



Project and Facilities Management Department

385 N. Arrowhead Avenue, 3rd Floor
San Bernardino, CA 92415

SPECIFICATIONS

for

FUEL TANK INFRASTRUCTURE - PHASE IV PROJECT
#10.10.1195
80311 Trona Road, Trona - California

August 23, 2023

Prepared by:



PROJECT & FACILITIES MANAGEMENT DEPARTMENT
PROJECT MANAGEMENT DIVISION

PROJECT # 10.10.1195 CHANGE ORDER # N/A

- NO EXCEPTION TAKEN
- MAKE CORRECTIONS NOTED
- REVISE & RESUBMIT
- REJECTED

The document has been reviewed for compliance with the INTENT of the bid documents.

By: Jeff Lawver, per email dated 08/30/23

By: _____ Date: _____

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SECTION 02 41 00

DEMOLITION

PART 1 – GENERAL

1.1 RELATED SECTIONS

- A. Section 31 20 00 “Earthwork”

1.2 REFERENCE STANDARDS

- A. The following is a list of standards which may be referenced in this Section:
 - 1. American National Standards Institute (ANSI): A10.6, Safety Requirements for Demolition Operations.
 - 2. Standard Specifications for Public Works Construction (“Standard Specifications”), 2018 Edition.

1.3 SUBMITTALS

- A. Existing Conditions: Contractor shall provide documentation of existing items, adjoining construction and site improvements, actual locations of capped conduits and equipment abandoned in place that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video, which shall be submitted digitally.
 - 2. Include plans and notations to indicate damage.
- C. Weight Tickets: Submit weight tickets provided by the receiving Landfill.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Contractor shall comply with hauling and disposal regulations of authorities having jurisdiction.

1.5 PROJECT CONDITIONS

- A. Contractor shall not commence demolition or earth moving operations until temporary erosion and sedimentation control measures, specified in

Section 312000 "Earthwork", Subsection 3.1 "Temporary Erosion and Sedimentation Control" are in place.

- B. Contractor shall maintain dust control at all times by watering.
- C. Contractor shall accurately locate all existing utilities to identify any conflicts with the proposed work.
- D. Contractor shall scan the work area using a metal detector of adequate strength prior to any excavation. Contractor shall be responsible for locating, protecting, and documenting on Record Drawings, all manholes, water valves, utility access frames and covers or other metal appurtenances buried below the existing pavement surface whether shown on the plans or not. Contractor shall notify Engineer immediately of any existing utility found that is not shown on the plans.
- E. Contractor shall protect in place existing improvements and utilities if specified to be protected in place in the plans.
- F. Any existing site improvements (not indicated on the plans to be removed) that are damaged during demolition operations shall be restored (at the expense of the contractor) to their original conditions, as acceptable to Engineer.
- G. Contractor shall remove all existing site improvements indicated on plans and as required for installation of new improvements.
- H. Contractor shall remove or abandon all existing utilities indicated on plans.
- I. Contractor shall comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the General Conditions, Contractor's safety requirements shall conform to ANSI A10.6.
- J. Contractor shall conduct demolition to minimize interference with adjacent building and parking lot areas.
- K. Contractor shall restore and clean-up site once site clearing operations are completed.
- L. If any material found within the Contractor's work area appears to be contaminated, it shall be handled per the contract documents.

1.6 DEFINITIONS

- A. ACM: Asbestos-containing material.
- B. ACP: Asbestos Cement Pipe
- C. Demolition: Dismantling, razing, destroying, or wrecking of any fixed building, structure, surface or subsurface feature, site element, or any part thereof.

- D. Remove: Detach items from existing construction and legally dispose of them to land fill off-site unless indicated to be removed and salvaged or removed and reinstalled.
- E. Modify: Provide all necessary material and labor to modify an existing item to the condition indicated or specified.
- F. Relocate: Remove, protect, clean and reinstall equipment, including electrical, instrumentation, and all ancillary components required to make the equipment fully functional, to the new location identified on the Drawings.
- G. Salvage/Salvageable: Remove and deliver, to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property to remain that of Engineer. Unless otherwise specified, title to items identified for demolition shall revert to Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PROTECTION

- A Protection of Existing Site Improvements:
 - 1. Survey the site and examine the Drawings and Specifications to determine the extent of the Work before beginning construction operations.
 - 2. Take necessary precautions to avoid damage to existing items scheduled to remain in place, to be reused, or to remain the property of Engineer; any Contractor-damaged items shall be repaired or replaced as directed by Engineer.
 - 3. Do not overload pavements to remain. Pavement outside work area damaged by Contractor due to Contractor operations shall be restored to preconstruction conditions at no cost to SBC. Contractor shall ensure that condition of existing pavement outside of work area is documented and included as part of the existing conditions submittal (1.3.A) to the Engineer.
 - 4. Do not overload already stabilized areas until Engineer agrees it is acceptable to do so.
- B. Protection of Personnel:
 - 1. During demolition, continuously evaluate the condition of the existing improvement being demolished and take immediate action to protect all personnel working in and around the demolition site.

2. Provide temporary barricades and other forms of protection to protect SBC personnel, subcontractor personnel, and any other people who may be present from injury due to demolition Work.
3. Provide protective measures as required to provide free and safe passage of SBC personnel, subcontractor personnel, and any other people who may be present to occupied portions of the structure.

3.2 RELOCATION OF EMERGENCY MATERIAL STORAGE CONTAINER

- A. Survey the site for existing improvements and utilities necessary for demolition, relocation and new work.
- B. Relocate the existing emergency material storage container as shown on plans prior to surveying and scanning for the existing underground utilities.
- C.

3.3 SAWCUT AND REMOVAL OF EXISTING PCC CURB, PAVEMENT AND SLAB

- A. Sawcut existing PCC curb, pavement and slab as required for new improvements.
- B. Legally remove, dispose, and recycle PCC waste materials as required.

3.4 BACKFILLING VOIDS LEFT BY REMOVALS

- A. All voids left by removals of shall be backfilled with properly compacted engineering fill per Section 312000 "Earthwork". The cost to place this fill material shall be incidental to the removal items of work.

