Subsurface physical conditions or unknown physical conditions that are unusual in nature shall be reported to the Owner's Representative immediately and confirmed in writing.

C. Regulatory Requirements

1. Where buildings or other improvements adjacent to the excavation may be damaged by these operations, the Contractor shall act as agent of OWNER and give the notice required by Section 832 of the California Civil Code relating to lateral and subjacent support.
2. The amount of dust raised during earthwork shall not exceed the limitations of the Yolo-Solano Air Quality Management District.

3.02 PROTECTION, SHEETING, SHORING, BRACING, AND EXCAVATION SLOPES

A. Protection Plan: When necessary to prevent caving and to protect adjacent structures or property, trenches and excavations shall be protected, shored, sheeted, braced, or sloped in accordance with California Code of Regulations (CCR) Title 8 and the regulations of local authorities having jurisdiction. Where trenches and excavations are equal to or greater than 5 feet in depth, the Contractor shall submit to the Owner's Representative a detailed plan for the protection and the safety of workers. If the protection plan varies from the support of excavation system standards of CCR Title 8, the plan and supporting calculations shall be prepared, stamped, and signed by a civil or structural engineer currently registered in the State of California. All protection plans shall be submitted to the Owner's Representative for review and acceptance prior to their construction and use in the work. If the trench protection system includes the use of a shield, the design, construction, and manner of using the shield shall be clearly indicated in the protection plan.

B. The protection plans shall be prepared in accordance with the following, and shall include supporting design calculations and shall cite all references used to substantiate the plans and calculations:

1. Design calculations shall follow the guidelines set forth in CCR Title 8, Chapter 4, Article 6 of the Construction Safety Orders, and shall be performed in accordance with appropriate and applicable design codes, including the American Institute of Steel Construction (AISC).
2. Industry standard accepted methods of analyses shall be used, and shall conform to the Caltrans Trenching and Shoring Manual, the NAVFAC Design Manual 7.01-Soil Mechanics, or the NAVFAC Design Manual 7.02-Foundations and Earth Structures.
3. Excavation plans shall include analyses and calculations demonstrating the stability of sloped excavations. The minimum factor of safety for temporary sloped excavations shall be not less than 1.25.

4. Calculations shall clearly identify all assumptions, references, data sources, vertical and lateral loads, surcharge loads, design loads and parameters utilized, and intended setbacks, weights, and configurations of equipment and stockpiles.
5. If support of excavation systems, including, but not limited to, shoring, bracing, and/or sheeting, are included in the plans, the design calculations, structural members and connection details utilized, construction methodology, manner of using the support of excavation systems, and detailed procedures for the installation and removal of the support of excavation systems shall be provided.
6. Shoring members and shields used in the support of excavation systems shall be certified with signature and stamp by a civil or structural engineer currently registered in the State of California indicating that the shoring members and the shields meet the calculated loads.
7. Locations where the plans and the supporting design calculations apply shall be indicated on the plans and in the design calculations.

C. The Contractor shall furnish, place, and maintain supports and shoring that may be required for trenches and excavations and shall be responsible for damages related to their inadequacy or failure.

D. Excavation widths shall be increased accordingly to accommodate the protective devices, which shall be maintained in place during execution of the work. Temporary measures installed to protect workers, shoring, and bracing shall be removed on completion of the work.

E. Loose material that appears dangerous to workers or to new or existing facilities shall be removed as a part of the excavation work. An increase in the size of the excavation as a result of this removal shall not relieve the Contractor from the necessity of making the removal.

F. Existing utilities and structures to remain within the limits of the work shall be supported and protected to the satisfaction of the Owner's Representative and the owner of the utilities and structures. Plans, calculations, and supporting documentation requirements for the support and protection of utilities and structures shall be the same as specified herein for protection plans.

G. All temporary support of excavation systems shall be designed and installed to allow for their removal without causing damage to adjacent structures, facilities, pipelines, or improvements. Methods utilized to install and remove support of excavation systems shall induce minimal or no ground vibrations to existing and newly-constructed features, and adjacent ground. Dynamic methods for support of excavation installation and its removal, including pile driving and vibratory removal, are prohibited.

H. The minimum horizontal separation between the outside edge of any existing and newly-constructed pipeline, conduit, ductbank, structure, or any other feature, and any support of excavation element or excavation required to install any support of excavation element shall be 2 feet, unless otherwise noted.

I. Temporary excavations shall not extend or fall below a 1½H:1V (horizontal to vertical) plane that projects downward from the outer lowest edge of any existing and newly-constructed adjacent facilities and features, including, but not limited to, roads, bedding of buried pipes, and structural footings and concrete slabs. The minimum horizontal setback from the top of a temporary sloped excavation at the existing ground surface and the outside edge of any existing and newly-constructed pipeline bedding, structure, or any other feature shall be 5 feet, unless otherwise noted.

3.03 WATER CONTROL

A. Excavation shall include the removal of water. When encountered, subsurface water flow into excavations shall be controlled in accordance with Section 02140.

B. Plan

1. During the construction period, the Contractor shall submit a plan in accordance with Section 01070 that provides a system for the control of surface, storm, and construction water, including water emanating from utilities and structures. The method of disposal shall:

a. Prevent erosion

b. Maintain the stability of fill, excavation, grading work, and adjoining utilities, structures, facilities, and land areas

c. Not cause interruption in water conveyance and delivery from the Toe Drain to the property to the west of the project site. Additional detail will be provided upon request by the Owner's Representative during construction.

2. Earthwork shall not begin on the site until the plan and drawing submittals are approved by the Owner's Representative.

C. Water from the construction site and drainage from areas used or occupied by the Contractor shall be disposed of in accordance with the method approved by the Owner's Representative. The Contractor shall ensure that storm or drainage water reaching the construction area will not cause damage. The Contractor shall be responsible for personal injury or damage to property on or off Owner's land due to:

1. Uncontrolled storm or drainage water

2. Interruption or diversion of water because of Contractor's operations

a. Coordinate construction activities and associated dewatering with neighboring tenants' water supply needs. Diversion of water around construction by pumping may be required to ensure constant uninterrupted delivery.

D. Water from the dewatering activity will be disposed of in adjacent agricultural drainage and supply canals that are proximal to each active site.

E. Trench excavations shall not be used as drainage ditches.

3.04 EROSION CONTROL

A. Exposed areas of construction shall be protected from erosion by wind and water in accordance with Section 01070 until stabilization is achieved or the project is complete.

B. Where necessary because of the terrain, erosion-control matting shall be installed.

C. Erosion-control measures shall not be removed without the approval of the Owner's Representative.

D. Silt and debris shall be removed from check berms, basins, or other drainage-control features after each rainstorm until the project is complete.

E. Precautionary measures shall be provided to prevent erosion of completed, graded areas.

3.05 EQUIPMENT

A. Compaction Equipment

1. The type of compaction equipment, including hand-operated equipment, shall be suitable for the type of soil being compacted and shall be adequate to obtain the percent compaction specified with the method employed.

2. Crushed rock and pea gravel shall be compacted with vibratory compactors, as approved by the Owner's Representative.

3. Equipment for placement and compaction shall be maintained in good condition at all times to ensure that the results obtained are uniform and the maximum obtainable for the specified equipment.

4. Impact-type stompers will not be allowed adjacent to structures or for pipeline backfill.

B. Moisture-Control Equipment

1. The type and quality of equipment for applying water shall be adequate for the work. It shall not leak, and mobile equipment shall be equipped with distributor bars or other approved devices to ensure uniform application.

2. Water-supply trucks shall be equipped with meters, gauges, or other devices to measure the quantity of water dispensed.

3.06 CLEARING, GRUBBING, AND STRIPPING

A. Clearing, grubbing, and stripping shall be in accordance with Section 02110. Clearing, grubbing, and stripping shall be completed as a separate item of work before beginning the excavation, stockpiling, trenching, or fill operations.

3.07 EXCAVATION

A. Exploratory Excavation

1. The Contractor shall coordinate with Owner's Representative to excavate and expose buried connections to existing utilities, and crossings of existing utilities where indicated on the drawings. The Contractor shall use caution during excavation. Excavation shall be performed prior to the preparation of shop drawings for connections and before fabrication of pipe, and the data obtained shall be used in preparing shop drawings.

2. Data, including dates, locations excavated, and sketches, shall be submitted to Owner's Representative within one week of excavation. The data shall be sufficient to determine the horizontal and vertical locations of the points of connections as well as the slope of existing utilities adjoining the point of connection.

3. Damage to utilities from excavation activities shall be immediately reported to the Owner's Representative and repaired by Contractor.

B. Whenever excavated materials are to be used directly in fill or are stockpiled for later use in fill, the excavation and stockpiling shall be performed using equipment and procedures selected to minimize the effects of natural stratification and variations in material and to optimize conditioning of materials for compaction.

C. Excavations and overexcavations called out on the drawings shall be accurately made to the lines, grades, elevations, and cross sections shown on the drawings. The bottom of excavations shall be undisturbed soil or rock.

1. Overexcavation of trenches or of structure foundations will not be permitted, except as specified or shown on the drawings, or directed by the Owner's Representative. Any unauthorized overexcavation carried below the grade or elevation specified, or indicated shall be backfilled and compacted to the required grade with the indicated or other material as directed by the Owner's Representative at no additional cost. The Contractor shall also avoid unnecessary disturbance of adjacent ground.

2. Pipe Trenches

a. Trenches and excavations for pipe installation shall be excavated per details shown on the drawings and with adequate allowance for bedding.

b. Where the bottom of a trench excavation is found to consist of soft or unstable material, which is incapable of properly supporting the pipe, such material shall be excavated to a depth and for length required, as determined by the Owner's Representative to expose competent materials. The native material in the trench shall be scarified and recompacted, or removed and refilled to the required grade with sand or crushed aggregate backfill and sand or crushed aggregate bedding material or as directed the Owner's Representative, and compacted as specified.

c. For gravity lines, excavation and pipe installations shall start at the downhill point of connection and proceed uphill.

d. Excavation for piping and utility lines shall be open-cut trenches with vertical sides unless otherwise shown on the drawings. In locations where space permits, sloping trench excavations may be used with the approval of the Owner's Representative.

3. For manholes, valves, or other accessories, excavations shall be large enough to provide at least 12 inches horizontal clearance between the inside face of excavation or shoring, and the feature being installed.
4. Whenever overexcavation, inaccurate trimming, or other activities result in a trench bottom which fails to provide uniform support for pipe, conduits, ducts, or other similar facility, the Contractor shall:
   a. Remove pipe, conduits, or ducts that are placed.
   b. Refill to the required grade with approved compacted material.
   c. Retrim the trench to the required section and grade.
5. Obstructions within the limits of required excavations, such as boulders, tree stumps, abandoned pipes and structures, and debris of all types shall be removed as part of excavation work.

D. The bottom of all excavations shall be approved by the Owner's Representative. If the Owner's Representative determines that material encountered at the base of an excavation or at foundation grade is unstable or unsuitable, the material shall be removed to expose acceptable material and replaced with approved fill material.

E. Where the foundation material at the bottom of an excavation is disturbed or loosened during excavation or otherwise, the disturbed material shall be recompacted or removed and replaced with approved materials as directed by the Owner's Representative.

F. Excavation adjacent to existing pipelines, structures, or other features shall be extended evenly on all sides of the feature.

G. Cut Slopes

1. Cut slopes that remain as visible features of the completed work shall be trimmed to the lines and grades shown on the drawings as the excavation advances.
2. Debris and disturbed, loose material shall be removed.
3. When completed, the average plane of cut slopes shall conform to the slopes shown on the drawings, and no point shall vary more than ±6 inches, measured normal to the slope. Where excavation is in rock, no point shall vary more than ±2 feet from the designated plane of the slope unless otherwise shown on the drawings.
4. At no time shall cut slopes be overexcavated or disturbed by overripping. Overexcavated or overripped areas shall be repaired to the satisfaction of the Owner's Representative.
5. The surface of bare cut slopes shall be maintained in a stable condition and shall be protected from erosion until completion of the project.

H. Suitable excavated materials may be stockpiled in the Contractor's designated areas. Unacceptable fill materials shall be removed to the designated permanent stockpile area.

3.08 PREPARATION OF SUBGRADE AREAS

A. General

1. Materials shall be excavated to sufficient depth to ensure complete removal of loose, soft, weak, unstable, organic, or other materials determined by the Owner's Representative as unsuitable for ditch blocks, diversion structures, agricultural berms, and road beds. Road beds shall be stripped and disced to a depth of 4 inches as a minimum preparation measure prior to placing initial course of fill.
2. Rocks, stones, or other objects shall not intrude into the space in which structural concrete is to be placed. The Contractor shall completely remove or cut back protruding materials to the limits of structural concrete. Rocks or stones, including those cut back and trimmed, which in the opinion of the Owner's Representative are loose or otherwise unstable for the prepared foundation shall be removed.

3. Upon completion of excavation, loose material shall be removed from the foundation surface. Foundation surfaces on soils shall be prepared in accordance with these specifications for the particular feature to be placed upon them.

4. Subgrades shall be compacted per SSPWC Section 301-1.

5. After completion of preparation, the Contractor shall promptly place concrete, backfill, aggregate, base course, or fill, as the case may be, upon it to prevent deterioration of the surface. Where deterioration of the surface occurs due to air-slaking, mechanical breakdown, loosening from traffic, erosion, or other cause, additional excavation, compaction, foundation preparation, and cleanup shall be performed as required.

B. Where the bottom line of excavations cannot be cut to a uniform surface due to rock, debris, or other hard formation, the interfering formation or rock shall be removed to the prescribed lines and thoroughly cleaned of mud and debris. The resulting overbreak below the bottom line shall be filled to the required grade with approved soil or rock materials.

C. Unless otherwise specified or indicated on the drawings, foundations for structures and slabs on grade shall be supported on compacted materials as follows:

1. Required overexcavation and recompaction beneath foundations of any structure and for any concrete slab shall be carried to a minimum depth of 24 inches below the lowest elevation of the structural foundations and concrete slab.

2. The lateral limit of the required overexcavation and recompaction for foundations and concrete slabs shall extend a horizontal distance of at least 3 feet beyond the foundations and slabs, or equal to the depth of required excavation below the lowest elevation of the structural foundations or concrete slab, whichever is greater. The lateral extent of required excavation shall be measured from the outside edge of the structural foundation or concrete slab.

3.09 PLACEMENT AND COMPACTION OF FILL

A. The operations of material conditioning, filling, and compaction shall be systematic. Methods that are not conducive to achieving the required percent compaction shall be changed immediately, as directed by the Owner's Representative.

B. Material Placement and Moisture Conditioning

1. Fill materials that are to be compacted shall be placed in horizontal layers 6 inches thick, maximum, measured before compaction, unless otherwise specified.

2. Each layer shall be spread evenly over the entire area and shall be thoroughly mixed during the spreading to obtain uniformity of material and moisture in each layer.

3. At the time of compaction, the moisture content of the fill material shall be between -1 and +2 percent of optimum moisture content for coarse-grained soils and within 2 percent above optimum moisture content for fine-grained soils, unless otherwise specified. For this purpose, coarse-grained and fine-grained soils shall be as defined in accordance with ASTM D2487. This required moisture content shall be achieved in fill materials prior to transport to the fill area and shall be maintained uniformly throughout each layer of material until compaction of the layer is complete. Only minor, final corrections to moisture conditioning may be done in the fill area. When necessary before compaction, limited, controlled sprinkling followed by discing, or limited, controlled sprinkling followed by air-drying and subsequent discing, may be performed to obtain a uniform moisture distribution.

4. Non-conforming materials requiring significant moisture conditioning shall be removed from the fill area and processed as necessary unless methods are approved by the Owner's Representative.

5. After compaction and as determined by the Owner's Representative, each layer shall be sufficiently scarified to provide a bond with the next layer.

C. Crushed Aggregate Base Roadway Paving

1. Crushed aggregate base installation shall be performed as specified in SSPWC Section 301-2.

D. Filling Against Abutting Slopes or Inclined Surfaces

1. Existing surfaces that are inclined at 5:1, horizontal to vertical, or steeper shall be horizontally benched when new fill is to be constructed against them.
2. Existing surfaces shall be cleared, grubbed, and stripped in accordance with Section 02110 before being benched. Benches shall be cut into the existing surfaces, at least 2 feet horizontally into existing soil, beyond the plane of the cleared existing slope surface, or design slope of the dredged channel, to expose a vertical surface of competent material, 2 feet high.
3. Material cut from the existing slope shall be recompacted along with the new fill material at the Contractor's expense, unless additional excavation is ordered by the Owner's Representative. The additional excavation will be measured and paid for as unclassified excavation.

E. Foundation/Subgrade Protection

1. After completion of foundation/subgrade preparation, the Contractor shall promptly place the first layer of fill.
2. Where deterioration of the foundation/subgrade occurs before the material of the first layer is applied, additional excavation, foundation/subgrade preparation, and cleanup shall be performed as required at no additional cost to Owner.

F. Condition of Fill

1. The fill throughout the cross section shall be free of lenses, pockets, streaks, and layers of material differing substantially in texture or gradation from the surrounding fill.
2. The condition of fill materials shall be maintained so that the surfaces will readily drain at all times.
3. Materials that become soft, unstable, yielding, or exhibit pumping shall be removed.
4. Ruts in the surface of a layer of fill shall be filled and leveled satisfactorily before compaction.
5. Fill material shall be removed as necessary where gradation, expansion index, sand equivalent, placement, moisture content, or compaction of the fill materials does not fully comply with these specifications. Unsatisfactory material shall be removed promptly and replaced with material that is in accordance with these specifications, or it shall be blended, disced, moistened, recompacted, or otherwise reworked to achieve compliance.

G. Compaction Methodology

1. After being placed, mixed, and spread evenly, each layer of native fill shall be thoroughly compacted to a minimum of 90% percent compaction.
2. The equipment and the method employed shall be demonstrated to be capable of achieving the required percent compaction in a test fill or an area identified as a test fill. The method shall not be subsequently changed unless another test section validates the change.
3. Compaction shall be continuous over the entire area.

H. Surfaces that are ruptured or uneven after compaction shall be repaired and re-leveled before the next layer of material is placed. However, where the compacted surface of any layer of material is too smooth or too dry to bond properly with the succeeding layer, the Owner's Representative may direct that it shall be scarified to no less than 3 inches nor more than 5 inches in depth and conditioned prior to the placing of the next layer.

I. Fill Adjacent to Pipes and Structures

1. Backfill shall not be placed against a structure until the structure has been inspected by the Owner's Representative and approved for backfilling. Backfill material shall not be deposited or placed against

concrete structures until a minimum of 7 days has occurred after concrete placement, or the specified 28-day compressive strength of the concrete has been attained.