3.5 CLEAN UP

- A. Debris and rubbish shall be removed from excavations, and shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

3.6 HAUL ROUTE AND DISPOSAL OF MATERIALS

- A. The Contractor shall make every effort to recycle demolished materials. Items required to be removed shall become the property of the contractor and shall be removed from Project site and be lawfully hauled and disposed of. The cost to haul and dispose removed items shall be included in the cost of the items of work.

- B. Contractor shall secure a Haul Route Permit from the City for all transport of import and export material on public streets.
- C. The transport of import and export material on public streets shall be in accordance with all local governing agency standards.

END OF SECTION 02 41 00

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SECTION 03 11 00
CONCRETE FORMWORK

PART 1 – GENERAL

1.1 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest issue of the publication shall be used.

1. American Concrete Institute (ACI) Publications:
ACI-318 Building Code Requirements
ACI-347 Recommended Practice for Concrete Formwork

1.2 RELATED SECTIONS

- A. Section 03 21 13 Galvanized Reinforcement Steel Bars
- B. Section 03 30 00 Cast-in-Place Concrete
- C. Section 03 35 23 Concrete Finishing and Sealing

1.1 SUBMITTALS

A. Provide submittals in accordance with Division One requirements.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 03300 - "Cast-In-Place Concrete": Supply of concrete accessories for placement by this section.

1.3 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements; and such that the resultant concrete conforms to required shape, line, and dimensions.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, ACI 318 and ACI 347

PART 2 – PRODUCTS

2.1 FORM MATERIALS

- A. Forms shall be of wood, plywood, reinforced plastic or metal. Plywood, other than for lining, shall be concrete-form plywood not less than 5/8-inch-thick conforming to Department of Commerce product standard PS-1 free of raised grain, torn surfaces, worn edges, patches, or other surface defects which would impair the texture of the concrete surface. Surfaces of steel forms shall be free from irregularities, dents and sags.

2.2 FORMWORK ACCESSORIES

- A. Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be of a commercially manufactured type. Nonfabricated wire shall not be used.
- B. Form ties shall be constructed so that the ends of end fasteners can be removed without causing appreciable spalling at the surface of the concrete. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 3/4 inch from the formed surface of concrete to be permanently exposed to view.

PART 3 - EXECUTION

3.1 FORM MATERIALS

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 ERECTION – FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301, ACI 318 and ACI 347.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to over stressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping.
- D. Align joints and make watertight. Keep form joints to a minimum.

3.3 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not let excess form coating material stand in puddles in the forms nor shall such coating come in contact with hardened concrete against which fresh concrete is to be placed.
- D. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are effected by agent. Soak inside surfaces of untreated forms with clean water prior to placement of concrete.

3.4 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items passing through concrete work.
- B. Locate and set in place items which will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

3.7 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

3.8 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

END OF SECTION 03 1100

SECTION 03 21 13

REINFORCEMENT STEEL BARS

PART 1 - GENERAL REQUIREMENTS

- 1.1 Scope - Fabricate and install reinforcing and the related accessories required for cast-in-place concrete work.
- 1.2 Applicable documents - The following specifications and standards of the issues currently in force form a part of this section and are applicable as specified herein.
 - A. American Society for Testing and Materials (ASTM) Publications:
A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 853 Wire, Steel, Carbon for General Use.

1.3 RELATED SECTIONS

- A. Section 03 11 13 Concrete Form Work
- B. Section 03 30 00 Cast in Place Concrete
- C. Section 03 35 23 Concrete Finishing and Sealing

PART 2 - PRODUCTS

- 2.1 Materials
 - A. Bars – All rebars shall be comply with ASTM A60 Grade 60 and Carrying rolled-on identifying marks to denote the mill location, bar size and grade 60 of steel shall also be marked to indicate minimum yield.
 - B. Tie bars – All tie bars shall comply with ASTM A60 grade 60.
 - C. Material - Use deformed bars unless otherwise specified or shown.

PART 3 - EXECUTION

- 3.1 Forming - Unless noted otherwise, bend bars cold. Do not straighten or rebend without specific approval from SBC.
- 3.2 Preparation - Remove from reinforcing scale, heavy rust, and any coating, which would reduce bond. Any rebar that comes in contact with form releasing agent shall be replaced.

- 3.3 Accessories - Provide spacers, chairs, wire ties, etc., necessary to properly assemble, space and support the reinforcing prior to concrete placement. Accessories shall be sized to provide required concrete coverage. Position and support bolts, anchors, and other cast-in place items with appropriate accessories.
- 3.4 Storage - Store reinforcing so that it is not less than 6 inches above ground.

END OF SECTION 03 21 13

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 A. RELATED SECTIONS

1. Section 03 11 13 Concrete Form Work
2. Section 03 21 13 Reinforcement Steel Bars
3. Section 03 35 23 Concrete Finishing and Sealing

B. Submittals: Submit the following:

1. Product data for reinforcement, forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Engineer.
2. Shop drawings for fabricating, bending, and placing concrete reinforcement.
3. Laboratory test reports or evaluation reports for concrete materials and concrete mix designs.
4. Written report to Engineer for proposed concrete mix at least 15 days prior to start of concreting. Do not begin concrete production until mixes have been reviewed by Engineer. Statement of mix design shall be signed by a registered Civil Engineer responsible for mix design.

C. Quality Assurance: Comply with provisions of ACI 301, "Specifications for Structural Concrete for Buildings," ACI 318, "Building Code Requirements for Reinforced Concrete," and CRSI "Manual of Standard Practice," except where more stringent requirements are indicated.

1. Concrete Testing Service: Engage a testing agency acceptable to Engineer to perform materials evaluation testing and to design concrete mixes. Tests of rejected materials shall be done at the Contractor's expense.

1.2 PRODUCTS

- A. Form Materials: Furnish form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.