2. Appropriate precautions shall be taken when backfilling within 2 feet of pipelines or within 5 feet of walls or structures to avoid creating or imposing loads which could damage the pipelines, walls, or structures or which could cause the settlement lateral movement of the pipeline, walls, or structures.
3. Fill shall not be dropped directly upon pipes, structures, or conduits. At these locations, heavy compaction equipment shall not be used, and backfill shall be placed in layers 4 inches thick, maximum.
4. Each layer shall be thoroughly compacted with hand-operated, power-driven tampers.
5. In addition to lightweight compaction equipment, the Contractor shall use shoring or other means to avoid overstressing adjacent walls, structures, or pipelines.
6. The fill shall be brought up evenly on all sides of the feature.
7. Care shall be exercised to prevent damage to coating or membrane systems. The Contractor shall repair damage.

J. Ponding and Jetting

1. Compaction by ponding or jetting will not be permitted.

K. Slope Construction

1. Compacted fill shall be overbuilt sufficiently to permit trimming to the design lines in fully compacted material.
2. Fill slopes shall be constructed simultaneously with the embankment fill or general fill area.
3. No point on the completed slope shall vary from the designated plane by more than 6 inches, measured normal to the slope face.
4. The surface of the bare fill slope shall be maintained in a stable condition and shall be protected from erosion until completion of the project.

L. When rain or impending rain stops work on a section of fill, the surface shall be smoothened and sealed with drum or wheeled rollers to facilitate drainage. Before resuming work in this area and placing the next layer, the surface shall be scarified and moisture-conditioned as directed by the Owner's Representative.

M. Unless otherwise directed by the Owner's Representative, the plane surface of completed fill shall be evenly trimmed and then rolled with drum or wheel rollers to provide a tight surface.

N. Abrupt transitions of grade in the foundation upon which fill material is to be placed shall be trimmed or filled, as applicable, to provide a smooth, regular surface. Abrupt transitions of grade shall be avoided when placing fill.

O. Trenches in Fill

1. Whenever piping, plumbing, or other utilities are to be installed in fill, the elevation of the top of the compacted fill shall be constructed a minimum of 2 feet above the top of the included feature, and the appropriate trench shall be excavated for the installation.

P. Compaction Requirement

1. Unless otherwise specified on the plans or herein, fill shall be compacted to a percent compaction of 90 percent, minimum.
2. Fill in corrugated HDPE trenches shall be per Section 02610. The upper 3 feet of trench backfill below pavements shall be compacted to a percent compaction of 90 percent, minimum.
3. Fill used to construct roads, road beds, ditch blocks and berms shall be compacted to a percent compaction of 90%, minimum, with the exception that fill materials having 45 percent or more passing

the Standard No. 200 sieve shall be compacted to a percent compaction in the preferred range of 90 percent to 92 percent. The percent compaction of these materials shall not exceed 93 percent.

4. The 95 percent relative compaction requirement of these specifications shall be considered satisfied when both of the following are met:
   a. At least 17 of any 20 consecutive density tests in a zone yield dry densities that are equal to or greater than 95 percent of the laboratory maximum dry density.
   b. No density test yields a dry density less than 93 percent of the laboratory maximum dry density.
5. The 90 percent relative compaction requirement of these specifications shall be considered satisfied when all density tests yield dry densities that are equal to or greater than 90 percent of the laboratory maximum dry density.
6. Final subgrade surfaces shall be compacted to the specified percent compaction and moisture content and then protected until the Contractor is ready to place concrete, pavement, or structure.

3.10 BACKFILL SLURRY

A. Backfill slurry shall be used only where shown on the drawings or directed by the Owner's Representative. It shall be placed in a flowable condition, at a slump consistent with placement conditions, and shall be uniformly vibrated throughout its entire depth.

3.11 RIP-RAP

A. Non-concreted: Non-concreted rip-rap shall be placed in accordance with SSPWC Section 300-11.2, unless otherwise shown on the drawings.

B. Dumping: Placement of rock by dumping will not be permitted.

3.12 EROSION CONTROL BLANKET PLACEMENT

A. Blanket Supplier Representation

1. Contractor shall coordinate with the blanket supplier for a qualified representative to be present at the job site at the start of installation to provide technical assistance as needed. Contractor shall remain solely responsible for the quality of installation.

B. Site Preparation

1. Before placing ECB, Contractor shall certify that the ground surface has been properly compacted, graded smooth, is free of depressions, voids, soft or uncompacted areas, obstructions (such as tree roots, protruding stones or other foreign matter), and is seeded and fertilized in accordance with project specifications. Contractor shall proceed only when site is prepared as described herein. Initiation of construction signifies that Contractor has verified and accepted preceding work as in conformance with this specification.

2. Contractor shall fine grade the ground surface by hand or small machine, addressing where necessary to remove local depressions, voids, rills or accumulations.

3. No vehicular traffic shall be permitted directly on the erosion control blanket.

C. Channel Installation

1. The ECB shall be installed as directed by the owner’s representative in accordance with manufacturer’s installation guidelines (WE_EXCEL_R1AN_INL available at www.westernexcelsior.com or by manufacturer representative), staple pattern specifications and CAD drawings as provided by Western Excelsior.

2. Erosion control blanket shall be installed parallel to the flow of water. The first roll shall be centered longitudinally in mid-channel (lateral) and anchored with staples (2.02). Subsequent rolls shall follow from channel center outward and be overlapped as shown in manufacturer’s installation specifications (WE_EXCEL_R1AN_INL available at www.westernexcelsior.com or by manufacturer representative).

3. Successive lengths of erosion control blanket shall be overlapped sufficiently for a common row of staples with the upstream end on top (shingled). Staple the overlap across the end of each of the overlapping lengths so that staples anchor through the nettings and bodies of both blankets. Overlapping of blankets shall be conducted as per manufacturer's installation instructions (WE_EXCEL_R1AN_INL available at www.westernexcelsior.com or by manufacturer representative).

4. An anchor trench shall be constructed at the upstream termination and along the longitudinal edges to prohibit overland flow from proceeding unabated under the blanket. Erosion control blanket shall be stapled to the bottom of the trench. The trench shall be backfilled, compacted and wrapped with the remaining tail of the ECB as per manufacturer's specifications (WE_EXCEL_R1AN_INL available at www.westernexcelsior.com or by manufacturer representative).

D. Quality Assurance

1. Erosion control blankets shall not be defective or damaged sufficiently to compromise the specified performance. Damaged or defective materials shall be replaced at no additional cost to the owner.

2. Product shall be manufactured in accordance with a documented Manufacturing Quality Control Plan (MQCP). At a minimum, the following documentation shall be provided upon request:

a) Inspection report of material produced in manufacturing lot.
b) Recorded weight of each blanket as manufactured.
c) Verification of material conformance with MQCP.

3.13 SILT FENCE

A. General

1. Install along the toe of fills over 10' in height, along the right-of-way line, parallel to streams or around an inlet to prevent sediment from entering the pipe system.

B. General Requirements:

1. The Contractor shall install a temporary silt fence in locations shown on the drawings, around inlets that accept flows containing silt, and other locations necessary to prevent the discharge of silt from the site.
2. Installation shall conform to the detail at the end of this section.
3. Fence construction shall be adequate to handle the stress from hydraulic and sediment loading.

C. Installation

1. Geotextile at the bottom of the fence shall be buried as indicated on the detail.
2. The trench shall be backfilled and the soil compacted over the geotextile. The geotextile shall be spliced together as indicated on the detail.
3. Post Installation

a. Post spacing shall not exceed 8' for wire support fence installation or 5' for self supported installations.
b. Posts shall be driven a minimum of 24" into the ground. Where rock is encountered, posts shall be installed in a manner approved by the Owner's Representative.
c. Closer spacing, greater embedment depth and/or wider posts shall be used in low areas, soft, or swampy ground to ensure adequate resistance to applied loads.

4. When support fence is used, the mesh shall be fastened securely to the upstream side of the post.

a. The mesh shall extend into the trench a minimum of 2" and extend a maximum of 36" above the original ground surface.

5. When self-supported fence is used, the geotextile shall be securely fastened to fence posts.
6. Maintenance

a. The Contractor shall maintain the integrity of silt fences as long as they are necessary to contain sediment runoff.
b. The Contractor shall inspect all temporary silt fences immediately after each rainfall and at least daily, during prolonged rainfall.
c. The Contractor shall immediately correct deficiencies.
d. The Contractor shall make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness.
e. Where a single fence is not adequate to handle the volume of silt or flows are not completely intercepted, additional silt fences shall be installed.

7. The Contractor shall remove and dispose of sediment deposits when the deposit approaches one-half the height of the fence.
8. The silt fence shall remain in place until the upstream surface is stabilized. Upon removal, the Contractor shall remove the silt fence, dispose of excess silt, and restore the disturbed area in accordance with Section 02921.

3.14 DISPOSAL OF UNSUITABLE AND EXCESS SUITABLE MATERIALS

A. Unsuitable excavated materials, oversized materials, excess earth materials, rubble, broken asphalt concrete, broken concrete, waste derived from earthwork, and other construction debris shall be stockpiled at an approved location shown on the plans or at the direction of the Owner's Representative. Export of excavated material from the site is prohibited.

B. The Contractor shall obtain permission from the owner or agency concerned before material is disposed of, either temporarily or permanently, on privately or publicly owned property. Satisfactory written evidence that permission has been obtained shall be furnished to the Owner's Representative prior to the beginning of disposal activities.

C. When determined by the Owner's Representative that Owner can utilize suitable excess excavated materials in areas within the site other than those shown on plans, the Contractor shall haul and place the materials in the areas designated by the Owner's Representative. The suitable excess material stockpile site shall be cleared, grubbed, and stripped as specified in Section 02110, and the stockpiled material shall be compacted and protected from erosion as specified. Materials shall be spread in layers not exceeding 12 inches in thickness, prior to compaction. A specified percent compaction requirement will not apply. Each layer of material shall be compacted by a minimum of two passes over the entire area of each layer with the equipment used for spreading. The exterior slope of the stockpile shall be inclined no steeper than 3:1 (horizontal to vertical). The top of the final configure stockpile shall have a uniform slope of between 2 percent and 3 percent across the entire stockpile to facilitate drainage.

D. Temporary Storage

1. Materials to be used for earthwork or materials to be disposed of offsite may be temporarily stored in areas of the site assigned for the use of the Contractor.

3.15 BLASTING

A. Blasting will not be permitted.

3.16 SOIL PREPARATION OF AREAS TO BE SEEDED

A. Areas of excavation that are intended to be planted shall be "soil roughened" by discing, or other mechanical means approved by the Owner's Representative. Soil roughening methods shall be capable of loosening the soil to a minimum depth of 4 inches.

3.17 SITE TOLERANCES

A. Trench subgrade shall be established to within ±0.10 foot of the subgrade level shown on the drawings.

B. Top of bedding for pipelines shall be within ±0.02 foot from the specified grade. Variations within this tolerance shall be compensating so that the average design grade is achieved.

C. Grading or subgrading shall be performed to achieve the elevations shown on the drawings with well-compacted, reasonably smooth, and uniform transitions connecting adjacent areas. Final grading of the worksite shall blend with the contours of the adjacent areas and shall be subject to the Owner's Representative's approval. The finished surface of a graded area shall not exceed a variation of ±0.1 foot from the established elevation.

3.18 FIELD QUALITY CONTROL

A. Materials shall not be used until tested and approved by the Owner's Representative.

B. Tests

1. The Owner's Representative will observe all excavation, filling, and compaction operations. Contractor shall be responsible for performing tests during the progress of the work to determine compliance with these specifications. The Contractor shall cooperate and assist as required in the making of these tests and shall allow a reasonable time for them to be performed. Where the fill surface is disturbed, density tests will be made in the compacted materials below the disturbed zone.

2. Where tests indicate material, moisture, or compaction deficiencies, the Contractor shall recompact or, where necessary, remove the unsuitable material and replace with acceptable material compacted as specified.

3. Gradation testing will be in accordance with ASTM D422.

C. The laboratory maximum dry density and optimum moisture content will be determined in accordance with ASTM D1557, except that the laboratory maximum dry density for cohesionless, coarse-grained, and free-draining materials will be determined in accordance with the procedure for maximum density detailed in ASTM D4253.

D. The field in-place dry density for soils and earth materials containing individual particle sizes no greater than 1-1/2 inches in maximum dimension will be determined in accordance with ASTM D1556 using a sand cone or USBR 7230 using a nuclear meter.

1. The field in-place dry density for soils and earth materials containing individual maximum particle sizes greater than 1-1/2 inches but no greater than 5 inches in dimension will be determined in accordance with ASTM D4914.

2. The field in-place dry density for soils and earth materials containing individual particle sizes greater than 5 inches in maximum dimension will be determined in accordance with ASTM 5030.

E. The field in-place dry density and moisture content for soils and earth materials containing oversized particles will be corrected in accordance with the basic procedures of USBR 7205, Section 11, Method B.

F. For rapid-compaction control, the Contractor shall hire a third party inspector to provide the Contractor with field estimates of percent compaction, using a method that yields accurate and consistent results.

3.19 PROTECTION OF PAVEMENT SUBGRADE

A. Prepared pavement subgrade shall be prepared and maintained in finished condition until placement of the aggregate base course.

B. Unnecessary traffic shall be kept off prepared pavement subgrade. Equipment used for transporting materials over the subgrade shall be equipped with pneumatic tires. If travel over the subgrade causes damage to it, it shall be repaired by the Contractor as required by the Owner's Representative.

C. The subgrade shall be protected during inclement weather.

D. Pavement subgrade materials that become saturated due to incidental surface water or groundwater or inclement weather shall be removed and replaced to the specified conditions prior to placing the aggregate base course.

3.20 FINAL GRADING

A. Areas that are not paved shall be graded to the elevations shown on the drawings or if no elevations or instructions are shown such areas shall be graded to match surrounding areas.

3.21 CLEANUP

A. Before acceptance of the work, the Contractor shall clear work areas by removing equipment, barricades, surplus materials, and rubbish. The project site shall be left in a condition acceptable to the Owner's Representative.

END OF SECTION

SECTION 02610
CORRUGATED POLYETHYLENE PIPE AND FITTINGS

PART 1 GENERAL

1.01 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.
2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M252, Standard Specification for Corrugated Polyethylene Pipe (75 to 250-mm Diameter)
2. AASHTO M294, Standard Specification for Corrugated Polyethylene Pipe, 300 to 1500-mm Diameter

C. American Society for Testing and Materials (ASTM)

1. ASTM D1056, Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber
2. ASTM D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals
3. ASTM D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Materials
4. ASTM F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

D. Standard Specifications for Public Works Construction (SSPWC)

1.02 SUBMITTALS

A. Product Data: The Contractor shall submit material specifications and catalog cuts including recommendations for installation, delivery, storage, and handling.

B. Certification: Written certification that all materials and testing are in accordance with the requirements of this section shall be furnished.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Care shall be exercised in handling, loading, unloading, and storing pipe and fittings to avoid distortion, scratches, gouges, dents, and, in particular, scuffing of the ends.

B. All plastic pipe and fittings shall be stored under cover in a flat, horizontal position, and protected from the sun and the elements until ready for installation.

C. Plastic pipe shall be transported in a vehicle having a bed long enough to provide support for the full length of the pipe. Any length of pipe or fitting that has been damaged or distorted shall be replaced.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe and fittings shall be made from high-density polyethylene (HDPE) virgin compounds conforming to the requirements of ASTM D3350 with a carbon black content of 2 percent to 5 percent for color and as an ultraviolet light stabilizer.

B. Polyethylene pipe of 3 inches through 60 inches shall be Type S with exterior annular corrugation and smooth interior, extruded from virgin HPDE compounds conforming to the requirements of AASHTO M252 or M294, except as otherwise in this section.

C. Fittings shall be in accordance with AASHTO M252 or M294. Where angle points are shown on the drawings, the angles can be made up by standard or special fittings and/or mitered curves consisting of 4-foot pipe lengths and deflected pipe joints or couplings. All fabricated fittings shall be fabricated in the pipe manufacturer's shop.

D. Pipe joints shall have a rubber gasket and may be made up by a bell-and-spigot system or coupling that provides a watertight joint. Rubber gaskets shall be in accordance with ASTM F477, or ASTM D1056, Grade 2A2. Couplings shall be corrugated to match the pipe corrugations and shall also incorporate a rubber gasket to ensure watertight joints.

E. Lubricant shall be used to lubricate joints in accordance with the manufacturer's printed recommendations.

F. The proposed piping system shall be designed to withstand a hydrostatic test of 10.8 psi when tested in accordance with ASTM D3212.

G. Approved products shall be Advance Drainage Systems, Model N-12; Hancor, Model Blue Seal; JM Eagle "Eagle Corr PE (Dual Wall) or equal.

H. Pipe couplers shall be “Polyseal” couplers manufactured by Mar Mac Products.

I. Chain for pipe anchor shall be galvanized 5/8" grade 80 alloy chain.

J. Pipe anchor concrete: The specified 28-day compressive strength of concrete shall be a minimum 3,000 pounds per square inch (psi). Concrete shall be a quality mix consisting of Portland cement, fine aggregate, coarse aggregate, and water.

K. Geotextile fabric trench liner shall be as specified on drawings.

2.02 QUALITY CONTROL

A. A representative sample of each size and lot of the manufactured plastic pipe that will be used shall be furnished to the Owner's Representative for inspection and confirmatory testing. A copy of the manufacturer's certification that all tests for the pipe required herein have been met shall be submitted to the Owner's Representative.

PART 3 EXECUTION

3.01 PREPARATION

A. All joints, and the preparation thereof, shall be in accordance with the manufacturer's printed recommendations, as specified herein, and with ASTM D3212. All joints shall be watertight under pressure and all conditions of expansion, contraction, and settlement.

3.02 INSTALLATION

A. The Contractor shall install the pipe in the locations to the alignment and depth shown on the drawings.

B. Excavation and backfill shall be as shown on the drawings and in accordance with the manufacturer’s written instructions, and Section 02200.

C. All pipes shall be inspected prior to assembly for chipping or damage in handling and shall be repaired as directed by the Owner's Representative. All materials damaged, distorted by more than 5 percent of nominal dimensions, lost, broken or deemed unsuitable due to the Contractor's method of installation, handling or from neglect shall be replaced by the Contractor at his/her expense.

D. Pipe laying, bedding, and installation shall be in accordance with the manufacturer’s written instructions, SSPWC Sections 306-1.2.1, 306-1.2.2, 306-1.2.10 through 306-1.2.13, except Section 306-1.2.11, and as specified herein. Geotextile fabric trench liner shall be as specified on drawings.

E. When the entire pipe length requires the use of a pipe segment less than 10 feet in length, the contractor shall couple the smaller segment directly behind the first full segment of pipe. The contractor shall not use a pipe segment less than 10 feet in length as the outfall of the pipe.

F. Installation of polyseal couplers shall be performed in the dry. Any couplers that become wet during installation or otherwise damaged or lost shall be replaced by the Contractor at his/her own expense. Each end of the pipe being joined shall be carefully aligned such that the maximum offset of the interior pipe wall does not exceed ½ inch.

3.03 HDPE PIPE ANCHOR

A. HDPE culvert pipe shall be anchored in locations as shown on the plans. Anchor blocks may be precast or cast-in-place and shall be sized and embedded in concrete anchor blocks to the depth shown on the plans. Anchor chain shall fit snugly around the inside corrugation of pipe such that the pipe is secured by the weight of concrete anchor blocks.

END OF SECTION

SECTION 02950
PLANTING

PART 1 GENERAL

1.01 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.

2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. American Association of Nurserymen, Inc. (AAN)

1. AAN American Standard for Nursery Stock

C. The Jepson Manual: Vascular Plants of California (Jepson Manual)

1. Botanical and common names for container stock and seed material

1.02 SUBMITTALS

A. Product Data: The following product data shall be submitted:

1. Application and installation instructions for fertilizers, soil conditioners, pesticides, antidesiccants, and erosion-control materials.

2. Seed mix. Contractor shall coordinate with Owner's Representative to develop an acceptable seed mix.

3. Mulch material. Contractor shall coordinate with Owner's Representative to select an acceptable mulch product.

B. Material Samples: The following samples shall be submitted:

1. Selective herbicide container

C. Test Reports and Certifications: The following reports and certifications shall be submitted:

1. Certificates of Compliance

a. A certificate of compliance with each delivery or bulk material delivery, stating the source, quantity, and type of material. Written certificates providing the manufacturer's analysis shall be submitted at the time of each delivery for the following:

(1) Herbicides, fungicides, and pesticides

(2) Mulch material, including straw, and binder

(3) Grass seeds or grass-seed mixtures

b. The Contractor shall submit a certificate of compliance certifying that the stabilizing emulsion is in accordance with this section.

2. Certificates of Inspection: Certificates of inspection shall accompany each shipment confirming that the shipment is in accordance with federal, state, and county laws that require inspection for plant diseases and infestations of insects.

D. License: A copy of a current license to apply herbicides.

E. Schedules: The following schedules shall be submitted:

1. A site preparation schedule, at least 20 calendar days prior to the start of site preparation, indicating the dates for the start and completion of the following operations:

a. Surveying and staking site preparation areas

b. Commencement and completion of vegetation cutting and clearing

c. Commencement and completion of weed abatement activities (including herbicide applications)

2. A maintenance schedule, at least 20 days prior to the start of the warranty period, indicating the number of labor-hours for each maintenance operation in each season.

F. Manufacturer's Printed Instructions: Manufacturer's printed instructions shall be submitted (as applicable) for the following:

1. Quantity, type, and application rate of herbicides

1.03 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. Pesticides: Pesticides shall be delivered in original, unopened containers with a legible label indicating the Environmental Protection Agency (EPA) registration number and the list of manufacturer's registered uses.

B. Pesticide materials and desiccant shall be stored away from plant materials. Secondary containment is required for pesticide storage to prevent contamination from spills.

PART 2 PRODUCTS

2.01 GRASS MATERIALS

A. Straw

1. Straw shall be a threshed straw of native grasses, rice straw, or equal. It shall be free from noxious weeds and foreign material. Mulch material must be approved by Owner's Representative prior to application.

B. Grass Seed

1. Seed shall be certified, blue-tag, clean, and shall be delivered in original unopened packages bearing an analysis of the contents. The purity and minimum germination rate shall be as shown on the drawings.

2. Seed shall be in accordance with the regulations of authorities having jurisdiction. Seed mix must be approved by Owner's Representative prior to application.

PART 3 EXECUTION

3.01 PREPARATION

A. Protection

1. Sseeding work shall not begin until site preparation work has been approved by the Owner's Representative.

2. Existing vegetation, wetlands, and other resources designated to remain shall be protected prior to construction.

3. Adjacent properties and other site structures that may be damaged during seeding work shall be protected. Damage shall be repaired and the area returned to the previous condition.

B. Seeding

1. Planting operations shall be conducted under favorable weather and soil conditions, as determined by the Owner's Representative.

2. Seeding work shall be performed before October 15 during the year of mitigation site construction.

C. Surface Preparation

1. Seeded area surface preparation shall be performed after Clearing and Grubbing (Section 02110 and Soil Preparation (Section 02200) have been completed.

3.02 SEEDED AREAS

A. Preparing Seeded Areas

1. The ground surface of seeded areas shall be loosened to a minimum depth of 4 inches and shall be free of large rocks, roots, and other materials. Loose rocks greater than 1 inch and debris brought to the surface during cultivation shall be removed. Weeds and grasses shall be dug out by their roots and disposed of off-site.

2. Seeding will not be permitted when wind velocities exceed 15 miles per hour.
3. The soil shall not be worked when the moisture content is so high that excessive compaction will occur, or when the soil is so dry that dust will form and clods will not break readily. When necessary, water shall be applied to provide ideal moisture content for tilling and planting operations.

3.03 MECHANICAL SEEDING

A. Exposed soil surfaces will be revegetated with the following seed mix:

1. All exposed soil on improved road embankments shall be seeded with an upland seed mix (Table 1) with a broadcast applicator at the prescribed rate. Prior to application, the exposed surfaces to be seeded shall be roughened with a disc to a depth of 4 inches.

Table 1. Upland seed mix

Species		**Application Rate (lbs/acre)**
Escort (Escort sterile wheat)	Triticum X Agropyron	30
Creeping wildrye	Leymus triticoides	6
Meadow barley	Hordeum brachyantherum	12
Small fescue	Vulpia microstachys	10
California poppy	Eschscholzia californica	2
California goldfields	Lasthenia californica	2
Arroyo lupine	Lupinus succulentus	4

3.04 MAINTENANCE

A. Maintenance shall begin after each area is seeded, inspected, and accepted by the Owner's Representative and shall continue until the end of the warranty period.

B. Maintenance of new planting shall consist of:

1. Watering seeded areas to keep soil moist but not saturated.

C. Where seeded areas do not establish uniformly or properly, as determined by the Owner's Representative, the areas shall be reseeded with the same seed mix at the rates specified on the drawings.

D. Cleaning: Seeded areas shall be maintained free of debris for the duration of the maintenance period.

3.05 FIELD QUALITY CONTROL

A. Inspections

1. General: Inspections will be made by the Owner's Representative. When requesting on-site inspection, the Owner's Representative shall be notified at least 2 working days in advance.
2. On-site inspections shall be scheduled as follows:
   a. Pre-job conference.
   b. At completion of site preparation.
   c. At seeded areas prior to applying seed.
   d. After seeding has been completed.
   e. During final inspection at the completion of the maintenance period.

B. Plant Material Inspection

1. Eight weeks after initial seeding of the last section of completed seeded area, and within 15 days after receiving written notice from the Contractor, the Owner's Representative will make an inspection to determine if a satisfactory (i.e. 70% cover or greater) groundcover has been produced. If a satisfactory stand has not been established, an additional inspection will be made after the Contractor notifies in writing that the seeded areas are ready for inspection.

C. Review Before Maintenance Period

1. A review shall be held at the completion of seeding operations and prior to the beginning of the maintenance period.
2. Five working days prior to the completion of work, the Contractor shall notify the Owner's Representative to arrange a mutually agreeable time for review may be arranged.
3. At the time of review, the seeded areas shall be neatly cultivated and raked and shall be free of weeds, and debris.
4. When the Owner's Representative accepts that the work has been performed in accordance with the drawings and these specifications, a written notice of preliminary acceptance will be given.

D. Maintenance Period: When the Owner's Representative requires corrective action or replacement of the work during the maintenance period, it shall be performed within 10 days after the Owner's Representative's direction. Corrective work and replacement of materials shall be in accordance with the drawings and these specifications.

E. Final Acceptance: Within 20 days of the end of the Maintenance Period, the Contractor shall notify the Owner's Representative for a final inspection. An inspection will be arranged within 15 days of this date. A Notice of Completion may be given when the terms of plant warranty have been fulfilled and the condition of the project site is as required by these specifications.

END OF SECTION

SECTION 02952
EROSION CONTROL – POST-CONSTRUCTION BMPs

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Contractor shall be responsible for keeping effective and maintaining all post-construction Best Management Practices (BMPs) throughout the work until final acceptance of all work in the contract. Following final acceptance, Contractor shall remove post-construction BMPs after turbidity requirement is met, per SWPPP. Contractor shall then remove post-construction BMPs from the site.

1.02 SUBMITTALS

A. Prior to delivery to the site, the Contractor shall submit samples and manufacturers' literature for the following items:

1. Silt/Turbidity Curtains

B. The Contractor shall submit all laboratory test data for all filter materials to the Engineer for review.

C. Test Reports and Certifications: Certificates of Compliance.

PART 2 PRODUCTS

2.01 MATERIALS

A. Silt Curtains: Silt curtains shall be installed as appropriate where construction results in connection to open water outside of the perimeter of the project area.

1. Manufacturers: Geotechnical Supply Incorporated, Granite Environmental, Elastec

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation of silt curtains shall be in accordance with the manufacturer’s written instructions.

3.02 MAINTENANCE

A. During the entire period of construction and until final acceptance of all work by the Owner's Representative, the Contractor shall maintain all silt curtains, where appropriate, in working conditions, including installation of replacement filters at the frequencies as recommended by the manufacturer and when necessary.

END OF SECTION

SECTION 32 86 00
PUMP STATION

Part 1 - General

1.01 DESCRIPTION

This specification shall cover the supply of all labor, materials, and equipment required for Pump Station Installation –installation of a pump station structure, new pump, motor, electrical panel and controls(including connection to electrical service), and new discharge pipe and appurtenances.

1.02 SUBMITTALS

A. Manufacturers' data, specifications, as well as operation and maintenance manuals shall be submitted for the pump, motor, float switch assembly, and electrical panel, electrical controls and appurtenances, discharge pipe and combination air/vacuum valve.
B. Pump station structure plan: Contractor shall provide construction drawings and calculations for the pump station structure certified by a licensed CA structural engineer. Contractor shall provide pump station plan to the Owner's Representative for approval prior to construction.
C. Pump: Final design parameters for the pump flowrate, total design head (TDH), Motor HP rating, electrical service requirements, as well as a pump curve shall be submitted to the Owner's Representative for approval, prior to purchasing and installation.
D. Pump screen: trash rack design and materials shall be submitted to Owner's Representative for approval prior to construction.
E.
F. Contractor shall submit construction details for pipe hangers and connection of the pump discharge pipe to the pump station structure.
G. Contractor shall supply submittal of pump station testing plan two weeks prior to final pump station testing date.

1.03 INSPECTION

A. Discharge pipe installation shall be inspected prior to installing bedding and prior to installing backfill.
B. Continuous inspection of all pump testing is required.

Part 2 – Materials

2.01 GENERAL

The Contractor shall supply all materials not specifically listed as supplied by the Owner to complete the installation of water control structures including nuts, bolts, sealants, lubricants and all accessories recommended by the material manufacturer or necessary for a complete installation.

2.02 PUMP AND APPURTENANCES – NEW PUMP STATION

New Pump shall meet the following minimum criteria:

Flowrate: 20,000 gpm minimum
Total Dynamic Head = Approximately 10.2 feet (to be confirmed by the contractor & supplier).

2.03 MOTOR

The contractor shall provide a motor sized to provide maximum efficiency to sufficiently power the Contractor-supplied pump. Motor power shall be not more than 75 HP.

2.04 PUMP SCREEN – TRASH RACK

Suction bell shall be protected with screens or a trash rack. The contractor shall supply a trash rack sufficient to keep large objects/debris from entering the suction intake of the pump facility. The screen – trash rack shall comply with all applicable environmental regulations. The trash rack shall be constructed of galvanized steel, stainless steel, or approved equal. The openings of the trash rack shall be sized to block objects/debris, and adequately pass a sufficient amount of water to operate the pump. Trash rack shall be attached to the piles on the pump station structure.

2.05 ELECTRICAL SERVICE PANEL

The Contractor shall supply a service panel, all labor, equipment, new conduits, and wire that comply with building code, required to operate the pump. Service panel shall per Section 16342 and consistent with service for typical agricultural water pumping applications. Appurtenances shall include at a minimum a float switch assembly, stilling tube, float ball, rods and connectors necessary for a complete operating system.

Power drop and coordination with PG&E will be responsibility of the Owner. Supplying the electrical service panel and power connection from the panel to the motor will be responsibility of the Contractor. A motor saver shall be incorporated into the electrical service to the pump. Owner is responsible for any permits, if required.

2.06 MAINTENANCE GRATING

Steel grating shall be according to specification SECTION 05530 METAL GRATING.

Both bearing bars and cross bars shall be continuous. Openings and ends shall be banded with bars having the same dimension as the bearing bars. All platform grating shall be removable for maintenance activities.

2.07 DISCHARGE PIPE

Pump station discharge pipe shall be 30-inch O.D. ASTM A53 Grade B A36 steel with 3/8 inch (minimum) wall thickness.

2.08 AIR/VACUUM VALVE

Vacuum/air release assembly shall be a combination assembly. The air valve shall be 4-inch nominal size, minimum. The vacuum valve shall be 4-inch nominal size, minimum. Use Flomatic Maxair 6524, 4-inch air and vacuum valve, or approved equivalent.

2.09 FLAP GATE

Flap gate shall be per specification section 33 49 00 Water Conveyance Structures.

2.10 CHECK VALVES

Check valves shall be specified by the pump manufacturer and shall be adequately sized for the pump flowrate and discharge pipe size.

2.11 PILING

All pilings shall be galvanized structural steel. Pile length shall be sufficient to accommodate platform design elevations shown on plans and shall meet bearing length requirements identified in the geotechnical investigation report. The required pile depth stated in the geotechnical investigation report for eight-inch-deep, 31-pound-per-foot (8WF31) wide flange members isat least 25 ft at the pump station at the southeast corner of the project.
If 8WF31 wide flange members are not used for the pump station piles, equivalent driving depths must be determined for the chosen members by a certified CA geotechnical engineer.

2.12 APPURTENANCES

The Contractor shall supply all nuts, bolts, and all accessories necessary for a complete installation. All connections and hardware shall be galvanized or stainless steel.

Part 3 - Execution

3.01 PUMP AND MOTOR INSTALLATION

Installation of the pump and motor shall be performed in a manner such that the new facilities are not damaged during construction and installation activities. The Contractor shall install a complete pumping system including connection to new discharge pipe, support structure, and other appurtenances for a complete operating pump station. A large capacity manual oil lubrication oiler shall be installed on the pump motor. The contractor shall install anti-vortex or flow directing features as necessary to prevent cavitation or pump failure. The contractor shall install a float switch to control the pump during operation. The float switch shall turn off the pump when the water level falls below the minimum pumping level. Contractor shall verify minimum pumping level with pump supplier and confirm with the Owner's Representative that design grading is sufficient to accommodate this water level at the base of the pump. If required to meet minimum submergence, Contractor shall excavate canal bottom material as needed.

The pump and motor shall be anchored to the pump station platform structure with appropriate supports and anchoring materials. The pump supports shall be independent of the maintenance grating, and the grating shall not be used to support the pump or motor.

3.02 MAINTENANCE GRATING

Installation of the maintenance grating shall not interfere with the pump operation, components or access for maintenance operations. Gratings shall be installed on top of the new pump station platform and sufficiently anchored with galvanized or stainless steel hardware.

3.03 FLAP GATE INSTALLATION

Water control flap gate shall be installed to provide a seal with the pipe and in a manner consistent with the manufacturer’s installation guidelines. The Contractor shall install the gate with all necessary framework and hardware to allow efficient operation of the gate. Contractor shall provide necessary supports and bracing. The Contractor shall attach flap gates to concrete weir boxes with a bolted

connection. Bolts shall be precast into the concrete weir box to allow for unobstructed operation of the gate.

The Contractor shall be responsible for performing all final adjustments to control gates such that all operating mechanisms are smooth and a seal is achieved as is intended by the design and specifications of the gates.

3.04 DISCHARGE PIPE INSTALLATION

Installation of the discharge pipe shall extend from the pump to the discharge location in the Cross Canal. All pipe connections shall be welded or otherwise restrained to provide a leak free connection.

3.05 AIR/VACUUM VALVE INSTALLATION

A combination air/vacuum valve shall be installed near the end of the pipe as shown on the plans. Contractor shall install valve per manufacturer instructions.

3.06 PILE INSTALLATION

A. General: The Contractor shall provide the necessary driving equipment that is capable of driving the specified pile to the depth and alignment shown based site conditions and knowledge of equipment capability.

B. Drive piles without varying more than 2 percent from the vertical. Ensure that pilings are within 4 inches of the position shown on Contractor's pump station structure plan after driving.

C. Do not splice piling.

D. If driving piling causes adjacent piling to rise, drive them down again if the Owner's Representative requires.

E. Correct all damaged or misplaced piles, at the Contractor's expense, either by removing and replacing the pile, or by driving a second pile adjacent to the damaged or misplaced pile, as the Owner's Representative approves.

F. Drive piles continuously to the required depth, unless the Owner's Representative approves discontinuous driving. The Owner's Representative may review discontinuous driving at the end of the initial driving. Perform subsequent driving as the Owner's Representative directs. For the purposes of this subsection, consider discontinuous driving as an interruption to driving a pile that lasts 3 hours or more.

3.07 COMPLETED PUMP TESTING

The completed pump station shall be tested to determine efficiency and flow rate characteristics at a minimum. Testing shall consist of a minimum of three 1 hour constant rate pumping tests, followed by a 12 hour constant rate pumping test. A plan outlining the planned pumping tests shall be prepared by the Contractor and submitted to the Owner's Representative prior to 2 weeks before test.

In case of pump failure for a period greater than 1% of elapsed pumping time from t=0, test shall be suspended until static water level has been attained. Should test be aborted as a result of a deficiency on the part of Contractor's equipment or personnel, time waiting and rerunning the pump test to the point where it was aborted shall be at no additional cost to this contract.

3.08 LOGS AND CLEANUP

A. Logs

Contractor shall furnish daily records or logs, which will give flow rates, efficiency, drive motor voltage & amperage and other information that may be requested by the Owner's Representative or Owner.

B. Cleanup

Following completion of work, Contractor shall remove from jobsite all excess materials, tools, and equipment, and shall legally dispose of all debris resulting from the work. Contractor shall leave jobsite grading in a neat and clean manner.

*** END OF SECTION ***

SECTION 33 49 00
WATER CONVEYANCE
STRUCTURES

Part 1 - General

1.01 DESCRIPTION

The work in this section shall include the supply of all labor, materials, and equipment required to complete the installation of the water control structures, pipe anchors, precast concrete weir boxes, canal gates and maintenance access as called for on the plans and/or specified herein.