- B. Reinforcing Materials: As follows:
1. Deformed Reinforcing Bars: ASTM A 615, Grade 60, unless otherwise indicated.
- C. Concrete Materials: As follows:
1. Portland Cement: ASTM C 150, Type V.
 2. Fly Ash: ASTM C 618, Type F.
 3. Aggregates: ASTM C 33.
 4. Water: Potable.
 5. No ducts or electrical conduits shall be embedded in the slab.
- D. Admixtures: Provide admixtures that contain not more than 0.1 percent chloride ions.
1. Air-Entraining Admixture: ASTM C 260.
 2. Water-Reducing, Retarding, and Accelerating Chemical Admixtures: ASTM C 494.
- F. Related Materials: As follows:
1. Waterstops: Flat dumbbell or center bulb type, size to suit joints, of either rubber (CRD C 513) or PVC (CRD C 572).
 2. Vapor Retarder: Clear 8-mil-thick polyethylene.
 3. Water-Resistant Barrier: Polyethylene membrane with multi-ply kraft paper and glass-fiber-reinforced core.
 4. Vapor Barrier: As noted on drawings.
 5. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
 6. Moisture-Retaining Cover: Waterproof paper, polyethylene film, or polyethylene-coated burlap, complying with ASTM C 171.
 7. Membrane-Forming Curing Compound: ASTM C 309, Type 1. Moisture loss not more than 0.55 kg/sq. meter when applied at 200 sq. ft./gal.
 8. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

- G. Mix Proportions and Design: Proportion mixes complying with mix design procedures specified in ACI 301.
1. Limit use of fly ash to not exceed 15 percent of cement content by weight.
 2. Design mixes to provide normal weight concrete with the following properties:
 - a. Caisson: Shall be 4000-psi, 28-day compressive strength; water-cement ratio, 0.50 maximum (for non-air-entrained) and 0.46 maximum (for air-entrained).
 - b. Wall footing: Shall be 3000-psi, 28-day compressive strength; water-cement ratio, 0.50 maximum (for non-air-entrained) and 0.46 maximum (for air-entrained).
 - c. Pave slab: Shall be 3000-psi, 28-day compressive strength; water-cement ratio, 0.50 maximum (for non-air-entrained) and 0.46 maximum (for air-entrained).
 3. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
 - a. Slabs: Not more than 3 inches.
 - b. Foundation: Not more than 4 inches.
 4. Adjust mix designs when material characteristics, job conditions, weather, test results, or other circumstances warrant. Do not use revised concrete mixes until laboratory test data and strength results have been submitted to and reviewed by Engineer.
- H. Use water-reducing, accelerating, and retarding admixtures that have been tested and accepted in mix designs in strict compliance with manufacturer's directions.
- I. Ready-Mix Concrete: ASTM C 94.
- J. Admixtures containing calcium chloride are not permitted for concrete used over metal deck.

1.3 EXECUTION

- A. Formwork: Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position. Select form materials to obtain required finishes.

1. Maintain formwork tolerances and surface irregularities within ACI 347 limits, Class A tolerances for concrete exposed to view and Class C tolerances for other concrete surfaces.
 2. Provide openings in formwork to accommodate work of other trades. Accurately place and securely support items built into forms.
 3. Clean and adjust forms prior to concrete placement. Apply form-release agents or wet forms as required. Retighten forms during concrete placement, if required, to eliminate mortar leaks.
- B. Vapor Retarders/Barriers: Place vapor retarder/barrier membrane for slabs on grade, with joints lapped 6 inches and sealed.
- C. Reinforcement: Accurately position and support reinforcement, and secure against displacement. Locate and support reinforcement to maintain minimum cover with metal chairs, runners, bolsters, spacers, and hangers as required. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
1. Dowel between new and existing adjacent slabs as indicated and/or required.
- D. Joints: Locate and install construction, isolation, and control joints as indicated or required. Locate construction joints so they do not impair strength and appearance of structure. Place isolation and control joints in slabs-on-ground to stabilize differential settlement and prevent random cracking. Match existing site joint layout pattern.
- E. Installation of Embedded Items: Set and build anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting diagrams, templates, and instructions provided by others for locating and setting.
1. Locate and support waterstops to prevent displacement.
- F. Concrete Placement: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," for placing concrete in a continuous operation within planned joints or sections. Do not begin concrete placement until other affected work is completed.
1. Consolidate placed concrete using mechanical vibrating equipment with hand rodding and tamping so that concrete is worked around reinforcement and other embedded items and into forms. Do not use vibration to move concrete horizontally.
 2. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.

- a. In cold weather comply with ACI 306.
 - b. In hot weather comply with ACI 305.
- G. Finish of Formed Surface: As follows:
1. Smooth-Formed Finish: Provide a smooth finish for concrete surfaces to be covered with a coating or covering material applied directly to concrete. Repair and patch defective areas, with projections completely removed and smoothed.
- H. Monolithic Slab Finishes:
1. Heavy broom finish to match existing.
- I. Curing: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, apply an evaporation-control compound according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
1. Begin initial curing as soon as free water has disappeared from exposed surfaces.
 2. Continue curing unformed concrete surfaces by continuously wetted absorptive cover, or by moisture-retaining cover curing. Cure formed surfaces by moist curing until forms are removed. Keep concrete continuously moist for not less than 72 hours for high-early strength concrete and 7 days for all other concrete.
- J. Field Quality Control: Perform sampling and testing during concrete placement,
As follows:
1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
 - b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
 - c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80

- deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
- d. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
 - e. Compressive-Strength Tests: ASTM C 39; one set for each 50 cubic yards or portion thereof.
2. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 3. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
 4. Test results will be reported in writing to Engineer, Structural Engineer, ready-mix producer, and Contractor within 72 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
 5. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
 6. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

END OF SECTION 03 30 00

SECTION 03 35 23

CONCRETE FINISHING AND SEALING

PART 1 - GENERAL REQUIREMENTS

1.1 RELATED SECTIONS

- A. Section 03 11 13 Concrete Form Work
- B. Section 03 21 13 Galvanized Reinforcement Steel Bars
- C. Section 03 30 00 Cast-in-Place Concrete

1.2 Scope - Provide Sikaflex-2c NS TG sealant on cast-in-place concrete between equipment pad and slab as called for on the drawings.

1.2 Related Work - Documents affecting work of this Division include, but are not necessarily limited to, Division 03300, CAST-IN-PLACE CONCRETE

1.3 Applicable Publications - Industry publications controlling the work of this Section include:

- A. American Concrete Institute (ACI):
ACI 301: Specifications for Structural Concrete for Buildings.
- B. American Society for Testing and Materials (ASTM):
ASTM C309: Liquid Membrane-Forming Compounds for Curing Concrete.