1.02 WORK INCLUDED

A. Installation of precast concrete weir boxes
B. Installation of canal gates.
C. Installation of flap gates.

1.03 SUBMITTALS

The Contractor shall submit for approval the materials and design specifications for the corrugated HDPE pipe, weir boxes and canal gates.

1.04 INSPECTION

The Contractor shall stop work and call for inspection at the following points of construction:

A. Before bedding of all structures and pipe.
B. Before backfill of all structures and pipe.

1.05 QUALITY CONTROL

All workmanship and materials furnished and supplied under this specification are subject to close and systematic inspection and testing by the Owner's Representative including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Owner's Representative reserves the right to reject any materials or works, which are not in accordance with the requirements of this specification.

The Owner's Representative shall be afforded full access for the inspection and control testing of materials, both at the site of work and at any plant used for the supply of the materials, to determine whether the materials are being supplied in accordance with this specification.

Part 2 - Materials

2.01 HDPE PIPE

HDPE (high density polyethylene) pipe shall be of the nominal size shown on the plans and as specified in Section 02610.

2.02 HDPE PIPE COUPLERS

Couplers shall be as specified in Section 02610.

2.03 HDPE PIPE ANCHOR

Pipe anchors shall be as specified in Section 02610.

2.04 PRECAST CONCRETE WEIR (WEIR BOX) WATER CONTROL STRUCTURES

Precast concrete weir box control structures (weir boxes) shall conform to the sizes and dimensions as shown on the plans. Weir boxes shall have an integral frame for stop logs. Each structure shall have an integral stub of like material and with dimension equal to that of the attached pipe as specified herein and on the plans. All structures shall be Twin Track weirs supplied from Briggs Manufacturing, Willows, CA or approved equal. Contractor shall purchase weir boxes with dimensional modifications as necessary to accommodate canal gates and flap gates.

2.05 CANAL GATES

Canal gates shall be Waterman C-10 or approved equal. Gate elevation control shall be provided by a threaded stem and handwheel mechanism attached to an integral support frame. The canal gate assembly shall be compatible with bolt mounting on a concrete weir box.

2.06 WOOD STOPLOGS

A complete set of stoplog boards shall be supplied for each structure. Each board will be cut to fit individual structures including a 3/8-inch clearance on each end to allow for swelling when wet. For weir structures 3 to 5 feet wide, stoplogs shall be 2x6 or 2x4 #2 Douglas Fir. Wood stoplogs shall be free of knots or knotholes.

2.07 ADHESIVE SEALANTS

Water tight adhesive sealant shall be used for attachment of HDPE pipe to all weir boxes. All surfaces shall be clean and dry prior to application. Adhesive sealants shall be allowed to cure in the dry and without disturbance in accordance with the manufacturer’s application instructions.

Weir boxes mounted to HDPE pipe shall be sealed with Henry 900 Construction and Flashing Sealant manufactured by Henry Company, or approved equal.

Part 3 - Execution

3.01 HANDLING AND STORAGE OF MATERIALS

All materials shall be handled and stored in careful and workmanlike manner to the satisfaction of the Owner's Representative.

Any cracks, chips, tears, dents, depressions, or other damage shall not be allowed and shall be replaced or repaired as directed by the Owner's Representative. The Contractor shall be responsible for replacement and reinstallation of any damaged structures, gates, pipe or other supplied materials to the project at his/her own expense.

3.02 WATER CONTROL STRUCTURE (WEIR BOX) INSTALLATION

The Contractor shall install all structures such that the structure is fully supported and level both in width and length. Excavation, base preparation, and backfill shall be performed in accordance with Section 02200, Earthwork, and according to the lines and grades specified on the plans. Installation not meeting this requirement shall be reinstalled at the Contractor’s expense. Attachment of pipe, support piles, and maintenance grating shall be as shown on the plans.

*** END OF SECTION ***

SECTION 05530
METAL GRATING

PART 1 GENERAL

1.01 REFERENCES

A. General

1. The publications listed below form a part of this section to the extent referenced.
2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. American Society for Testing Materials (ASTM)

1. ASTM A36, Standard Specification for Carbon Structural Steel
2. ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3. ASTM A153, Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
4. ASTM A307, Standard Specification for Carbon Steel Bolts and Studs (60,000 psi Tensile Strength)
5. ASTM A510, Standard Specification for General Requirements for Wire Rods and Course Round Wire, Carbon Steel
6. ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts
7. ASTM A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
8. ASTM F436, Standard Specification for Hardened Steel Washers

C. National Association of Architectural Metal Manufacturers (NAAMM)

1. NAAMM MBG 531, Metal Bar Grating Manual
2. NAAMM MBG 533, Welding Specifications for Fabrication of Steel, Aluminum, and Stainless Steel Bar Grating

1.02 SUBMITTALS

A. Product Data: Manufacturers' data and instructions on all grating systems shall be submitted.

B. Shop Drawings: Before beginning fabrication of gratings, the Contractor shall submit complete shop layout and detail drawings to the manufacturer showing size of panels and location of openings through the grating. Whether or not shown on the plans, standard trim banding shall be provided at the ends of all bearing bars, load banding shall be provided at all penetrations through the grating , toe boards shall be added, and any other item to be included with the grating.

C. Calculations for Contractor-developed details shall be submitted. Calculations shall be stamped and signed by a Civil Engineer registered in the state of California.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Grating shall be delivered to the site on pallets or other packaging suitable to protect the grating during shipping and jobsite storage and to keep items for a particular location or assembly together until they are installed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Size, type, and designation of grating shall be as shown on the drawings.

B. Carbon Steel Grating: Unless otherwise shown on the drawings carbon steel grating materials shall be as follows:

1. Bearing bars, banding, and toe plates (where specified) shall be in accordance with ASTM A36 or ASTM A1011.
2. Cross bars and connecting bars of rectangular section shall be in accordance with ASTM A1011. Round wire rod cross bars shall be in accordance with ASTM A510.

3. Saddle clips shall be in accordance with ASTM A36.
4. Bolts (heavy hex) and studs shall be in accordance with ASTM A307, Grade A.
5. Nuts shall be heavy hex nuts in accordance with ASTM A563, Grade A.
6. Washers shall be in accordance with ASTM F844, or when hardened steel washers are shown on the drawings, washers shall be in accordance with ASTM F436.

2.02 GRATING FABRICATION

A. General Requirements for Steel Grating

1. Gratings shall be fabricated to the dimensions shown and of the materials called out on the drawings.
2. For detailed grating information not specifically stated on the drawings, the grating shall be in accordance with this section, and the following criteria shall be used:
3. Pedestrian grating shall be welded type W-19-4 grating selected from the NAAMM MBG 531 tables for a uniform live load of 100 pounds per square foot and a concentrated point load of 300 pounds unless noted otherwise on drawings. The maximum allowable deflection shall not exceed 1/4-inch . Grating shall be positively anchored to the supporting framing or structure. Pedestrian grating shall be anchored by saddle clips with a minimum of 8 per grating panel. Banding:
   a. Banding bars shall be of the same thickness and depth as the bearing bars.
   b. Load banding shall be provided at all penetrations through the grating where more than 1 bearing bar is cut. Banding bars shall be welded at every intersection with grating bearing bars.
   c. Standard trim banding shall be provided at the ends of all bearing bars.
4. Welding of grating shall be in accordance with NAAMM MBG 533. Grating with welds not meeting the visual acceptance standards of NAAMM MBG 533 will be rejected and shall be replaced.
5. Toe plates shall be welded to the metal grating at all locations on the pump station platform. Toe plates shall be welded to ends, and where not present on sides of walkways. Toe plates shall be 4 inches tall above the top of the grating. Toe plates are not required for grating installed on top of weir box openings.

B. Carbon Steel Grating

1. Carbon steel grating shall be galvanized after fabrication in accordance with ASTM A123. Zinc coating shall have an average weight of 2.0 ounces per square foot and shall be not less than 1.8 ounces per square foot.
2. Attachment bolts, nuts, washers, and saddle clamps shall be galvanized in accordance with ASTM A153.

PART 3 EXECUTION

3.01 INSTALLATION OF GRATING

A. Supports shall be thoroughly cleaned before grating is installed on the supports.

B. Gratings shall be installed in the arrangement shown on the approved shop drawings.

1. Panels shall be placed with equal gaps between panels throughout the area covered.
2. Grating shall be installed level and firmly supported at bearing ends. Supports not providing level and firm support shall be adjusted or removed and replaced to provide support to the satisfaction of the Owner's Representative.

C. Pump station platform grating shall be anchored with a minimum of 2 welded or fastened attachments at each end of each panel and 1 welded or fastened attachment at the midpoint of each side of each panel for lengths greater than 4 feet. Weir box grating shall be attached with a minimum of 2 fastened attachments at each end of the panel.

D. Grating with banded holes that do not match the penetration or support intended to pass through them, or grating needing other modification shall be removed from the jobsite and repaired at the manufacturer's plant, or a new piece shall be fabricated to fit the conditions.

3.02 FIELD QUALITY CONTROL

A. Grating damaged or deflected due to overloading will be rejected and shall be replaced.

END OF SECTION

SECTION 05530
SAFETY WALKWAYS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install Grip Strut Grating, as specified, in all areas where shown on the drawings.

1.02 QUALIFICATIONS

A. All Grip Strut Grating and accessories, unless otherwise indicated, shall be manufactured by Cooper B-Line, and shall be installed in accordance with its current recommendations.

1.03 SUBMITTALS

A. The Contractor shall furnish shop drawings of grating layout, framing and supports, unit dimensions and sections, fastener and weld types and locations.

B. Calculations for Contractor-developed details shall be submitted. Calculations shall be stamped and signed by a Civil Engineer registered in the state of California.

1.04 STORAGE AND HANDLING

A. All materials shall be stored and handled to avoid damage. Damaged or deteriorated materials shall be removed from the premises.

PART 2 PRODUCTS

2.01 GRATINGS

A. Heavy-Duty Grip Strut Safety Grating Walkway, Catalog Number H-85010-W, 36” with 5” toe boards, 10 ga. (ASG steel), 8 diamond serrated, carbon steel, mill-galvanized before fabrication (ASTM A525).

2.02 ACCESSORIES

A. Heavy-Duty Grip Strut Hold-Down Clip, stainless steel, Catalog Number H-BC-10. Use with 3/8” square-shank carriage bolts, nuts, and washers obtained locally.

B. Heavy-Duty Grip Strut Splice Plate, Catalog Number P-H-Sp-U), 30”, 9 gauge mill-galvanized steel.

PART 3 EXECUTION

3.01 BEARING SURFACES

A. Prior to grating installation, inspect supports for correct size, layout and alignment, and verify that bearing surfaces are smooth and free of debris. Report in writing to the Owner's Representative any defects so they can be corrected before grating is installed.

3.02 GRATING INSTALLATION

A. Install grating in accordance with manufacturer’s recommendations and shop drawings. Position grating sections flat and square with ends bearing minimum 1-1/2” on supporting structure.

B. For sections over 12’-0” long, and when Heavy-Duty Grip Strut Hold-Down Clips are used, 3” minimum bearing surface is required.

C. Space grating sections a minimum 1/4” from vertical steel sections, and 1/2” from concrete walls. Allow maximum clearance between sections at joints of 1/4” at side channels, 3/8” at ends.

D. Band random-cut ends and diagonal or circular cut exposed edges with a bar of grating thickness minimum 1/8” and width equal to overall depth, welded at contact points of the Owner's Representative’s discretion.

3.03 GRATING ATTACHMENT

Attach grating to supports without warp or deflection as follows:

A. Single plank application: Secure plank ends to supporting members at every point of contact. At each end, use Heavy-Duty Grip Strut Hold-Down Clips with 3/8” square shank carriage bolts and nuts, 3/8” lag bolts, or secure each side channel to support by 1/8” x 1” long fillet welds. Where connections are made off-grade with walkway, or to a weir box, attachment details shown on plans shall be followed.

SECTION 16010

ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Electrical distribution system and utilization equipment.

B. Related Sections:
   1. Section 16062 - Grounding.
   2. Section 16950 - Electrical Testing.

1.02 SYSTEM DESCRIPTION

A. Furnish and install a tested and working electrical system, as indicated on the Drawings and as specified. System includes all items not specifically mentioned in these Specifications or indicated on the Drawings or accepted Shop Drawings, but which are obviously necessary to make a complete working installation, and shall be deemed to be included herein.

B. Notify ENGINEER of discrepancies within the Contract Documents and discrepancies between the Contract Documents and actual field conditions.

C. The Specifications and Drawings indicate or specify minimum sizes of equipment, electric devices, and other components of electrical system, but the Specifications and Drawings do not indicate every offset and fitting, or every structural or mechanical difficulty that may be encountered during the execution of the Work.

D. Install equipment at locations indicated on the Drawings as closely as field conditions permit. Obtain accepted equipment submittal dimensions prior to installing pads, conduits, and cable trays.

E. Make minor variations to alignment of equipment and/or installation of raceway systems to avoid conflict with other portions of the Work.

F. Single Line Diagrams: Single line diagrams indicate circuit voltages for low voltage equipment as follows:
   1. Single line diagrams also indicate wire and conduit sizes, circuit protection rating, and other pertinent data. Use single line diagrams to resolve conflicts.
   2. When not indicated on the Drawings, provide grounding in accordance with NEC Article 250 and as specified in Section 16062.

G. Electrical Utility Services:
   1. Provide electrical work in accordance with requirements of the serving utility Pacific Gas & Electric, and local and state inspection authorities. Note that some service requirement details are indicated on the Drawings and are in conformance with the utility's requirements at the time of design.
   2. Coordinate and obtain inspections and final installation approval from serving utilities and other authorities having jurisdiction.

1.03 PERFORMANCE REQUIREMENTS

A. Operate electrical equipment successfully at full-rated load, without failure, at an ambient air temperature of 40 degrees Celsius, and rated for an altitude of 500 feet.

B. Coordination of Electrical Equipment Rating: Verify actual equipment, motor full-load, and locked-rotor current ratings. When providing equipment with different motor full-load and locked-rotor current ratings than indicated on the Drawings, coordinate branch circuit conductor sizes, motor overload protection, motor controllers, control power transformers, and branch circuit overcurrent protection required for equipment provided.

C. Branch Circuit Conductor Current Carrying Capacity: Minimum 125 percent of the full-load current rating of equipment.

D. Branch Circuit Conductor Size: Adequate to prevent voltage drop greater than 2 percent from branch circuit protection device to equipment with equipment running at full-load and rated voltage. Include conductor derating in accordance with ambient temperature and conduit fill requirements.

E. Motor Running Overload Protection Devices:
   1. Rated or selected to trip at no more than the following percent of motor nameplate full-load current rating:
      a. 125 percent for motors with marked service factor not less than 1.15.
      b. 125 percent for motors with marked temperature rise not over 40 degrees Celsius.
      c. 115 percent for all other motors.
   2. Size and provide upon verification of actual motor or nameplate data.
   3. Where power factor correction capacitors are provided on load side of motor running overload protection device, selection or setting shall be based on the improved power factor of motor circuit and not the full-load nameplate current of motors.

F. Overload Heaters Required for Motors with Temperature Rise of 50 Degrees Celsius: As selected from motor controller manufacturer's overload heater selection tables.

G. Motor Controller Size: Coordinated with horsepower size of motor.

H. Motor-Branch-Circuit Short Circuit and Ground Fault Protections Device: Capable of tripping open in 30 seconds or less on locked-rotor current of motor. This device shall also protect the motor-branch-circuit conductors and the motor control apparatus against overcurrent due to short-circuit or ground faults. Protect motor control circuits with device type specified or as indicated on the Drawings.

1.04 SUBMITTALS

A. Shop Drawings and Product Data:
   1. Include data on and details of control devices, fixtures, wire, cables, raceways, and other electrical equipment specified or indicated on the Drawings.

B. Project Record Documents:
   1. Submit in accordance with Section 01770. Include drawings of wiring

terminations at electrical equipment including, but not limited to:
a. Terminal/junction boxes.
b. Revised Shop Drawings reflecting modifications made during progress of the Work including testing, and revised Specifications and Drawings with conductors identified identically as on the Specifications and Drawings and accepted Shop Drawings. Updated Shop Drawings shall include all drafting work.

C. Acceptance Testing Information and Documents: Submit as specified in Section 16950.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Perform electrical work, including connection to electrical equipment integral with mechanical equipment, in accordance with latest published requirements of the following codes and code/standard making organizations:
1. American National Standards Institute (ANSI).
2. American Society for Testing and Materials (ASTM).
3. Institute of Electrical and Electronics Engineers (IEEE).
4. Insulated Cable Engineers Association (ICEA).
5. National Electrical Code (NEC).
6. National Electrical Contractors Association (NECA).
7. National Electrical Safety Code (NESC).
8. National Electrical Manufacturers Association (NEMA).
9. National Fire Protection Association (NFPA).
10. State and local codes.
11. Uniform Building Code (UBC).

B. When applicable, materials and equipment used in performance of electrical work shall be listed or labeled by Underwriter's Laboratories or other equivalent, recognized, and independent testing laboratory, for the class of service intended.

C. Manufacturer Qualifications:
1. Low Voltage Equipment: Manufacturer of proposed product with components uniquely selected by engineering review.
a. Proprietary bussing and enclosure designs listed by UL in manufacturer's own file for minimum 15 years with satisfactory performance record.
b. Capable of providing warranty for assembly when built-up with components from various manufacturers.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Ship electrical panels switchboards, motor control centers, and other electrical distribution equipment in sealed dust and moisture-proof plastic sheet enclosures. Equipment containing dirt, dust, water, grease, rust, or damaged parts or components may be rejected.

B. Provide for delivery, unloading, transportation, and storage of equipment until installation. Protect electrical and instrumentation equipment and panels from physical and environmental damage. Store and maintain equipment in a weatherproof building until installed.

C. Store electrical equipment, including motor control centers, instrumentation control panels, and other enclosures that house electronic equipment rated for a specified ambient or environmental temperature range, in air conditioned buildings to protect equipment from temperatures above 90 degrees Fahrenheit and heated buildings to protect equipment from temperatures below 40 degrees Fahrenheit. Assume liability for the storage facilities or equipment stored therein.

D. Maintain storage facilities in neat condition with utilities. Maintain stored equipment in same condition as when received.

E. Provide continuous access for inspection of stored equipment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 PREPARATION

A. Where it becomes necessary to cut into existing work for the purpose of making electrical installations, use core drills for making circular holes. Other demolition methods for cutting or removing shall be reviewed by the ENGINEER prior to starting the work.

3.02 INSTALLATION

A. Corrosion Protection:
   1. Isolate dissimilar metals, except conduit and conduit fittings, that may come in contact, with neoprene washers, 9 mil polyethylene tape, or gaskets.
   2. Restore factory finishes which are damaged or rusted to their original new condition in accordance with manufacturer's instructions.

B. Install electrical work prior to placing floors and walls. Provide all sleeves and openings through floors and walls required for passage of all conduits and other raceways. Sleeves shall be rigidly supported and suitably packed or sealed to prevent ingress of wet concrete or water.

C. Provide all insets and hangers required to support raceways and other electrical equipment. If the inserts, hangers, sleeves, or openings, are improperly placed or installed, do all necessary work to rectify the errors.

3.03 CLEANING

A. Clean each piece of electrical equipment, both inside and outside, and retouch equipment to match existing paint.

END OF SECTION

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Basic electrical materials and methods.

1.02 REFERENCES

A. American Society for Testing Materials (ASTM):
   1. A 525 - Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized), by Hot-Dip Process.

B. National Electrical Manufacturers' Association (NEMA).

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Connections of electrical equipment to supports shall be designed to resist the operating forces plus seismic forces.
   2. Seismic design shall conform to the requirements of Section 01612. Calculations shall be by a registered civil or structural engineer in the state where the Project is located.

1.04 SUBMITTALS

A. Shop drawings and product data.

1.05 WARRANTY

A. Submit manufacturer's standard warranty.

1.06 EXTRA MATERIALS

A. Furnish and install a minimum of 10 percent spare terminal blocks in each terminal/junction box.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Unless specified otherwise indicated on the Drawings, the fabricator of major electrical equipment, such as lighting and distribution panelboards, switchgear, variable frequency drives, and motor control centers, shall also be the manufacturer of the major devices herein.

2.02 MATERIALS

A. Materials, equipment, and parts comprising any unit or part thereof specified or indicated on the Drawings shall be new and unused, of current manufacture, and of highest grade consistent with the industrial industry standards. Damaged materials, equipment, and parts are not considered to be new and unused and will not be accepted.

2.03 EQUIPMENT

A. Support Channels: Steel, hot-dip galvanized with G90 coating in accordance with ASTM A 525, or stainless steel.
   1. Manufacturers: One of the following or equal:
      a. Unistrut.
      b. Superstrut.
      c. Globe Strut.

B. Support Channel Bolts, Nuts, and Washers: Stainless steel.

C. Non-Fused Terminal Blocks: Sized as required for conductors.
   1. Manufacturers: One of the following or equal:
      a. Square D Company.
      b. Buchanan.

D. Fused Terminal Blocks: Circuit isolation, fused switch type, sized as required for conductors. Fuse size shall be based upon actual load and conductors to be protected.
   1. Manufacturers: One of the following or equal:
      a. Square D Company.
      b. Buchanan.

E. Control Relays:
   1. Industrial 600 volt, 10 ampere type with contact arrangement and operating coils of proper voltage as required by control circuit sequence; with minimum of 4 reversible-pole contacts; coils sealed by pressure molding.
   2. Non-industrial or plug-in type control relays shall be prohibited unless accepted in writing.
   3. Manufacturers: One of the following or equal:
      a. Square D Company.
      b. Cutler-Hammer.

F. Reset Timers and Repeat Cycle Timers:
   1. Industrial type; 120 volts alternating current, 60 hertz operating power; 6 amperes minimum at 120 volts alternating current output unless otherwise indicated on the Drawings or specified.
   2. In enclosure as indicated on the Drawings or specified; plug-in or non-industrial timers shall be prohibited unless accepted in writing.
   3. Manufacturers: One of the following or equal:
      a. Eagle.
      b. Paragon.

G. Twenty-Four Hour Timers:
   1. Heavy-duty industrial, 120 volts, 60 hertz alternating current operating power, electronic type; 15 amperes at 120 volts alternating current output, single channel type; lithium battery-backed; single pole double throw.
   2. In DIN enclosure, plug-in or non-industrial timers shall be prohibited unless accepted in writing.
   3. Manufacturers: One of the following or equal:
      a. Paragon, EC Series
      b. Tork, equivalent model.

H. Timing Relays: Heavy-duty industrial, 600 volt, 10 amperes.
   1. Manufacturers: One of the following or equal:
      a. Square D Company.
      b. Cutler-Hammer.

I. Nameplates:
   1. Type: Black lamicoid with white letters.
   2. Fastener: Round head stainless steel screws.

J. Automatic Equipment and High Voltage Warning Signs:
   1. Type: Suitable for exterior use and meeting OSHA regulations.

K. Underground Hazard Tape: 6 inches wide.
   1. Manufacturers: One of the following or equal:
      a. Panduit.

PART 3 EXECUTION

3.01 GENERAL

A. Verify dimensions indicated on the Drawings. Actual locations, distances, and levels will be governed by actual field conditions. The CONTRACTOR shall also review information indicated on the Drawings for architectural, structural, yard, mechanical, and other specialties, and the accepted electrical and mechanical shop drawings, and shall adjust his work to conform to all conditions indicated thereon.

B. Coordinate for consistency lens colors of all pilot lights included in all equipment assemblies specified in Divisions 11 through 16 (subject to ENGINEER's acceptance).

3.02 EQUIPMENT INSTALLATION

A. Anchor electrical equipment to building floors, electrical equipment foundations, or other supports by bolts and anchor bolts and studs.

B. Anchor each piece of electrical equipment with minimum 1/2 inch diameter Type 316 stainless steel bolts, anchor bolts, or studs. Acceptable connectors shall be furnished in each corner of each section of electrical equipment, minimum.

C. Where plates are embedded in concrete supporting electrical equipment, fasten electrical equipment to the embedded plates with minimum 1/2 inch diameter welded studs. Where required, the number of studs connecting the embedded

plates to floors shall be increased as required based upon the calculations of seismic forces in order to resist the forces from the electrical equipment supplied. The additional studs shall be deemed as part of these Contract Documents.

3.03 TORQUING

A. After installing and before energizing electrical equipment, torque each bolted bus and cable connection in accordance with manufacturer's recommendations with calibrated torque wrenches. Include each bolt at each connection, both factory and field installed, for motor control centers, variable frequency drives, bus ducts, switchgear, switchboards, and other equipment installed.

3.04 CONDUCTOR FASTENERS

A. Use screw type conductor fasteners and other permanent, such as epoxy conductor adhesives, in junction or pull boxes, termination cabinets, panels, panelboards, switchboards, switchgear, motor control centers, variable frequency drives, or other enclosures containing electrical devices and/or conductors. Do not use glue-on type conductor fasteners.

3.05 SUPPORT CHANNELS

A. Install channels, as required for support of raceways, cable trays, device enclosures, and other electrical equipment.

B. Separate iron or steel supports from aluminum with 1/4 inch neoprene or other non-metallic gaskets.

C. Paint field cuts and scratches of galvanized steel channels with a cold galvanizing spray paint.

3.06 TERMINAL BLOCKS

A. Furnish and install terminal blocks in control panels, cabinets, terminal/junction boxes, variable frequency drives, motor control centers, switchgear and similar equipment and identify the terminal blocks by numbering and labeling in accordance with accepted shop drawings. The terminal blocks shall be circuit isolation fused-switch type where indicated on the Drawings and as required.

3.07 ADJUSTING

A. Adjust, set timers and contacts for proper equipment operation in accordance with Section 01756.

3.08 DEMONSTRATION

A. Demonstrate operation of equipment.

END OF SECTION

SECTION 16062

GROUNDING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Grounding electrode systems, consisting of concrete encased bare ground conductors and ground rods.

B. Related Sections:
   1. Section 16950 - Electrical Testing.

1.02 REFERENCES

A. National Electrical Code (NEC), Article 250 - Grounding.

PART 2 PRODUCTS

2.01 MATERIALS

A. Driven Ground Rods:
   1. Copper-covered steel.
   2. 3/4-inch diameter.
   3. 10 feet long, minimum.

B. Ground Conductor: Bare copper.

C. Precast Ground Wells:
   1. Brooks Products, Inc., valve boxes.
   2. Christy, valve boxes.
   3. Or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install concrete encased bare ground conductor in each duct bank. Run grounding electrode system conductors continuously in duct banks, through manholes, handholes, other raceway boxes, and cable tray exteriors. Connect conductors to structure ground ring or grounding system to provide a continuous grounding electrode system.

B. Bond electrical enclosures, including metallic raceways, panels, switchboards and other similar metallic panels, cases and devices associated with power, instrumentation, and control systems to the grounding electrode system.

C. Drive ground rods and install grounding conductors prior to construction of concrete slabs and duct banks.
   1. Extend grounding conductors through concrete to accessible points for grounding equipment and electrical enclosures.
   2. Install grounding system at each structure where switchgear, motor control centers, switchboards, panelboards, panels, or other electrical equipment are installed.

D. Provide exothermic welded connections for grounding cable to cable and mechanical connections for grounding cable to rods.

E. When size is not indicated on the Drawings, size grounding conductors in accordance with NEC Table 250-66 and Table 250-122.

F. Install a green insulated equipment grounding conductor, or multi-conductor cable with integral green insulated grounding conductor, with each feeder and branch circuit from the power source grounding means to the load equipment or device.

G. Install ground bushings at both ends of rigid conduit runs. Do not use locknuts. Bond ground bushings to the grounding system.

H. When not indicated on the Drawings, install grounding electrode systems in compliance with NEC-250, Part C.

3.02 FIELD QUALITY CONTROL

A. Test ground resistance, as specified in Section 16950, of entire system and at each building/structure where electrical equipment is installed.

Comment [sld1]: Not used. Need replacement text.

B. Invite ENGINEER to witness ground resistance testing.

C. Where maximum allowable ground resistance of 5 ohms is exceeded, install additional grounding mats or ground rods until ground resistance is equal to or below maximum allowable ground resistance.

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Identification of electrical conductors, raceways and equipment, and electrical equipment signs.

1.02 REFERENCES

A. National Electrical Code (NEC):
   1. Article 110–22 - Disconnecting Means.
   2. Article 210–4 - Multiwire Branch Circuits.
   3. Article 200 - Use and Identification of Grounded Conductors.
   4. Article 384 - Switchboards and Panelboards.
   5. Article 300 - Wiring Methods.

1.03 SUBMITTALS

A. Shop Drawings:
   1. General: Submit shop drawings for electrical equipment room layouts, drawn at a minimum at 1/4 inch = 1 foot, scale.
   2. Cross Reference: Diagram shall carry a uniform and coordinated set of wire numbers and terminal block numbers to permit cross-referencing between the contract document drawings, the drawings prepared by the CONTRACTOR, and equipment O&M Manual Drawings.
   3. Drawing number cross references and continuation references shall also be provided. CONTRACTOR-prepared drawings shall reference applicable CONTRACTOR drawings such as P&IDs, control and logic diagrams, interface wiring diagrams, panel drawings, etc. CONTRACTOR-prepared drawings shall also reference applicable drawings provided by equipment manufacturers.
   4. On any drawing prepared for this project, if a wire, circuit, enclosure, panel, or device is continued on another drawing, the continuation drawing shall be referenced (and vice-versa). Wherever wires are shown connected to terminals, the drawings which show the continuation of the circuits on those terminals must be referenced.
   5. Interconnection Diagrams: Cables shall not be installed into raceways until the wiring interconnection diagrams are reviewed by the design engineer.
   6. Include tagging system, labels, markers, hazard tape, nameplates and signs.

B. Product Data: Include tagging system, labels, markers, and hazard tape.

C. Project Record Documents:
   1. Document wire, cable, and conductor tags, and bundle tags installed in accordance with the Contract Documents.
   2. Document installed wire, cable, and conductor tags and bundle tags when not specifically indicated.

3. Indicate on Record Drawings deviations from accepted shop drawing conductor identification.

1.04 QUALITY ASSURANCE

A. Pre-installation Conference:
   1. Conduct in accordance with Section 01312.
   2. Purpose: To clearly define requirements specified for circuit/cable/conductor identification, hold a meeting including representatives of CONTRACTOR, OWNER, and ENGINEER prior to significant cable or conductor purchase and installation/termination.

PART 2 PRODUCTS

2.01 LABELS

A. Manufacturers: One of the following or equal:
   1. Brady.
   2. Seton.

B. Type: Sleeve type.

2.02 CONDUCTOR AND CABLE MARKERS

A. Manufacturers: One of the following or equal:
   1. Brady.
   2. Seton.

B. Type: Slip-on PVC sleeve or strap-on type.

C. Printed using Brady marker "XC PLUS," or equal.

D. Markers used in tunnels or other wet locations shall be on heat-shrinkable marking sleeves.

E. Use self-laminating vinyl on white background for markers within electrical equipment such as panels, termination cabinets, motor control centers.

2.03 RACEWAYS IDENTIFICATION (TAGS)

A. Conduit numbers shall be pressure stamped into a noncorrosive 2 inch long, 1/2-inch wide stainless steel tape, Dymo marking system or equal. A tag with number shall be fixed with No. 18 AWG or larger type 304 stainless steel wire, to each conduit segment and at the end of each conduit and within 3 feet of each pull box, panelboard and switchboard.

2.04 NAMEPLATES, LABELS AND SIGNS

A. Nameplates:
   1. Type: Black lamicoid with white letters.
   2. Fastener: Round head stainless steel screws.

B. Automatic Equipment and High Voltage Warning Signs:
   1. Type: Suitable for exterior use and meeting OSHA regulations.

C. Underground Hazard Tape: 6 inches wide.
   1. Manufacturers: One of the following or equal:
      a. Panduit.
      b. Thomas and Betts.

PART 3 EXECUTION

3.01 CIRCUIT IDENTIFICATION

A. Identify 3-phase system conductors and cables as Phases A, B, and C and identify 1-phase system conductors and cables at electrical equipment including, but not limited to, switchgear, switchboards, panelboards, motor control centers, and motors.
   1. Match OWNER's existing electrical system identification scheme or meet requirements of the authority responsible for the project.
   2. 3-phase 480 Volts AC System Conductors: Phase A, brown; Phase B, orange; Phase C, yellow.
   3. Single-Phase Conductors for 120/240 VAC Circuits: Phase A, black; Phase B, red; Phase C, blue.
   4. Neutral Conductor: White for 120 VAC and gray for 277 VAC.
   5. Insulated Equipment Grounding Conductor: Green.
   6. General Purpose AC Control Conductors: Purple.
   7. General Purpose DC Control Conductors: Purple with white stripes.

B. Use color coding and phasing consistent throughout the site. Bus bars at panelboards and motor control centers to be connected Phase A-B-C, top to bottom, or left to right facing connecting lugs.

C. Conductors Number 2 American Wire Gauge (AWG) and smaller to be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables to be coded by the use of colored tape.

D. In addition to color coding, for all 1-phase and 3-phase systems, identify each cable (single or multi-conductor) and conductor at each end, in each manhole, pullbox, cable tray, or other component of the raceway system. This identification is applicable to all power, control, alarm, signal, and instrumentation cables, and conductors.

E. Identify each cable (single or multi-conductor) and groups or bundles of individual single conductors in each manhole, pullbox, cable tray or other component of the raceway system with circuit identification markers. Implement a "from-to" cable/conductor bundle tagging system as part of this identification effort.

F. Identify each individual conductor at each termination. This includes such locations as switchgear, switchboards, motor control centers, variable frequency drives, control panels, junction/terminal boxes, all field devices, and all other locations where conductors are terminated. Identify the termination of these conductors in

accordance with the accepted shop drawings. Tag conductors with sleeve type labels.

G. Where more than 1 nominal voltage system exists, identify each ungrounded system conductor by phase and system. Permanently post means of identification at each branch-circuit panelboard, switchboard, switchgear, motor control center, or other type of power distribution equipment.

H. Include the following minimum information for wire and cable identification.
   1. Circuit number or load identification tag number.
   2. Origin (from source).
   3. Destination (to load).

3.02 NAMEPLATES

A. Furnish and install nameplates for all electrical equipment indicated on the Drawings or specified.

B. Each disconnect means for service, feeder, branch, or equipment conductors and pushbutton stations shall have nameplates indicating its purpose or identifying the load.

3.03 AUTOMATIC EQUIPMENT WARNING

A. Mount permanent warning signs at mechanical equipment which may be started automatically or from remote locations. Fasten warning signs with round head stainless steel screws or bolts, located and mounted in a manner acceptable to ENGINEER.

B. Place a warning ribbon or other effective means suitable for conditions above ductbank underground installations.

C. Place warning signs on utilization equipment that has more than one source of power. Provide panel and circuit number of conductor tag of the power source disconnect.

D. Place warning signs on utilization equipment that has 120 VAC control voltage source used for interlocking. Provide panel, circuit number, and conductor tag of control voltage source disconnect.

END OF SECTION

SECTION 16123

600 VOLT OR LESS WIRES AND CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. 600 Volt Class wire and cable.
   2. Instrumentation Class wire and cable.
   3. Fire Alarm wire and cable.
   4. Communication wire and cable.

B. Related Sections:
   1. Section 16075 - Electrical Identification.
   2. Section 16133 - Conduits.
   3. Section 16134 - Boxes.
   4. Section 16950 - Electrical Testing.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. B 3 - Standard Specification for Soft or Annealed Copper Wire.
   2. B 8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

B. Insulated Cable Engineers Association (ICEA).

C. National Electrical Code (NEC):
   1. Article 250 - Grounding.
   2. Article 310 - Conductors for General Wiring.
   3. Article 760 - Fire Alarm Systems.

D. Underwriters' Laboratories, Inc., (UL):
   1. UL 1277 Subject - Electrical Power and Control Tray Cables with Optional Optical-fiber Members.

1.03 SUBMITTALS

A. Shop Drawings: Show splice locations. Submit cable pulling calculations for all cable feeder larger than 2/0 AWG and pulling lengths longer than 200 feet. Submit cable pulling calculations for all conductor runs longer than 400 feet.

B. Product Data: Include wires, cables, pulling compounds, and splicing materials.

1.04 QUALITY ASSURANCE

A. Conform to ASTM and ICEA standards.

B. Furnish mechanical conductor connector and heat-shrink type insulation by same manufacturer.

PART 2 PRODUCTS

2.01 WIRE AND CABLE MATERIALS

A. Conductors: ASTM B 8, soft drawn copper, maximum 12 months old, minimum 97 percent conductivity. American Wire Gauge (AWG) sizes as indicated on the Drawings, Class B or C stranded.

B. Insulation Thickness: Minimum specified by NEC Article 310.

C. Conductor Sizes: As indicated on wiring schedules and Drawings.

2.02 600-VOLT CLASS CABLE

A. Power Wire and Cable:
   1. Manufacturers: One of the following or equal:
      a. Okonite Company.
      b. BICC Cable.
      c. Rockbestos Company.
      d. Rome Cable Corporation.

B. Control Wire and Cable:
   1. Manufacturers: One of the following or equal:
      a. Okonite Company.
      b. BICC Cable.
      c. Rockbestos Company.
      d. Rome Cable Corporation.

C. Insulation for Individual Wires or Multiple Conductor Cable for Power and Control Circuits:
   1. Type XHHW-2 insulation to be used in all locations.