PART 2 - PRODUCTS

Not Applicable to this Section.

PART 3 - EXECUTION

3.1 Formed Surfaces -

- A. Unspecified Finish - If the finish of formed surfaces is not specifically called out on the drawings, provide the following finishes as applicable:
 - 1. Rough form finish for all concrete surfaces not exposed to public view.

2. For all concrete surfaces exposed to public view, match adjacent finish surface and as approved by PFMD.
- B. Rough form finish -
1. Leave surfaces with the texture imparted by forms, except patch tie holes and defects.
 2. Remove fins exceeding 1/4" in height.
- C. Smooth form finish -
1. Coordinate as necessary to secure form construction using smooth, hard, uniform surfaces, with number of seams kept to a practical minimum and in a uniform and orderly pattern.
 2. Patch tie holes and defects.
 3. Remove fins completely.
- D. Related Unformed Finish - At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- 3.2 Finishing Floor Slabs -
- A. "Class A" - True plane within 1/8" in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction.
- B. "Class B" - True plane within 1/4" in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction.
- C. Unspecified - All interior concrete slabs shall be placed to a Class A plane tolerance with a troweled finish. All exterior concrete slabs shall be placed to a Class B plane tolerance with a broom finish.
- D. Floated finish - After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further until ready for floating. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after the first floating, check the planeness of the surface with a ten foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots, and produce a surface with a Class B tolerance throughout. Refloat the slab immediately to a uniform sandy texture.
- E. Broom finish - Provide a floated finish as described above. While the surface is still plastic, provide a textured finish by drawing a fiber bristle

broom uniformly over the surface. Provide the texturing in one direction only.

- F. Scratch Finish - Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated. After placing slabs, plane surface to tolerances for floor flatness (Ff) of 15 and floor levelness (F1) of 13. Slope surfaces uniformly for drainage or to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
- G. Sealer and Hardener - Sealer/hardener shall be applied to all interior concrete floors, which do not receive a floor covering.
- H. Cleaning - Prior to treatment, the floors shall be thoroughly cured, cleaned and perfectly dry, with all work above them completed. On areas where forms are recently removed, remove all form oil and breaking compound residue to assure penetration of the product into the surface.

3.3. Application - In accordance with manufacturer's instructions.

3.4 Concrete Curing and Protection

- A. General - Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
- B. Initial Curing - Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
- C. Curing Methods - Perform curing of concrete by moist curing, or by moisture-retaining cover curing, or by curing and sealing compound, or by combinations thereof, as herein specified.
- D. Moist Curing
 1. Keep concrete surface continuously wet by covering with water; or
 2. Use continuous water-fog spray; or
 3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place

absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.

- E. Moisture-Retaining Cover Curing - Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3-inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during period using cover material and waterproof tape.
 - F. Curing and Sealing Compounds - Apply curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - G. Curing Formed Surfaces - Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specific above, as applicable.
 - H. Curing Unformed Surfaces - Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces, by application of appropriate curing method.
 - I. Treated Surfaces - Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.
- 3.5 Removal Of Forms - Formwork not supporting weight of concrete, such as walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.
- 3.6 Concrete Surface Repairs
- 1. Repair and patch defective areas with cement mortar immediately after removal of forms.
 - 2. Cut out honeycomb, rock pockets, voids over 1/4-inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to

a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried.

3. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
 - A. Repair of Formed Surfaces - Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Owner's Representative. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar.
 1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
 - B. Repair of Unformed Surfaces -
 1. Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish.
 2. Correct low and high areas as herein specific. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.
 3. Repair finished unformed surfaces that contain defects that affect durability and concrete. Surface defects, as such, include crazing and cracks in excess of 0.01-inch wide or that penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
 4. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
 5. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound; Finish repaired areas to

blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Owner's Representative.

6. Repair defective areas, except random cracks and single holes not exceeding 1-inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

END OF SECTION 03 35 23

SECTION 09 91 13
EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Engineer will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include, but are not limited to, the following factory-finished components:
 - a. Metal lockers.
 - b. Elevator entrance doors and frames.
 - c. Elevator equipment.
 - d. Finished mechanical and electrical equipment.
 - e. Light fixtures.

2. Concealed surfaces include, but are not limited to, walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Utility tunnels.
 - d. Pipe spaces.
 - e. Duct shafts.
 - f. Elevator shafts.
3. Finished metal surfaces include, but are not limited to, the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
4. Operating parts include, but are not limited to, moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for shop priming metal fabrications.

1.3 DEFINITIONS

- A. Flat: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Velvet: 5 to 10 units at 60 degrees and 10 to 15 units at 85 degrees, according to ASTM D 523.
- C. Eggshell: 10 to 15 units at 60 degrees and 15 to 30 units at 85 degrees, according to ASTM D 523.
- D. Low-Luster and Low-Sheen: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

- E. Semigloss: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss and Full Gloss: More than 75 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification. Use same designations indicated on Drawings and in schedules. Include color designations.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
 - a. VOC Content: Include VOC content for each product.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8-1/2 by 11 inches.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Applicator.

1.6 CLOSEOUT SUBMITTALS

- A. Coating Maintenance Manual: Upon conclusion of the project, the Applicator, paint manufacturer, or paint supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" or equal. Manual shall include:
 - 1. Area summary with finish schedule.
 - 2. Area detail designating where each product / color / finish was used.
 - 3. Product data pages for each product used.

4. Material Safety Data Sheets (MSDS) for each product used.
5. Care and cleaning instructions.
6. Touch-up procedures.
7. Samples of each color and finish used.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Paint: 5 percent, but not less than 1 gallon of each material and color applied.
 - a. Provide extra materials in unopened 1 gallon containers.

1.8 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. The Engineer will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of not less than 100 sq. ft.
 - b. Other Items: Engineer will designate items or areas required.
 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Engineer at no added cost to Owner.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. VOC content.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.
 3. Store on shelves or wood pallets.