D. Jackets for Multiple Conductor Cable for Power and Control Circuits: Type CPE.

E. Multi-Conductor Cable Insulated Grounding Conductors:
   1. Color: Integral green.
   2. Sizes: In accordance with NEC 250-122.

F. Solid-conductor wire, Number 12 AWG and smaller, may be used only for lighting and receptacle circuits.

2.03 INSTRUMENTATION CLASS CABLE

A. Single Pair or Triad Applications:
   1. Manufacturers: One of the following or equal:
      a. The Okonite Company, Okoseal-N Type P-OS.
      b. Equivalent manufactured by Cooper Industries, Belden Wire and Cable Division.

B. Multiple Pair or Triad Applications:
   1. Manufacturers: One of the following or equal:
      a. The Okonite Company, Okoseal-N Type SP-OS.
      b. Equivalent manufactured by Cooper Industries, Belden Wire and Cable Division.

C. Approved for cable tray installation in accordance with the National Electrical Code.

D. Number of Individually Shielded, Twisted Pairs and Triads: As indicated on the Drawings or as necessary for the application.

E. Voltage Rating: 600 volts.

F. Cable Type: TC.

G. Temperature Rating: 90 degrees Celsius dry location, 75 degrees Celsius wet location.

H. Conductors: Bare, soft annealed copper in accordance with ASTM B 3, Class B, 7-strand concentric in accordance with ASTM B 8.

I. Conductor Insulation: Flame-retardant polyvinyl chloride, 15 mils nominal thickness, with nylon jacket 4 mils nominal thickness, 90 degrees Celsius temperature rating in accordance with Underwriters' Laboratory Subject 1277.

J. Color Code: Provide conductor color code as specified in Section 16075.

K. Single Pair or Triad Shielding:
   1. Group Shielding: Minimum 1.35 mil double-faced aluminum/synthetic polymer-backed tape overlapped to provide 100 percent coverage.
   2. Drain Wire: 7-strand tinned copper drain wire, 2 sizes smaller than conductor.

L. Multiple Pair or Triad Shielding:
   1. Group Shield: 1.35 mil aluminum-polyester tape overlapped to provide 100 percent coverage and a 7-strand tinned copper drain wire, 2 sizes smaller than conductor. Completely isolate group shields from each other.
   2. Cable Shield: 2.35 mils double-faced aluminum and synthetic polymer backed tape overlapped to provide 100 percent coverage and a 7-strand tinned copper drain wire, same size as conductors.

M. Jacket: Black, flame-retardant in accordance with Underwriter's Laboratory Subject 1277, 90 degrees Celsius temperature rating, rip cord laid longitudinally under jacket to facilitate removal.

N. Conductor Size: Number 16 AWG minimum unless otherwise indicated on the Drawings.

O. Numerically identify one conductor within each pair and triad.

2.04 RELATED MATERIALS

A. Splicing Material:
   1. In conformance with ANSI C119.1, IEEE 383, and ICEA 5-19-81.

2. Manufacturers: One of the following or equal:
    a. Elastimold.
    b. Thomas-Betts.
    c. Raychem, FCSM Series.

B. Wire Nuts:
1. Rated 600 volt with live-spring feature for tight fitting connections.
2. Manufacturers: One of the following or equal:
    a. 3M.
    b. Thomas and Betts.

C. Junction Boxes and Terminal Cabinets: As specified in Section 16134.

D. Pulling Compound: As recommended by conductor manufacturer.

2.05 WIRE AND CABLE FABRICATION

A. Permanently mark American Wire Gauge (AWG) size, grade of insulation, voltage, and manufacturer's name on outer covering at maximum 24 inch intervals.

B. Identify and mark conductors in accordance with NEC Article 310.

C. Color code wire and cable as specified in Section 16075.
1. Integrally color insulation for Number 2 AWG and smaller.
2. Wrap colored tape around cable larger than Number 2 AWG.

D. Fabricate cable ends with provisions for field testing.

2.06 SOURCE QUALITY CONTROL

A. Test full lengths in accordance with ASTM and ICEA Standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install continuous circuit conductors from source to load without splices or terminations in intermediate manholes or pull boxes, except for Number 10 AWG and smaller conductors for lighting and receptacles.

B. Splices:
1. Where splices are necessary because of extremely long wire or cable lengths that exceed standard manufactured lengths, install and label junction boxes for power conductors or termination cabinets for control and instrument conductors.
2. Power and control conductors routed in common raceways may be spliced in common junction boxes.
3. Install NEMA 4X junction and terminal boxes in wet and outdoor locations. Clearly label junction and terminal boxes containing splices with the word "SPLICE."
4. Leave sufficient slack at junction boxes and termination boxes to make proper splices and connections. Do not pull splices into conduits.

C. Properly coat wires and cables with pulling compound before pulling into conduits and prevent mechanical damage to conductors during installation.

3.02 600-VOLT CLASS CABLE

A. Size power conductors in accordance with National Electrical Code when sizes are not indicated on the Drawings.

B. Install minimum Number 12 AWG wiring for power circuits unless otherwise specified or indicated on the Drawings, and minimum Number 14 AWG for control wiring unless otherwise specified.

C. Install minimum 14 AWG for internal panel control wiring with type MTW or SIS insulation.

D. Do not exceed cable manufacturer's pulling tension and side-wall pressures.

E. Terminations and Splices (600 Volt or Less):
   1. Terminations: Terminate control and instrument conductors in terminal boxes in accordance with Section 16134.
   2. Splicing: Join conductors mechanically with splice connectors and install heat-shrink type insulation. Splice conductors in accordance with manufacturer's instructions. Make waterproof heat shrink type splices in wet and below grade locations.
   3. Splice or weld grounding conductors of different sizes.
   4. Conductor Number 10 AWG and smaller for lighting and receptacle circuits may be spliced in junction boxes with wire nuts.

F. All conductors of size No. 1/0 AWG and smaller for installation in cable trays and continuing without splices via other conduits; they shall be of the multi-conductor type with overall jacket.

3.03 INSTRUMENTATION CLASS CABLE

A. Install instrumentation class cables in separate raceway systems.
   1. Install instrument cable in metallic conduit within non-dedicated manholes or pull boxes.
   2. Install cable without splices between instruments or between field devices and instrument enclosures or panels.

B. Do not make intermediate terminations, except in designated terminal boxes indicated on the Drawings.

C. Ground cable shields at only one location, typically at panels, not at field instruments.

3.04 SIGNAL CABLE AND CONDUIT INSTALLATION

A. Separate and isolate electrical signal cables from sources of electrical noise and power cables by minimum 12 inches.

3.05 FIELD QUALITY CONTROL

A. Testing: As specified in Section 16950.

B. Grounding

3.06 FIELD CONDITIONS AND RELATED REQUIREMENTS

A. Existing underground water table is near or above the location for new ductbanks.

B. Existing underground pull boxes, handholes, ductbanks, and manholes contain excessive amounts of water, conductors and debris.

C. CONTRACTOR shall include cost for necessary dewatering, equipment cost to identify raceways, and cleaning equipment to perform the work required for new underground ductbanks, manholes and pull boxes.

D. CONTRACTOR shall include necessary cost to clean all underground ductbanks and pull boxes prior to installation of required new conductors.

3.07 WIRING ALLOWANCES

A. CONTRACTOR shall include allowance of necessary conductors and termination to provide any and all motorized equipment, electrical outlets, fixtures, communication outlets, instruments, and devices within 10 linear feet of location shown on the Drawings.

B. CONTRACTOR shall include allowance of necessary conductors and related materials to provide any and all pull boxes, manholes and ductbanks within 20 linear feet of location shown on the Drawings.

C. Prior installation of any raceway or related items identified in paragraphs A and B above, the OWNER shall have the right to make changes related to preferred location, at no additional cost.

D. CONTRACTOR shall include allowance to provide necessary conductors for all equipment specified, identified in wiring/raceway schedules, equipment schedules, panelboards schedules, electrical single line diagrams, block diagrams, process and instrumentation diagrams (P&IDs), fixture schedules, and devices. Said necessary conductors may not be shown on the plan drawings, but they shall be sized by CONTRACTOR in accordance with requirements of the National Electrical Code, and included in this allowance if the conductor are necessary for the complete operation of the included device or equipment.

E. Include cost allowance to provide the following wiring for potential extra items not included in contact documents:
   1. 500 linear feet of No. 12 AWG-XHHW-2 copper single conductor for installation in conduit.
   2. 300 linear feet of No. 14 AWG-XHHW-2 for installation in conduit.
   3. 100 linear feet of No. 16 AWG shielded one pair cable for installation in conduit.
   4. 500 linear feet of No. 12-2 w/Ground AWG-XHHW-2 with jacket for installation in conduit.

END OF SECTION

SECTION 16133

CONDUITS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

B. Conduit Types:
   1. Galvanized rigid steel conduit
   2. Flexible conduit
   3. Polyvinyl chloride-coated rigid steel conduit
   4. Rigid nonmetallic polyvinyl chloride conduit.

C. Related Sections:
   1. Section 16050 - Basic Electrical Materials and methods.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. C80.1 - Rigid Steel Conduit, Zinc Coated.

B. Electrical Manufacturers Association (NEMA):
   1. RN-1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

C. National Electrical Code (NEC):
   1. Article 348 - Electrical Metallic Tubing.
   2. Table 300-5 - Minimum Cover Requirements (0 to 600 volts, Nominal).
   3. Article 500 - Hazardous (Classified) Locations.
   4. Table 10-4(b) - Minimum Cover Requirements (over 600 volts, Nominal).

D. Underwriters' Laboratories, Inc (UL):
   1. JUL 6 - Rigid Metal Conduit.

1.03 SUBMITTALS

A. Product data.

B. Shop Drawings: Installation drawing including individual conduit numbers, routing, conduit sizes, circuit numbers contained in each conduit, and number and size of wires in each conduit.

PART 2 PRODUCTS

2.01 CONDUIT

A. Galvanized Rigid Steel Conduit:
   1. Domestic raw steel, made smooth, clean, and free of burrs and rough spots to enhance wire pulling; interior and exterior surfaces coated with solid, unbroken layer of zinc; threads hot dip galvanized after cutting; entire surface finish coated with secondary bichromate treatment applied over galvanizing able to extend surface protection and prevent oxidation; threads protected by color coded end caps to provide quick trade size identification.
   2. Manufacturers: One of the following or equal:
      a. LTV Steel Tubular Products Company, Galvite.
      b. Triangle PWC, Inc.
      c. Allied Tube and Conduit Corporation.

B. Liquid-Tight Flexible Conduit: Grounding type, weatherproof, watertight, maximum 60-inch lengths.
   1. Manufacturers: One of the following or equal:
      a. American Brass Company.
      b. General Electric.
   2. Flexible Metal Conduit: Aluminum with minimum trade size of 1/2-inch, maximum length allowed 60 inches.
   3. Manufacturers: One of the following or equal:
      a. ALFLEX
      b. Allied Tube and Conduit Corporation.

C. Polyvinyl Chloride-Coated Rigid Steel Conduit:
   1. Galvanized rigid steel conduit with coating conforming to ANSI C80.1 and UL 6; bendable without damage to coatings.
   2. Manufacturers: One of the following or equal:
      a. Perma Kote by Robroy Industries.
      b. OCAL, Inc.

D. Rigid Nonmetallic Polyvinyl Chloride Conduit:
   1. High density, Schedule 40, 90 degrees Celsius, heavy-duty polyvinyl chloride, made from virgin polyvinyl chloride compound; maximum 6 grams per 100 grams smoke emission.
   2. Manufacturers: One of the following or equal:
      a. Carlon.
      b. Triangle Conduit and Cable.

2.02 RELATED MATERIALS

A. Couplings, Connectors, and Fittings:
   1. Threaded.
   2. Manufactured with same materials and process as corresponding conduit.

B. Condulet Fittings:
   1. With wedge nut covers, weathertight when located outdoors or in wet or corrosive locations, matching type for corresponding conduit systems.

2. Manufacturers: One of the following or equal:
    a. Crouse-Hinds.
    b. Appleton.

C. Galvanized Rigid Steel Conduit Expansion Fittings for Exposed Locations:
1. Manufacturers: One of the following or equal:
    a. OZ/Gedney, Type AX with jumper.
    b. Appleton, Type XJ with Jumper.

D. Galvanized Rigid Steel Conduit Expansion Fittings at Structural Expansion Joints:
1. Manufacturers: One of the following or equal:
    a. Spring City, Type D.
    b. Crouse-Hinds, Type D.

E. Conduit Seals:
1. Manufacturers: One of the following or equal:
    a. Appleton.
    b. Crouse-Hinds.

F. Polyvinyl Chloride-Coated Rigid Steel Conduit Couplings: One provided loose with each length of conduit.

G. Fasteners for Polyvinyl Chloride-Coated Rigid Steel Conduit: Polyvinyl chloride-coated steel fasteners with Type 316 stainless steel bolts, nuts, and hardware.

H. Fasteners for Galvanized Rigid Steel Conduit: Galvanized steel fasteners with Type 316 stainless steel bolts, nuts, and hardware.

I. Conduit Mounting Strut:
1. Type 316 stainless steel for mounting of polyvinyl chloride-coated rigid steel conduit.
2. Hot-dip galvanized for other conduit types.

J. Conduit Thruwall Seals:
1. Hot-dip galvanize.
2. Polyvinyl chloride oversize sleeve.
3. Manufacturers: One of the following or equal:
    a. O-Z/Gedney, Type "WSK."

2.03 POLYVINYL CHLORIDE-COATED RIGID STEEL CONDUIT FABRICATION

A. Coat rigid steel conduit, conduit fittings and hangers with polyvinyl chloride.

B. Conduit:
1. Ensure that surfaces, including galvanizing, remain intact and undisturbed on both inside and outside of conduit throughout preparation and application processing.
2. Bond polyvinyl chloride coating to outer surfaces of conduit**.**
3. Provide bond between polyvinyl chloride coating and conduit surface that is greater than tensile strength of plastic.
4. Provide minimum 40 mil thick coating on conduit.
5. Coat interior of conduit and condulet fittings with nominal 2 mil thick corrosion-resistant urethane finish.

6. Coat threads with clear urethane finish.

C. Couplings:
   1. Bond polyvinyl chloride coating to outer surfaces of couplings.
   2. Extend polyvinyl chloride sleeve equal to outside diameter of uncoated conduit beyond both ends of coupling approximately 1 pipe diameter or 1-1/2 inches, whichever is smaller.
   3. Provide minimum 40 mil thick coatings on couplings and sleeves.
   4. Bond polyvinyl chloride coating to outer surface of conduit bodies and fittings.
   5. Extend polyvinyl chloride sleeves from hubs.
   6. Provide same coating thickness on conduit bodies, fittings, and sleeve walls as on couplings in length and thickness.
   7. Coat covers on conduit bodies on both sides so covers are completely interchangeable.
   8. Coat interior of conduit couplings, sleeves, and conduit bodies with corrosion-resistant urethane finish.

D. Ensure that inside of conduit bodies remain undisturbed during processing and retain manufacturer's finish.

E. Polyvinyl Chloride Coated, Mounting Hardware, and Associated Fittings:
   1. All mounting hardware and associated fittings shall be polyvinyl chloride coated in accordance with the intent of reference NEMA RN-1.
   2. The polyvinyl chloride exterior coating shall have a normal thickness of 40 mils (.040 inch) except where part configuration or application otherwise dictate.
   3. All fasteners for polyvinyl chloride coated fittings and mounting hardware shall be of the Type 316 stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install conduit runs in accordance with schematic representation as indicated on the Drawings and as specified. Modify conduit runs to suit field conditions, as accepted by the ENGINEER.

B. Install conduit runs for lighting and receptacle circuits, whether or not indicated on the Drawings, for circuit numbers indicated on the Drawings.

C. Install straight and true conduit runs with uniform and symmetrical elbows, offsets, and bends. Make changes in direction with long radius bends or with condulet fittings.

D. Install conduit runs so that runs do not interfere with proper and safe operation of equipment and not block or interfere with ingress or egress, including equipment removal hatches.

E. Expose conduit runs in buildings and structures, unless otherwise indicated on the Drawings.

F. Securely fasten exposed conduits with clamps or straps. Run exposed conduit on walls and ceilings only, parallel to planes of walls or ceilings. Do not run conduit

diagonally. Securely fasten exposed polyvinyl chloride-coated rigid steel conduits with Type 316 stainless steel clamps or straps.

G. Use flexible conduit for short lengths required to facilitate connections between rigid conduit and motors, vibrating equipment, or control equipment.

H. Support conduit runs on water-bearing walls 1 inch away from wall on an accepted channel. Use hot-dip galvanized steel or stainless steel channels, consistent with type of conduit being installed. Do not run conduit in water-bearing walls unless otherwise indicated on the Drawings.

I. Encase underground conduit runs, including conduit runs below slabs-on-grade, in a concrete envelope as specified and indicated on the Drawings.

J. Install underground installations of direct buried cable, conduit, or other raceways to meet minimum cover requirements of NEC Table 300-5 and Table 710-4(b). Exceed minimum NEC requirements where indicated on the Drawings or specified.

K. Thoroughly ream conduit after threads have been cut to remove burrs. Seal joints with accepted conductive sealant compound and make watertight. Set up joints tight. Use bushings or conduit fittings at conduit terminations.

L. Install runs between pull boxes or junction boxes with total bends equaling not more than 270 degrees. Install NEC required pull boxes at locations acceptable to the ENGINEER. Plug conduits brought into pull boxes, manholes, handholes, and other openings until used to prevent entrance of moisture. Cap spare conduits and provide plastic pulling tape below threaded cap. Provide bonding bushing and bond wire.

M. Provide appropriate hangers, supports, fasteners, and seismic restraints to suit applications.

N. After complete installation of 2 inch and larger conduit runs, snake conduits with conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of conduit. Remove and replace conduits through which mandrel will not pass.

O. Clean and ensure that new and existing conduit runs are not crushed or creased. Verify internal dimensions of existing conduit prior to installation of conductors. Verify that no foreign objects or obstructions are present in conduit prior to installing conductors.

P. Install conduit system to provide firm mechanical assemblies with electrical conductivity throughout.

Q. Install expansion fittings across expansion joints and at other locations where necessary to compensate for thermal or mechanical expansion and contraction as indicated on the Drawings.

R. Install conduits complete between outlets, boxes, and circuit source before conductors are installed.

S. Install minimum 2 inch ductbank raceways, unless otherwise indicated on the Drawings.

T. Make ductbank raceway to external conduit size transitions at pullboxes and manholes.

U. 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 pullboxes.

V. Install conduit thruwall seals where indicated on the Drawings.

3.02 POLYVINYL CHLORIDE-COATED RIGID STEEL

A. Attach cover to conduit body with Type 316 stainless steel screws.

B. Where patching is required, apply 40 mil thick polyvinyl chloride coating in accordance with manufacturer's instructions.

3.03 RIGID NONMETALLIC POLYVINYL CHLORIDE

A. Reinforce encasement as indicated on the Drawings. Install conduit supports at 30-inch intervals.

3.04 SCHEDULES

A. Conduit Sizes: In accordance with NEC, unless otherwise indicated on the Drawings or specified as follows:
   1. Concealed conduit in partitions or accessible ceilings: Minimum 3/4 inch.
   2. Exposed Conduit: Minimum 3/4 inch.
   3. Rigid Steel Encased In Concrete: Minimum 1 inch.
   4. Rigid Non-Metallic Polyvinyl Chloride Encased In Concrete: Minimum 2 inches.
   5. Direct Buried Conduit Size: Minimum 2 inches.

B. Conduit Uses and Applications:
   1. Rigid Steel Conduit: Typical, Exposed Conduit Runs in dry and non-corrosive locations, unless otherwise noted.
   2. Liquid Tight Flexible Conduit: final motor and instrument connection in non-hazardous areas.
   3. Polyvinyl Chloride-Coated Rigid Steel Conduit:
      a. Entering or exiting concrete including minimum 12 inches above and below grade or finished floor.
      b. In exposed outdoor locations.
   4. Rigid Nonmetallic Polyvinyl Chloride Conduit: Runs concealed or concrete encased in walls, floors, and underground duct banks.

3.05 FIELD CONDITIONS AND RELATED REQUIREMENTS

A. Underground water table may be near or above the location of new ductbanks.

B. CONTRACTOR shall include cost for necessary dewatering, cleaning equipment to perform work in underground ductbanks, pull boxes and manholes, prior to installation of required new conductors.

3.06 RACEWAYS ALLOWANCES

A. CONTRACTOR shall include allowance of necessary raceways and supports to provide any and all motorized equipment, electrical outlets, fixtures, communication outlets, instruments and devices within 10 linear feet of location shown on the Drawings.

B. CONTRACTOR shall include allowance of necessary raceways, trench, excavation, backfill, and related materials to provide any and all pull boxes, manholes and ductbanks within 30 linear feet of location shown on the Drawings.

C. Prior to installation of any raceway or related items identified in paragraphs A and B above, the OWNER shall have the right to make changes related to preferred location, at no additional cost.

D. CONTRACTOR shall include allowance to provide necessary raceways for all equipment specified, identified in wiring schedules, equipment schedules, panel boards schedules, electrical single line diagrams, block diagrams, process and instrumentation diagrams (P&IDs), fixtures schedules, and devices. Said necessary conduits may not be shown on the plan drawings, but they shall be sized by CONTRACTOR in accordance with requirements specified and the National Electrical Code, and include in this allowance, the raceways necessary for the installation of the conductors and for the complete operation of the included device or equipment.

E. In addition to the above, include the following allowance for extra items not specified or identified on the documents.
   1. 100 feet of 3/4-inch exposed rigid steel conduit with fittings, and supports, in locations up to 20 feet above finish floor.
   2. 100 feet of 1-inch exposed rigid steel conduit with fittings, and supports, in locations up to 20 feet above finish floor.
   3. 100 of 1-inch PVC coated rigid steel conduit with fittings and supports, in locations up to 20 feet above finish floor.
   4. 100 feet of 2-inch PVC-schedule 40 conduit, encased in concrete, including necessary excavation.
   5. 10 equipment terminations with 3/4 inch flexible liquid tight conduit including boxes and fittings.

3.07 RACEWAYS IDENTIFICATION

A. Each new conduit, new wireway, and new boxes shall be identified by a specific number. The numbering system shall be in accordance with identification named on the Drawings or the process equipment identification. Products for identification of raceways are specified in Section 16075.

END OF SECTION

SECTION 16134

BOXES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Outlet boxes, device boxes, metallic pull boxes, junction boxes, termination boxes.
   2. Concrete pull boxes.
   3. Fasteners used with wiring devices.

B. Related Sections:
   1. Section 16950 - Testing, Training, and Facility Start-Up.
   2. Section 16050 - Basic Electrical Materials and Methods.

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA):
   1. OS1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
   2. OS2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.

B. National Electrical Code (NEC):
   1. Article 370 - Outlet, Device, Pull and Junction Boxes, Conduit Bodies and Fittings.

C. National Electrical Manufacturers Association (NEMA):
   1. NEMA FB1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
   2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 SUBMITTALS

A. Product Data.

B. Shop Drawings: Include identification and sizes of pull boxes for ENGINEER's acceptance prior to fabrication and installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Device Boxes, Metallic Pull Boxes and Junction Boxes: One of the following or equal:
   1. Crouse-Hinds.
   2. Appleton.
   3. O-Z/Gedney.

B. Floor Outlet Boxes with 1 Inch Conduit Knockouts: One of the following or equal:
   1. Steel City, 640 Series.
   2. Hubbell.

C. Concrete Pull Boxes with Covers: One of the following or equal:
   1. Quickset.
   2. Utility Vault Company.

2.02 DEVICE BOXES AND JUNCTION BOXES

A. Materials: Heavy-duty rigid steel or rigid copper free aluminum, compatible with the location and conduit system being used, unless otherwise specified or indicated on the Drawings.

B. For Indoor or Non-Corrosive Areas: Provide cast FD type device boxes with epoxy finish, and compatible with the location and conduit system being used.

C. For Outdoor Locations, Corrosive Areas, or Wet Process Locations: Provide cast FD type boxes with PVC coating for outdoor locations, corrosive areas and wet process locations and compatible with the location and conduit system being used.

D. Coverplates:
   1. Indoor: Provide lighting switch and receptacle boxes of Type 302 stainless steel cover plates with cover gaskets, except where otherwise specified or indicated on the Drawings. Provide other boxes with Type 304 stainless steel cover screws and with cover gaskets.
   2. Outdoor and Corrosion Resistant: Provide lighting switch and receptacle boxes, weatherproof with yellow fiberglass lift cover plates with cover gaskets.

2.03 FLOOR OUTLET BOXES

A. Suitable for receptacles, communications and data outlets as specified and indicated on the Drawings, complete with gaskets and cover plates.

B. Dual-gang, heavy-duty cast iron, suitable for wiring devices to be installed to make a complete and operable system and installation.

2.04 CONCRETE PULL BOXES

A. Precast concrete pull boxes in locations indicated on the Drawings and as required by NEC.

B. Designed for heavy traffic conditions, with pull box and cover designed for heavy traffic bridge loading.

C. Minimum 3 feet by 4 feet by depth as necessary for ductbank depth, required with 3/4-inch diameter pulling irons located at each end. Constructed of reinforced Class A concrete.

D. Identification: Furnish covers with "Electrical" engraved on top side.

2.05 METALLIC PULL BOXES

A. Boxes for applications in dry and non-corrosive location:
   1. Fabricated from 11 gauge (minimum) steel or aluminum, completely weatherproof with gasketed removable covers; compatible with type of conduit systems being used; manufactured, furnished, and installed complete with grounding lug.

B. Boxes for applications in wet areas, outdoor locations and NEMA 4X designated areas: Fabricated from 11 gauge, 316 stainless steel, with gasketed covers and labeled NEMA 4X.

C. Boxes in Locations Subject to Flooding, Temporary Submersion, or for Applications in NEMA 6 Designated Areas: Boxes shall be fabricated of cast aluminum, with gasketed cover, stainless steel cover screws, ground flange and listed NEMA 6.

2.06 FASTENERS

A. Electroplated or stainless steel in boxes with wiring devices.

B. Screws, Nuts, Bolts, and Other Threaded Fasteners: Stainless Steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Comply with the National Electrical Code.

B. Terminal blocks installed in junction/terminal boxes as specified in Section 16050.

C. Install concrete pull boxes on 12 inches of compacted clean aggregate base course as specified in Section 02722, and in such a manner that the cover of the pull box will be flush with finish grade.

D. Provide weatherproof conduit hubs for all conduit connections to metallic pull boxes.

E. Phosphatize and prime with rust-resistant paint metallic pull box surfaces. Finish shall be 2 coats of ANSI 61 gray enamel paint.

F. Size pull boxes to meet National Electrical Code requirements and to provide sufficient room for the future conduits and cables indicated on the Drawings.

G. Furnish and install pull boxes as indicated on the Drawings and as specified. Install additional pull boxes as required to meet cable manufacturer's pulling tension requirements.

H. Install pull boxes such that access to them is not restricted by obstructions such as pipes, valves, ladders.

I. Secure metallic pull box covers with Type 316 stainless steel screws or bolts with coated threads.

J. Provide adequate supporting pillar(s) for boxes to be located above ground or above decks, where there is no structural wall or surface for box mounting.

3.02 ADJUSTMENT

A. Adjust equipment as specified in Section 1695.

END OF SECTION

SECTION 16135

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Cabinets and enclosures to house electrical controls, instruments, terminal blocks, and similar equipment.

B. Related Sections:
   1. Section 16010 - Electrical Requirements.

1.02 REFERENCES

A. National Electrical Code (NEC).

B. National Electrical Manufacturers' Association (NEMA).

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Unless otherwise specified or indicated on the Drawings, enclosures to house electrical controls, instruments, terminal blocks, and similar equipment shall be NEMA 12 for indoor, dry and non-corrosive locations and NEMA 4X for outdoor installations, wet locations and corrosive designated areas and shall be compatible with the conduit system being used.
   2. Specific control panel enclosures shall be as specified in Division 13 of these Specifications or as indicated on the Drawings.

1.04 SUBMITTALS

A. Submit in accordance with Section 01330.

B. Submit product data and mounting supports.

C. Calculations:
   1. Conditioning System Sizing: Submit calculations.

1.05 WARRANTY

A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. NEMA 12 Steel Enclosures: One of the following or equal:
   1. Hoffman Engineering Company.
   2. Rittal.

B. NEMA 4X Stainless Steel Enclosures: One of the following or equal:
   1. Hoffman Engineering Company.
   2. Henessy Products, Inc.
   3. Carlon.

C. Enclosure Air Conditioner: One of the following or equal:
   1. Hoffman Engineering Company.

2.02 FABRICATION

A. NEMA 12 Steel Enclosures:
   1. Fabricate enclosures from 14 gauge steel with continuous welded seams.
   2. Doors: Doors shall have full length piano hinges with the door removable by pulling the hinge pin.
   3. Provide a rolled lip around 3 sides of the door and around all sides of the enclosure opening.
   4. Gaskets: Attach gasket with oil-resistant adhesive and hold it in place with steel retaining strips.
   5. Provide hasp and staple for padlocking.
   6. Provide a print pocket for each enclosure.

B. NEMA 4X Stainless Steel Enclosures:
   1. Provide enclosures that consist of base and cover which shall be of Type 316 stainless steel with minimum thickness of 12 gauge. The enclosures shall be provided with cover hinges to form a weathertight seal between the cabinet and door.

2.03 FINISHES

A. Steel Enclosures:
   1. Do not paint NEMA 4X enclosures. Door fronts shall be ground smooth.
      a. Print pockets and interior panels shall be steel with a white enamel finish.
   2. Provide NEMA 12 and NEMA 4 enclosures with white enamel interior finish: The finish shall be light gray enamel, ANSI 61 exterior, over phosphatized surfaces. Panels shall be white enamel.
   3. Special finishes and colors shall be furnished for wet locations.

B. Other portions of these Contract Documents shall be checked for special conditions.

2.04 ENCLOSURE AIR CONDITIONERS

A. Provide electrical equipment enclosures with complete air conditioning system as indicated on the Drawings and as specified.
   1. Enclosures to be climate controlled, equipped with integral self-contained air conditioning units complete with thermostats.
   2. The industrial grade air conditioners to constantly cool and recirculate the internal enclosure air which is kept completely separated from the external, or ambient air (closed-loop system).
   3. Provide units suitable for operation in the environment as specified in Section 16010. The units to be complete with all gaskets, mounting hardware, and air inlet filter.

B. Electrical Requirements:

1. Power supply to the air conditioners to be as indicated on the Drawings.
2. Make adjustments to the power supply circuits (conduits and wires and other components) as necessary to accommodate the air conditioning equipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner. Install in accordance with Section 16050.

C. Install cabinet fronts plumb.

D. Top mounted air conditioning units installation shall not allow condensation to damage electrical equipment or enclosure.

E. Provide size of pull boxes to meet National Electric Code requirements and ample space for conductors and devices.

F. Provide adequate supports and anchors to resist seismic forces.

G. Provide adequate supporting pillar(s) for cabinets to be located above decks, above slabs or where there are no structural wall or surface for cabinet mounting.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Wiring devices including the following:
   1. Snap switches and toggle switches.
   2. Plugs and receptacles.
   3. Control and push-button stations.
   4. Pilot devices.

B. Related Sections:
   1. Section 16950 - Testing, Training, and Facility Start-Up.

1.02 SUBMITTALS

A. Product Data.

1.03 QUALITY ASSURANCE

A. Provide industrial grade products for wiring devices. Commercial grade products are not acceptable, unless otherwise specified or indicated on the Drawings.

1.04 WARRANTY

A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 SNAP OR TOGGLE SWITCHES

A. Manufacturers: One of the following or equal:
   1. Hubbell.
   2. General Electric.
   3. Leviton.
   4. Bryant.

B. Number of Poles: As indicated on the Drawings.

C. Rating: 20 amperes, 125 volt.

D. Special Switches and Covers: As specified or indicated on the Drawings.

2.02 120 VOLT RECEPTACLES

A. Manufacturers: One of the following or equal:
   1. Hubbell.

2. General Electric.
3. Leviton.
4. Bryant.

B. Duplex Receptacles: 2-pole, 3-wire, grounded, 125 volts, industrial, rated at 20 amperes.
1. Special Receptacles and Covers: As specified in Section 16134 or as indicated on the Drawings.

C. Ground Fault Interrupter Receptacles (GFI): Rated at 20 amperes at 125 volts alternating current.

2.03 240 VOLT RECEPTACLES

A. Manufacturers: One of the following or equal:
1. Hubbell.
2. General Electric.
3. Leviton.
4. Bryant.

B. Types: Single and 3-phase; suitable for equipment served.

C. Rating: 20 amperes at 250 volts alternating current, unless otherwise indicated on the Drawings**.**

2.04 480 VOLT PLUGS AND RECEPTACLES

A. Manufacturers: One of the following or equal:
1. Killark W Series.
2. Crouse-Hinds.
3. Leviton.
4. Bryant.

B. Types: Heavy-duty, 3-phase, weather resistant, grounding type, 4-wire, 4-pole device, suitable for equipment served.

C. Rating: 60 amperes at 480 volts alternating current, unless otherwise indicated on the Drawings or specified.

2.05 DISTRIBUTED CONTROL SYSTEM RECEPTACLES

A. Manufacturers: One of the following or equal:
1. Hubbell.
2. Square D Company.
3. Leviton.
4. Bryant.

B. Type: Surge suppression/isolated ground, red, minimum 20 amperes rated at 125 volts alternating current, with gasketed cover plate.

2.06 UNINTERRUPTIBLE POWER SYSTEM RECEPTACLES

A. Manufacturers: One of the following or equal:
1. Hubbell.

2. Square D Company.
3. Leviton.
4. Bryant.

B. Type: Surge suppression/isolated ground, red, minimum 20A rated at 125 volts alternating current, with gasketed cover plate.

2.07 LOCAL PUSH-BUTTON MOTOR CONTROL STATIONS

A. Manufacturers: One of the following or equal:
1. Furnas Electric Company.
2. Square D Company.
3. Allen-Bradley.
4. Siemens.
5. Cutler-Hammer.
6. General Electric.

B. Types: Heavy-duty, oiltight/watertight.

C. Components: Selector switches, pilot light, and push buttons.

D. Enclosures: As follows, unless otherwise indicated on the Drawings or specified:
1. For Nonhazardous Indoor Locations: NEMA 12.
2. For Outdoor Locations: NEMA 4X.

E. Field Located Maintained Push Buttons: Red mushroom head, push-to-stop, pull-to-reset, with maintained contacts.

2.08 PILOT DEVICES

A. Manufacturers: One of the following or equal:
1. Furnas Electric Company.
2. Square D Company.
3. Allen-Bradley.
4. Siemens.
5. Cutler-Hammer.
6. General Electric.

B. Type: Heavy duty, suitable for mounting in control stations, on switchgear, switchboards, variable frequency drives, motor control centers, control panels, and other electrical equipment.

C. Components: Oiltight/watertight push buttons, selector switches, pilot light, and incidental items.

D. Casting: Durable 1 piece with chrome plated octagonal mounting nuts.

E. Push Buttons: Heavy-duty plastic.

F. Pilot Light Lenses: Shatter resistant plastic.

2.09 CORD CONNECTOR GRIPS

A. Non-Hazardous Areas:
   1. Manufacturers: One of the following or equal:
      a. Killark, Series Z.
   2. Aluminum cord connector.
   3. Stainless steel mesh grip.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install wiring devices in accordance with manufacturer's instructions.

B. Mount wiring devices as indicated on the Drawings**.**

3.02 LOCAL PUSH-BUTTON MOTOR CONTROL STATION INSTALLATION

A. Install Start-Lockout-Stop push-button control stations adjacent to every motor unless otherwise indicated on the Drawings.

3.03 ADJUSTMENT

A. Adjust wiring devices as specified in Section 01756.

3.04 PROTECTION

A. Protect products until acceptance by OWNER.

END OF SECTION

SECTION 16273

50 KILOVOLT-AMPERE AND BELOW
LOW VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Single-phase and 3-phase low voltage lighting and power distribution transformers rated 50 kilovolt-ampere and less.

1.02 REFERENCES

A. American National Standards Institute (ANSI).

B. National Electrical Manufacturers Association (NEMA).

C. Institute of Electrical and Electronic Engineers (IEEE).

D. National Electrical Code (NEC):
   1. Article 450 - Transformers and Transformer Vaults.

1.03 SUBMITTALS

A. Product Data: Include specifications and ratings.

B. Shop Drawings: Submit in accordance with Section 01330.

1.04 WARRANTY

A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Low Voltage Lighting and Power Transformers: One of the following or equal:
   1. Cutler-Hammer.
   2. General Electric Company.
   3. Square D Company.

2.02 DISTRIBUTION TRANSFORMERS - LOW VOLTAGE LIGHTING AND POWER

A. Premium high efficiency quiet type, with 2 primary winding taps 2-1/2 percent above and below nominal.

B. Furnish with a BIL of 10 kilovolt with a temperature class of 185 degrees Centigrade for transformers up to 25 kilovolt-ampere and a temperature class of 220 degrees Centigrade for transformers rated at 30 kilovolt-ampere and larger.