1.10 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50- and 95-degree F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5-degree F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers Names: Shortened versions (shown in parentheses) of the following manufacturers names are used in other Part 2 articles:
1. Behr Process Corporation (Behr).
 2. Dunn-Edwards Corporation (Dunn-Edwards).
 3. Frazee Paint/Comex Group (Frazee).
 4. Glidden Professional (Glidden).
 5. PPG Engineerural Finishes, Inc. (PPG)
 6. Sherwin-Williams Company (The) (Sherwin-Williams).
 7. Vista Paint (Vista).
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles for the paint category indicated.
- C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

2.2 SUSTAINABILITY REQUIREMENTS

- A. Comply with applicable provisions in the CGBC.

2.3 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Material Quality:

1. Provide paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application

indicated. Paint-material containers not displaying the manufacturer's product identification will not be acceptable.

2. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Colors: As indicated on Drawings or, if not indicated, as selected by Engineer from manufacturer's full range.

2.4 PRETREATMENT FOR GALVANIZED METAL

- A. Galvanized Metal Pretreatment: Factory-formulated galvanized metal pretreatment for exterior and interior application.
 1. Behr: Krud Kutter; Metal Clean & Etch.
 2. Dunn-Edwards: Supreme Chemical; Metal Clean and Etch (SCME-01).
 3. Frazee: Jasco; Prep N Prime.
 4. Glidden: Jasco; Prep N Prime.
 5. PPG: Duraprep Concentrated Multi-Purpose Cleaner Prep120.
 6. Sherwin-Williams: DTM Wash Primer B71Y1.
 7. Vista: Krud Kutter; Metal Clean & Etch.

2.5 METAL PRIMERS

- A. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
 1. Behr: Premium Plus Exterior Multi-Surface Primer & Sealer (436): Applied at a dry film thickness of not less than 1.8 mils.
 2. Dunn-Edwards: Provide one of the following:
 - a. GALV-ALUM Premium (GAPR00): Applied at a dry film thickness of not less than 2.0 mils.
 - b. ULTRA-GRIP Premium Interior/Exterior Multi-Surface Primer UGPR00: Applied at a dry film thickness of not less than 1.5 mils.
 3. Frazee: Provide one of the following:
 - a. 561 Alkyd Acrylic Metal Primer: Applied at a dry film thickness of not less than 1.8 mils.

- b. 309 Ultratech Universal Water-Based Metal Primer: Applied at a dry film thickness of not less than 2.0 mils.
4. Glidden: Devflex Waterborne Acrylic DTM Primer 4020PF: Applied at a dry film thickness between 2.0 and 4.0 mils.
5. PPG: Pitt-Tech Plus DTM Industrial Primer 90-912: Applied at a dry film thickness between 2.0 and 4.0 mils.
6. Sherwin-Williams: Pro Industrial Pro-Cryl Primer, B66-310 Series: Applied at a dry film thickness between 2.0 and 4.0 mils.
7. Vista: 4800 Metal Pro Primer: Applied at a dry film thickness of not less than 2.5 mils.

2.6 WATER-BASED PAINTS

- A. Exterior Semigloss Acrylic Enamel: Factory-formulated semigloss waterborne acrylic-latex enamel for exterior application. 35 to 70 units at 60 degrees, according to ASTM D 523.
 1. Behr: Premium Plus Exterior Semi-Gloss (5050): Applied at a dry film thickness of not less than 1.4 mils.
 2. Dunn-Edwards: SPARTASHIELD (SSHL50): Applied at a dry film thickness of not less than 1.5 mils.
 3. Frazee: 124 Mirro Glide 100% Acrylic Semi-Gloss: Applied at a dry film thickness of not less than 1.4 mils.
 4. Glidden: Ultra-Hide 150 Exterior Semi-Gloss Paint 2416V: Applied at a dry film thickness of not less than 1.6 mils.
 5. PPG: Speedhide Exterior 100% Acrylic Latex Semi-Gloss 6-900XI: Applied at a dry film thickness of not less than 1.4 mils.
 6. Sherwin-Williams: Provide one of the following:
 - a. Sonoran Int/Ext Acrylic Latex Semi-Gloss, B40WJ9850 Series: Applied at a dry film thickness of not less than 1.5 mils.
 - b. Solo 100% Acrylic Int/Ext S/G A76 Series: Applied at a dry film thickness of not less than 1.5 mils.
 7. Vista: 7000 Acriglo Semigloss: Applied at a dry film thickness of not less than 1.4 mils.

2.7 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. The owner will engage the services of a qualified testing agency to sample paint materials. The contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to the Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by a testing agency.
2. The testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. The contractor shall remove noncomplying paint materials from the Project site, pay for testing, and repaint surfaces painted with rejected materials. The contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.
- D. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 1. Notify Engineer about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.

- B. Remove door and other hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint faces, all four edges, edges of cutouts, and mortises of exterior doors and gates and entire exposed surface of exterior door frames.
 - a. Paint all surfaces that will be covered by door hardware including, but not limited to, kick, mop, and armor protection plates.
 - 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 4. Primers specified in painting schedules are required on items that are factory primed or factory finished.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. The contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Engineer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a galvanized metal primer.
 - a. Pretreatment: Exterior galvanized metal pretreatment.
 - b. Primer: Exterior galvanized metal primer.
 - c. Finish Coats: Exterior semigloss acrylic enamel.

END OF SECTION 09 91 13

SECTION 23 05 53

IDENTIFICATION for PIPING and EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to be included in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. Champion America.
 - e. Craftmark Pipe Markers.
 - f. Seton Identification Products.
2. Material and Thickness: stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 3. Letter Color: Black.
 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. Champion America.
 - e. Craftmark Pipe Markers.
 - f. Seton Identification Products.
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.

9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Carlton Industries, LP.
 4. Champion America.
 5. Marking Seviles Inc.
 6. Stranco, Inc.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Red.
- D. Background Color: Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Carlton Industries, LP.
 - 4. Champion America.
 - 5. Marking Services Inc.
 - 6. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to indoor located pipe without fasteners or adhesive. Provide fasteners for outdoor piping.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters at least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 DUCT LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Carlton Industries, LP.
 - 4. Champion America.
 - 5. Marking Services Inc.
 - 6. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: White.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 STENCILS

- A. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brimar Industries, Inc.
 - b. Carlton Industries, LP.
 - c. Champion America.
 - d. Marking Services Inc.
 - 2. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
 - 3. Stencil Material: Fiberboard or metal.
 - 4. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
 - 5. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

2.6 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.

3. Carlton Industries, LP.
 4. Champion America.
 5. Marking Services Inc.
 6. Seton Identification Products.
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.032-inch or stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link chain or beaded chain.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

2.7 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Carlton Industries, LP.
 4. Marking Services Inc.
 5. Seton Identification Products.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
1. Size: 3 by 5-1/4 inches minimum.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary captions such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustic ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where the flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule:
 - 1. Diesel Fuel Piping: White letters on a safety-green background.
 - 2. Gasoline Fuel Piping: Black letters on a safety-orange background.
 - 3. Water Piping: White letters on a safety-gray background.

3.5 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For toilet exhaust ducts.
 - 3. Green: For return-, and mixed-air ducts.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and fuel terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions like those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Diesel Fuel: 1-1/2 inches, round.
 - b. Gasoline Fuel: 1-1/2 inches, round.
 - c. Water: 1-1/2 inches, round.
 - d. Gas: 1-1/2 inches, round.
 - 2. Valve-Tag Colors:
 - a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
 - b. Flammable Fluids: Black letters on a safety-yellow background.
 - c. Combustible Fluids: White letters on a safety-brown background.
 - d. Potable and Other Water: White letters on a safety-green background.
 - e. Compressed Air: White letters on a safety-blue background.
 - f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background.

3.7 WARNING-TAG INSTALLATION

- A. Write the required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 23 11 01

FUEL-OIL PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following fuel-oil piping materials and methods to complement other Division 23 Sections.
 - 1. Piping materials and installation instructions are common to most piping systems.
 - 2. Concrete base construction requirements.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Mechanical sleeve seals.
 - 6. Equipment nameplate data requirements.
 - 7. Labeling and identifying mechanical systems and equipment is specified in Division 23 Section "Identification for Piping and Equipment."
 - 8. Nonshrink grout for equipment installations.
 - 9. Field-fabricated metal and wood equipment supports.
 - 10. Installation requirements common to equipment specification sections.
 - 11. Mechanical demolition.
 - 12. Cutting and patching.
 - 13. Touchup painting and finishing.
- B. Pipe and pipe fitting materials are specified in Division 23 piping system Sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by station occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by station occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. NP: Nylon plastic.
 - 4. PE: Polyethylene plastic.
 - 5. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. CR: Chlorosulfonated polyethylene synthetic rubber.
 - 2. EPDM: Ethylene propylene diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.
- B. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- C. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and station components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 - 1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - 2. Clearances for installing and maintaining insulation.
 - 3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - 4. Equipment and accessory service connections and support details.
 - 5. Exterior wall and foundation penetrations.
 - 6. Fire-rated wall and floor penetrations.
 - 7. Sizes and location of required concrete pads and bases.
 - 8. Scheduling, sequencing, movement, and positioning of large equipment into stations during construction.
 - 9. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - 10. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

- D. Samples: Of color, lettering style, and other graphic representation required for each identification material and device.

1.5 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other station components.
- B. Arrange for pipe spaces, chases, slots, and openings in station structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in station.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Section 23 11 01 for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
 - 2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
 - 3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
 - 4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.
 - 5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.
- F. Brazing Filler Metals: AWS A5.8.

1. BCuP Series: Copper-phosphorus alloys.
 2. BAg1: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements: Manufacturer's standard solvent cements for the following:
1. ABS Piping: ASTM D 2235.
 2. CPVC Piping: ASTM F 493.
 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- K. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
1. Sleeve: ASTM A 126, Class B, gray iron.
 2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
 3. Gaskets: Rubber.
 4. Bolts and Nuts: AWWA C111.
 5. Finish: Enamel paint.

2.3 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types, and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.5 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
 5. PVC: Manufactured, permanent, with nailing flange for attaching to wooden forms.
 6. PVC Pipe: ASTM D 1785, Schedule 40.
 7. PE: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

2.6 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23 Sections. If more than one type is specified for application, selection is Installer's option, but provide one selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
 2. Location: Accessible and visible location.
- C. Stencils: Standard stencils, prepared for required applications with letter sizes complying with recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch- high letters for ductwork and not less than 3/4-inch- high letters for access door signs and similar operational instructions.
1. Material: Fiberboard.
 2. Material: Brass.
 3. Stencil Paint: Standard exterior-type stenciling enamel; black, unless otherwise indicated; either brushing grade or pressurized spray-can form and grade.
 4. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ASME A13.1 for colors.
- D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap on, color-coded, complying with ASME A13.1.
- E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.
- F. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine sub core, unless otherwise indicated.
1. Fabricate in sizes required for message.
 2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
 3. Punch for mechanical fastening.
 4. Thickness: 1/16 inch, unless otherwise indicated.
 5. Thickness: 1/8 inch, unless otherwise indicated.
 6. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches long; 1/8 inch for larger units.
 7. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.
- G. Plastic Equipment Markers: Color-coded, laminated plastic. Comply with the following color code:
1. Green: Diesel equipment and components.
 2. Yellow: Gasoline equipment and components.
 3. Yellow/Green: Combination Diesel and Gasoline equipment and components.
 4. Brown: Energy reclamation equipment and components.

5. Blue: Equipment and components that do not meet any criteria above.
 6. For hazardous equipment, use colors and designs recommended by ASME A13.1.
 7. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.
 8. Size: Approximate 2-1/2 by 4 inches for control devices, dampers, and valves; and 4-1/2 by 6 inches for equipment.
- H. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.
1. Multiple Systems: If multiple systems of same generic name are indicated, provide identification that indicates individual system number and service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."
- 2.7 GROUT
- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psig, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 23 piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipes and calculate friction loss, expansion, pump

sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

- C. Install piping at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to station walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other station elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Sleeves are not required for core drilled holes.
- N. Permanent sleeves are not required for holes formed by PE removable sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Build sleeves into new walls and slabs as work progresses.
 - 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC Pipe Sleeves: For pipes smaller than 6-inch NPS.