C. Noise Level: Sound level shall not exceed 44 dBA measured at 5 feet from transformer after installation.

D. Primary and secondary voltage, phase, and kilovolt-ampere shall be as indicated on the Drawings.

2.03 SOURCE QUALITY CONTROL

A. Core and coil assemblies shall conform to ANSI Standard C89.2 sound rating.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer printed instructions and approved shop drawings.

END OF SECTION

SECTION 16342

600 VOLT PUMP PANEL

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: 600 volts-alternating current motor control centers, ready to use, completely engineered and assembled.

B. Related Sections:
1. Section 16050 - Basic Electrical Materials and Methods.
2. Section 16075 - Electrical Identification.
3. Section 16273 - 50 Kilovolt-Ampere and Below Low Voltage Distribution Transformers
4. Section 16412 - Low Voltage Circuit Breakers
5. Section 16422 - Motor Starter.
6. Section 16426 - Molded Case Circuit Breaker Switchboards.
7. Section 16448 - Panelboards
8. Section 16950 - Electrical Testing.

1.02 REFERENCES

A. National Electrical Manufacturer's Association (NEMA):
1. ICS-2 - Industrial Control Devices, Controllers, and Assemblies.

B. Underwriters' Laboratories, Inc. (UL):
1. UL 845 - Motor Control Centers.

C. National Electrical Code (NEC):
1. Article 430 - Motors, Motor Circuits, and Controllers.

1.03 SUBMITTALS

A. Shop Drawings:
1. Plan, front and side view drawings, including overall dimensions of each motor control center. Identify shipping slips and show conduit stub-up area locations indicated on the Drawings.
2. Internal schematic and point-to-point wiring diagrams of each plug-in unit, including circuits of the solid-state reduced-voltage controllers that are part of the motor control center. Wiring diagrams shall include wire identification and terminal numbers. Indicate devices regardless of their physical location on the diagrams. Indicate on diagrams the specific device location symbols and their respective legend as indicated on the Drawings. Match identification numbers of motor starter, relay, timer coil, and respective contacts with those indicated on the Drawings. Identify on each respective wiring diagram specific equipment names consistent with those indicated on the Drawings.
3. External connection diagram showing the wiring to the external controls and devices associated with the motor control center.
4. Single-line diagrams for each motor control center showing circuit breakers, motor circuit protectors, motor starters, variable frequency drives, instrument

transformers, meters, relays, timers, control devices, lighting and distribution transformers, panelboards, and other equipment comprising the complete assembly. Indicate electrical ratings of equipment and devices on these single-line diagrams.

5. Bill of material list for each motor control center and each motor control unit.
6. Nameplate schedule for each motor control center.

B. Project Record Documents:
   1. Submit in accordance with Section 01770.
   2. Submit an additional set of Drawings showing motor control center system. Reference the Contract Drawings by circuit numbers, equipment designations, and locations.

C. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

A. Each component, as well as the complete assembly, shall be constructed and tested in accordance with latest NEMA Standards for Industrial Control, publication ICS-2.

1.05 WARRANTY

A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Cutler-Hammer.
   2. Square D Company.
   3. Allen-Bradley Company.
   4. Tesco.

2.02 ENCLOSURES

A. In accordance with NEMA Standard, as indicated on the Drawings and as specified.

B. NEMA 3R industrial use enclosure, unless otherwise indicated on the Drawings.

C. Rigidly form each vertical section that holds the units of minimum 12 gauge, cold-rolled steel.

D. Wiring: NEMA Class II, Type B.

2.03 UNIT DOORS

A. Mount on the stationary structure and hinge on side away from vertical wireway, with slotted thumb screws to hold in closed position.

B. Provide positive action linkage with disconnect operating mechanism. Design mechanism so that it can be locked in the OFF position with 1 to 3 padlocks. When handle is not padlocked, door to open by release of door interlock with small tool.

C. When door is closed, operating mechanism shall indicate ON or OFF position, and door interlock shall automatically become effective. Design disconnect operating mechanism against inadvertent operation when door is open.

D. Provide each plug-in unit door with nameplate, specified elsewhere, that indicates circuit number, load name and tag number, where applicable. Attach nameplate to door with stainless steel screws.

2.04 Pump Panel

A. Completely enclose with sheet steel.

B. Provide a wireway inside unit to accommodate wiring without removing barriers or plates.

C. Control Wiring Within Each Unit and Interconnection Wiring Between Units: Copper, MTW, 90 degrees Celsius, 600 volt, Number 14 AWG minimum.

D. Size power wiring to suit maximum horsepower rating of unit, Number 12 AWG minimum.

E. Identify power and control wiring at each termination point (both ends) in accordance with accepted shop drawings, using appropriate labels specified in Section 16075.

F. Main Disconnect, control power transformer, hand off auto switch, elapse timer, soft start motor starter.

2.05 TERMINAL STRIPS

A. Starters of Size 2 and Smaller: Terminate starter wiring (power and control wiring), and external field wiring on terminal strips provided in each unit.

B. Starters of Size 3 and Larger: Terminate control leads on the terminal strips.

C. Characteristics: As specified in Section 16050.
   1. Split-type to facilitate wiring connections for disconnecting factory or field conductors.
   2. Rated to accept conductor sizes as specified and as indicated on the Drawings.
   3. Provide with a minimum of 25 percent spare terminals.
   4. Rate terminal strips as disconnecting means for foreign interlock voltages.

2.06 PAINTING

A. Finish metal surfaces and structural parts with a phosphatizing, or equal, treatment prior to painting. Paint control centers with gray undercoat equal to zinc chromate.

B. Finish interior surfaces including bus support angles, control unit back plates, and top and bottom unit barrier plates with baked white enamel.

C. Finish exterior of enclosure with ANSI 61 Gray, or in a color selected by ENGINEER.

2.07 DEVICES

A. Devices such as magnetic starters, circuit breakers, relays, timers, push buttons and other pilot devices, nameplates, conductors, circuit identification, shall conform to other Sections of the Specifications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install motor control centers to allow complete unit door swing required for unit removal. This is specifically required where a vertical section of MCC is set next to a wall to the left of the MCC station.

3.02 FIELD QUALITY CONTROL

A. Testing: Test as specified in Section 16950.

3.03 DEMONSTRATION

A. Demonstrate operation of equipment.

3.04 PROTECTION

A. Protect products until acceptance by OWNER.

END OF SECTION

SECTION 16412

LOW VOLTAGE CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Low voltage circuit breakers as indicated on the Drawings and as specified.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA): Standards Publication No. AB1.

B. National Electrical Code (NEC): Article 430-52.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Circuit Breakers: Manufacturers: One of the following or equal:
   1. Cutler-Hammer.
   2. General Electric Company.

B. Motor Circuit Protectors: One of the following manufacturers or equal:
   1. Cutler-Hammer.
   2. General Electric Company.

2.02 CIRCUIT BREAKERS - LOW VOLTAGE

A. Circuit Breaker Frame and Trip Ratings: As indicated on the Drawings and coordinated with the ratings of the equipment actually furnished. Modify ratings where necessary to suit this equipment and in accordance with the short circuit fault analysis and protective device coordination study.

B. Circuit Breakers for Motor Control Centers: As specified and indicated on the Drawings. Where no indication of type is given on the Drawings, the following governs:
   1. When an integral part of a UL-listed combination controller: Motor circuit protectors.
   2. All other circuit breakers: Molded case circuit breakers.

C. Provide motor circuit protectors and circuit breakers with non-aluminum line and load terminals suitable for the required conductor type, size, and number of conductors.

D. Panelboard Circuit Breakers: Bolt-in type. Snap-in circuit breakers are not acceptable.

2.03 MOLDED-CASE CIRCUIT BREAKERS

A. Molded-case Circuit Breakers: Ambient compensating which provides inverse time delay overload and instantaneous short circuit protection by means of a thermal magnetic element. Accomplish compensation by a secondary bimetal that will allow the breaker to carry rated current between 25 degrees Centigrade and 50 degrees Centigrade with tripping characteristics which are approximately the same throughout this temperature range.

B. Circuit Breaker Ratings and Modifications: As indicated on the Drawings.

C. On Breakers with Interchangeable, Thermal, Adjustable Magnetic Trip: The accessibility and position of the adjustment knob shall not be changed from those on the standard breaker.

D. Circuit Breakers for Mounting in Motor Control Centers or for Separate Mounting: Air-break type, quick-make and quick-break, 600 volt, with number of poles as indicated on the Drawings. Minimum Frame Size: 100 amperes.
   1. Provide each breaker pole with inverse time delay and instantaneous circuit protection.

E. Breakers: Operated by a handle and provided with a quick-make, quick-break switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents.
   1. Tripping Due to Overload, Short Circuit, or Ground Fault: Clearly indicate tripping by the handle automatically assuming a position between the manual ON and OFF positions.
   2. Latch Surfaces: Ground and polished.
   3. Poles: Constructed so they all open, close and trip simultaneously.
   4. Conform to the applicable requirements of NEMA Standard No. AB1.

F. Breakers: Completely enclosed in a molded case.
   1. Non-interchangeable Trip Breakers: Sealed covers.
   2. Interchangeable Trip Breakers: Sealed trip unit to prevent tampering.
   3. Ampere Ratings: Clearly visible.
   4. Contacts: Non-welding silver alloy.
   5. Arc Extinction: Accomplished by means of arc chutes.

G. Minimum Interrupting Ratings: At least equal to the available short circuit at the line terminals as determined by the CONTRACTOR's short circuit fault analysis and as accepted by the ENGINEER, but not less than 42,000 RMS amperes.

2.04 MOTOR CIRCUIT PROTECTORS

A. Motor Circuits: Protected by motor circuit protectors, as permitted by Item I below.

B. Motor Circuit Protectors: Operated by a handle and provided with a quick-make, quick-break switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents.
   1. Tripping: Clearly indicated by the handle automatically assuming a position between the manual ON and OFF positions.
   2. Latch Surfaces: Ground and polished.
   3. Poles: Constructed so they all open, close, and trip simultaneously.

C. Motor Circuit Protectors: Completely enclosed in a molded case.
   1. Trip Unit: Sealed to prevent tampering.
   2. Ampere Ratings: Clearly visible.
   3. Contacts: Non-welding silver alloy.
   4. Arc Extinction: Accomplished by means of arc chutes.

D. Provide each pole of motor circuit protectors with instantaneous short circuit protection by means of a single adjustable magnetic only element. The single adjustment screw is to adjust all poles simultaneously.

E. Furnish motor circuit protectors with provision for locking the maximum achievable trip setting to values less than maximum obtainable trip setting. Each adjustment typically to have 8 main setting points and mid-setting points following a linear scale so that each point has a significant value within calibration tolerances.

F. Motor Circuit Protectors: Suitable for use with current limiters, having 100,000 ampere interrupting capacity and a built-in trip indicator, that are fully coordinated with the motor circuit protectors so that the motor circuit protectors will open all 3 phases if the limiter operates.
   1. Current limiters shall be so constructed that they can only be replaced by an identical or similar limiter having the same interrupting capacity.

G. Minimum Interrupting Rating: At least equal to the available short circuit current at the line terminals as determined by the CONTRACTOR's short circuit fault analysis as accepted by the ENGINEER, but not less than 42,000 RMS amperes.

H. Motor Circuit Protectors Continuous Current Rating: As specified herein or as indicated on the Drawings.
   1. Setting: The motor circuit protectors setting shall be in accordance with the CONTRACTOR's protective device coordination study as accepted by the ENGINEER and in accordance with the motor circuit protectors manufacturer's recommendation based on motor nameplate current or actual motor current, whichever is larger.

I. Utilize an instantaneous trip circuit breaker or motor circuit protector only as part of a listed combination motor controller which provides coordinated motor branch-circuit overload, and short-circuit and ground-fault protection in accordance with NEC Article 430-52.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 16422

MOTOR STARTERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Manual starters, magnetic contactors, overload relays, combination starters and related motor controllers.

B. Related Sections:
   1. Section 01330 - Submittal Procedures.
   2. Section 16010 - Electrical Requirements.
   3. Section 16342 - 600 Volt Motor Control Centers.

1.02 REFERENCES

A. National Electrical Code (NEC):
   1. Article 430 - Motors, Motor Circuits and Controllers.

B. National Electrical Manufacturers Association (NEMA).

1.03 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330.

B. Manufacturer's installation instructions.

1.04 WARRANTY

A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Soft Starters: One of the following or equal:
   1. Cutler-Hammer.
   2. Allen-Bradley.
   3. Square D Company.

2.02 STARTERS

A. Suitable for the horsepower ratings specified, and in accordance with NEC Article 430.

B. Verify motor ratings and coordinate starter and overload trip ratings with actual horsepower and nameplate current ratings of motors installed.

C. Magnetic Contactors: Factory adjusted and chatter free.

D. Overload Relays: Install bimetallic type overload relays in each line conductor as indicated on the Drawings. Provide contacts for remote monitoring of overload status as indicated on the Drawings.

E. Mount extended overload reset buttons to be accessible for operation without opening door of enclosure. Plastic overload relay reset buttons with plastic operator shafts are unacceptable.

F. Provide starters Size 2 and larger with arc quenchers on load breaking contacts.

G. Minimum Size Starter: NEMA Size 1, and not smaller than size indicated on the Drawings.

H. Provide starters of sufficient size to accommodate motors furnished, including larger starters required for larger motors supplied by CONTRACTOR.

I. Combination Starters: Furnish complete with a 120 volt control transformer unless otherwise noted.

J. Control Fuses: Size and furnish as required and where indicated in the schematics.

PART 3 EXECUTION

3.01 INSTALLATION

3.02 APPLICATION

A. Supply circuit breaker trip elements and starter overload trip elements to meet above normal ambient temperatures where such conditions are anticipated (subject to ENGINEER's acceptance).

3.03 DEMONSTRATION

A. Demonstrate operation of equipment.

3.04 PROTECTION

A. Protect products until acceptance by OWNER.

END OF SECTION

SECTION 16448

MINI POWER ZONE PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Dead-front panelboards, including lighting distribution and control panelboards.

B. Related Section:
   1. Submittal Procedures.
   2. Section 16075 - Electrical Identification.
   3. Section 16412 - Low Voltage Circuit Breakers.
   4. Section 16950 - Electrical Testing.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA):
   1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

B. Underwriters' Laboratories, Inc. (UL):
   1. UL 67 - Panelboards.

1.03 PERFORMANCE REQUIREMENTS

A. Minimum Interrupting Capacity of Device: Equal to available short circuit current at line terminals as determined by CONTRACTOR's short circuit fault analysis as accepted by ENGINEER, but not less than 22,000 amperes.

B. Provide main bus rating of panelboards, number of poles, and provisions for number of circuits as indicated on the Drawings.

1.04 SUBMITTALS

A. Product Data: Include manufacturer's specifications and description.

B. Shop Drawings: Submit in accordance with Section 01330. Include panelboard layout.

1.05 WARRANTY

A. Provide manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Mini Power Zone Panelboards: One of the following or equal:
   1. Cutler-Hammer.

2. Square D Company.
3. General Electric Company.

2.02 INTERIOR

A. Bus: Size main bus bars in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 50 degrees Centigrade above specified ambient maximum.
   1. Tin-plated copper bussing.

B. Install protective devices such that they can be replaced without disturbing adjacent units.

C. Number branch circuits and spares as indicated on the Drawings and furnish complete typed circuit schedule in directory cardholder affixed to panel under a transparent cover.

D. Phase busing shall be full size and height without reduction. Include full size neutral bars with suitable lugs for the maximum number of circuits which can be connected to the panel.

E. Spares and spaces for future protective devices in panels indicated on the Drawings shall be bussed for panel rating or the main circuit breaker rating.

F. Provide panels with tin plated copper ground bus separate from neutral bars. Ground bus to have suitable lug for each circuit breaker installed including future circuits.

2.03 ENCLOSURES

A. Size panelboards sufficiently to provide minimum 4 inches of gutter space on all sides. Doors shall be such that:
   1. Live parts shall not be exposed when circuit breakers or switches are put in service.
   2. Hinges and latches shall not require tools to operate.

B. Furnish lock and minimum 2 keys each panelboard. Key all panelboard locks alike.

C. Enclosure type as indicated on the Drawings. Where not indicated on the Drawings:
   1. Indoor Enclosures: NEMA 12.
   2. Outdoor Enclosures: NEMA 4X.

D. Mounting shall be as indicated on the Drawings.

E. Finish stand alone panelboards with a primer, rust-resistant phosphate undercoat and 2 coats of oven-baked enamel with finish color ANSI 61 gray or a color to be selected by the ENGINEER.

F. Finish motor control center mounted panelboards to match the MCC finish and color, unless directed otherwise.

2.04 CIRCUIT BREAKERS

A. Circuit Breakers: As specified in Section 16412.

2.05 IDENTIFICATION

A. Label panelboards to indicate use as service entrance equipment where indicated on the Drawings or specified.

B. Label panelboards with UL short circuit current rating.

C. Provide each panelboard which is not an integral part of a motor control center with a lamicoid nameplate on outside of door, as specified in Section 16075, Electrical Identification.

PART 3 EXECUTION

3.01 INSTALLATION

A. As indicated on the Drawings, or as required, in a workmanlike manner.

3.02 FIELD QUALITY CONTROL

A. Test main circuit breaker(s) as specified in Section 16950.

END OF SECTION

SECTION 16500

LIGHTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Lighting fixtures, lamps, ballasts, poles, and accessories.

1.02 REFERENCES

A. Underwriters' Laboratories, Inc. (UL):
   1. UL 1029 - High-Intensity Discharge Lamp Ballasts.

1.03 SUBMITTALS

A. Product Data:
   1. Applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, beam lumens.
   2. Submit pole seismic and wind-load design calculations before fixtures and poles are manufactured.

B. Samples: Include finish Sample for lighting fixtures and poles.

C. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Lighting Fixtures: As noted on Lighting Fixture Schedule.

B. Plugs and Receptacles: As specified in Section 16140.

2.02 FIXTURES

A. Lighting Fixtures: As described in Lighting Fixture Schedule, as specified, and as indicated on the Drawings.
   1. Fixtures shall include lamps, ballasts, poles, mounting hardware, and appurtenances to provide complete operating units.

PART 3 EXECUTION

3.01 INSTALLATION

A. Surface and Flush Mounted Fixtures: Solidly connected to a junction box.

B. Suspended Fixtures: Hung utilizing pendant mounting or stainless steel chains and hooks. Electrically connect each fixture, or row of fixtures.

C. Pole Mounted Fixtures: Mount on steel, aluminum, or fiberglass poles as described in Lighting Fixture Schedule and as indicated on the Drawings.
   1. Ground or bond metal poles to the plant grounding system.
   2. Poles shall have adequate handholes in accordance with NEC requirements.
   3. Poles shall have weatherproof switches, receptacles, photo cells where indicated on the Drawings.

3.02 LIGHTING FIXTURE SCHEDULE

3.03 PROTECTION

A. Protect products until accepted by OWNER.

END OF SECTION