- b. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
 - c. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
 - d. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 7 Section "Joint Sealants" for materials.
5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- Q. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 - 3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stopping materials. Use USG fire stopping system to seal pipe penetration in accordance with the Standard ASTM E 814 or ASTM E 1966
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- V. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
- 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
4. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube."
5. Soldered Joints: Construct joints according to CDA's "Copper Tube Handbook."
6. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
7. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
8. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
9. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
10. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. ABS Piping: ASTM D 2235 and ASTM D 2661.
 - c. CPVC Piping: ASTM D 2846 and ASTM F 493.
 - d. PVC Pressure Piping: ASTM D 2672.

- e. PVC Nonpressure Piping: ASTM D 2855.
 - f. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
11. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
- a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- W. Piping Connections: Make connections according to the following, unless otherwise indicated:
- 1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
 - 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form.
- C. Install equipment level and plumb, parallel, and perpendicular to other station systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment giving right of way to piping installed at required slope.

3.3 LABELING AND IDENTIFYING

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: According to ASME A13.1.
2. Plastic markers, with application systems. Install on insulation segment if required for hot, uninsulated piping.
3. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior non-concealed locations:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch if flow pattern is not obvious.
 - c. Near locations if pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
 - g. On piping above removable acoustical ceilings, omit intermediately spaced markers.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of mechanical equipment.
 1. Lettering Size: Minimum 1/4-inch- high lettering for name of unit if viewing distance is less than 24 inches, 1/2-inch- high lettering for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of the size of principal lettering.
 2. Text of Signs: Provide name of identified unit. Include text to distinguish between multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

3.4 PAINTING AND FINISHING

- A. Apply paint to exposed piping according to the following, unless otherwise indicated:
 1. Interior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 2. Interior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 3. Interior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.

4. Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
 5. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 6. Exterior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
- B. Do not paint piping specialties with factory-applied finish.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1, "Structural Welding Code-Steel."

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach substrates as required to support applied loads.

3.7 DEMOLITION

- A. Disconnect, demolish, and remove Work specified in Division 23 Sections and as indicated on drawings.
- B. If pipe, ductwork, insulation, or equipment is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.
- D. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.
- E. Removal: Remove indicated equipment from Project site.
- F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.8 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.9 GROUTING

- A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will encounter grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to the manufacturer's written instructions.

END OF SECTION 15050

**SECTION 23 11 10
EARTHWORK FOR CONDUIT / PIPING**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This Section includes limited scope instructions for methods and materials applicable to excavation for underground utilities and services, including underground piping under the building and from building to utility connection, tanks, basins, and equipment.

1.02 SUBMITTALS

- A. Submit schedules in accordance with Conditions of Contract and Divisions 1 and 23 specification sections.
 - 1. Indicate proposed methods and schedule of operations prior to commencement of work.
 - 2. Include coordination for shut off utility services where required.
 - 3. Maintain services in areas outside construction limits, where such a service exists.
 - 4. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1.

1.03 DEFINITIONS

- A. Excavation consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.
- B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.
- C. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular subbase, drainage fill, or topsoil materials.
- D. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.

1.04 CODES AND ORDINANCES

- A. Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

1.05 PROJECT CONDITIONS

- A. Conditions Affecting Excavations: The following project conditions apply:
 - 1. Maintain and protect existing building services which transit the area affected by selective demolition.
 - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- B. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support, and protect services during excavation operations. Remove existing underground utilities indicated to be removed.
- C. Should uncharted, or incorrectly charted, piping, or other utilities be encountered during excavation, consult utility Owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
- D. Use of Explosives: Use of explosives is not permitted.

1.06 SEQUENCE AND SCHEDULING

- A. Coordinate the shut off and disconnection of utility services with Owner and utility company.
- B. Provide a minimum of 48-hour notice to Engineer prior to utility interruption.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Select Bedding Sand: Dry riverbed sand free of any debris or organic matter.
- B. Mastic Coatings: "Henry's" oil base roof mastic.

- C. Polyethylene sheeting not less than 8 mils thick.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas where earthwork is to occur. Determine extent of work and effect on existing conditions to remain. Advise Engineer of any conditions that might create extensive alteration beyond indicated scope.
- B. Clearances: Take special notice and maintain the required horizontal and vertical depth clearances from structural footings for utility trenches running parallel to footings. Do not violate the area of the footing bearing prism. In the event of conflict (i.e., the utility cannot be relocated, or its depth changed), proceed as directed by the Engineer. Lower structural footings to maintain proper clearances for underground utilities trenching without additional cost to Owner.

3.02 EXCAVATION

- A. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.
- B. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time-period excavations will be open.
 - 1. Remove shoring and braces when no longer required. Where sheeting is allowed to remain, cut the top of sheeting at an elevation of 30 inches below finished grade elevation.
- C. Install sediment and erosion control measures in accordance with local codes and ordinances.

3.03 DEWATERING

- A. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
 - 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.

2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

3.04 MATERIAL STORAGE

- A. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
 1. Locate and retain soil materials away from edge of excavations. Do not store within dripline of trees indicated to remain.
 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

3.05 TRENCHING

- A. Do all necessary trenching, excavation, shoring, and backfilling required for the proper laying of the pipelines.
- B. Pipe Trench Dimensions: The following requirements are considered minimal unless otherwise indicated, to provide adequate pipe clearances and bedding. Provide trenches wider than the specified minimum where required to properly install the piping. In the event utility company regulations, code requirements, or the pipe manufacturer's recommendations differ from these provisions, the most restrictive requirements shall take precedence:

1. Pipe Burial Depths:

Sewer & Drainage:	24"(a) + pipe O.D.(b) + 3" bed of sand
Fuel-Oil and Gas:	30" + pipe O.D. + 4" bed of sand
Electrical Conduit and Water:	
PVC:	30" + conduit/pipe O.D. + 4" bed of sand
All other:	24" (30" at planters) + conduit/pipe, bed of sand O.D. + 4" bed of sand
Pre-insulated Piping	24" + jacket O.D. + 4" bed
Condenser Water (PVC)	30" + pipe O.D. + 4" bed

Notes:

- a. Finish grade to top of pipe, typical.
- b. O.D.: Outside dimension.

2. Trench Widths:

Sewer & Drainage:	12" + pipe O.D. for 4" to 18" diameter pipe
Fuel-Oil and Gas:	8" + pipe O.D.
Electrical Conduit:	8" + conduit/pipe O.D.
Water (Domestic and Fire)	
Pre-insulated Pipe	8" + jacket O.D.
Condenser Water	8" + pipe O.D.

- C. Where rock is encountered, carry excavation below required elevation and backfill with a layer of select bedding sand prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
- D. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.
- E. Do not install copper piping or metal fuel-oil / gas piping in a common trench with other dissimilar metal piping or conduit; separate a minimum of 4 feet when running parallel to such piping or conduit.
- F. Separate multiple parallel lines of piping in a common trench a minimum of 12 inches, both horizontally and vertically, between individual pipes.
- G. Install domestic water piping, running parallel in a common trench with sewer or drainage lines, on a solid shelf 12 inches above the sewer or drainage piping.
- H. Do not run electrical power and communications conduit in a common trench with sewer, drainage, water, or gas piping.
- I. Provide and install a bare 14-gauge copper "Tracer" wire, continuous for entire length, for all underground non-metallic piping. Secure to piping at alternate joints, at each fitting and at each valve. Locate "Tracer" wire along side pipe, but not under pipe.
- J. Install thrust blocks in all pressurized lines. Install thrust blocks in accordance with pipe manufacturers recommendations.

3.06 EXCAVATION FOR STRUCTURES

- A. Excavation for Basins, and Mechanical Structures: conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus, a sufficient distance to permit placing and removal of concrete formwork,

installation of services, other construction, and for inspection.

1. Excavate, by hand, areas within dripline of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter larger with emulsified asphalt tree paint.
2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

3.07 BACKFILLING AND FILLING

- A. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
- B. Bedding: Lay and bed pipe in compact select dry river-bed bedding sand, thickness as specified herein and backfill with the same sand material to a height of one foot above the top of pipe.
 1. Sewer lines except as hereinafter specified may be bedded in the native soil provided it is rock free and sandy. Dig out under bell portions of the piping for uniform bearing.
 2. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
 3. Under concrete building / foundation slabs, set piping on a 6-inch bed of dry riverbed sand and backfilled to 12" of finish grade with dry river bed sand. Remainder of backfill to be approved backfill material.
 4. Under conduit, piping, and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
 5. For conduit / piping less than 30 inches below the surface of roadways, provide 4-inch-thick concrete base slab support. After installation and testing of conduit / piping, provide a 4-inch-thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
 6. Other areas, use excavated or borrowed materials.
- C. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Do not backfill until installation has been approved and as-built drawings are up to date.
 2. Inspection, testing, approval, and locations of underground utilities have been recorded.
 3. Removal of concrete formwork.
 4. Removal of shoring and bracing, and backfilling of voids.
 5. Removal of trash and debris.
- D. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- E. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to the required percentage as specified in Division 2. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- F. Spread backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately the same elevation in each lift.

3.08 SUBSIDENCE

- A. Subsidence: Where subsidence occurs at mechanical and electrical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.09 CORROSION PROTECTION

- A. All below ground metallic fittings, valves, flanges, bolts, pipes (which are not factory coated with a bituminous material) shall be protected against corrosion as follows:
1. All metallic components as described above shall receive a heavy coating of "Henry's" oil base roof mastic.

2. After mastic coating is completed and inspected, wrap entire metallic component with a minimum of 8 mil. polyethylene wrap overlapped 50% of the circumference and extended beyond ends of component as required for polyethylene to be secured to piping. The overlap seam shall be located to avoid backfill material from entering the encapsulated area. The ends and seam of the polyethylene material shall be secured to the piping and sealed with 3M Scotch/Wrap N. 50, 10 mil., 2" wide, printed, pipe wrap sealing tape.
3. The mastic coating shall be inspected and approved prior to the finish application of the polyethylene material, which shall also be inspected.

END OF SECTION

SECTION 23 11 13

FUEL-OIL PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes diesel fuel piping, specialties, day tank, and accessories within the station.
- B. Related Sections include the following:
 - 1. Fuel-Oil Piping Materials and Methods: Section 23 11 01
 - 2. Painting: Section 09 91 13

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working-Pressure Rating: Unless otherwise indicated, minimum pressure requirement for fuel oil piping is 150 psig.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Specialty valves.
 - 2. Fuel oil transfer pumps. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
- B. Shop Drawings: Fuel oil piping and equipment. Include plans and attachments to other Work.
 - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

- D. Maintenance Data: For fuel oil transfer pumps to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of oil transfer pumps and are based on the specific model indicated. Other manufacturers' products complying with requirements may be considered. Refer to Division 1 Section "Substitutions."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASME B31.9, "Station Services Piping," for fuel oil piping materials, installation, inspection, and testing.
- D. Comply with NFPA 30, "Flammable and Combustible Liquids Code," and NFPA 31, "Installation of Oil Burning Equipment," for fuel oil piping materials, components, installations, inspection, and testing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Oil Shutoff Valves:
 - a. Conbraco Industries, Inc.; Apollo Div.
 - b. Morrison Bros. Co.
 - c. Jomar International, Ltd.
 - d. Kitz Corp. of America.
 - e. McCanna, Inc.
 - f. Nibco, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - 2. Emergency Shutoff Valves:
 - a. Neles-Jamesbury (Series 5150, Model No. 82T010).

- b. Morrison Bros. Co.
 - c. Nibco, Inc.
 - d. Watts.
 - e. Approved equal.
3. Oil Safety Valves:
- a. Suntec Industries, Inc.
 - b. Webster Heating.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, and fitting materials.
- B. Steel Pipe: ASTM A 53, Type E or S, Grade B, Schedule 40, black.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
 - 2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
 - 3. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
 - 4. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
 - 5. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
 - 6. Steel Flanges and Flanged Fittings: ASME B16.5.
 - 7. Gasket Material: Thickness, material, and type suitable for fuel oil.
- C. Flexible Connector: Stainless steel inner hose and braided exterior sleeve, suitable for minimum 200 psi WOG and 250 degrees F. All flexible connectors must have welded (not swaged or crimped) ends. All flexible connectors must be vacuum rated.
- D. Transition Fittings: Type, material, and end connections to match piping being joined.
- E. Pipe Connectors: UL 567, swivel, or compression type for connection to equipment.
- F. Common Joining Materials: Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joining materials not in this Section.

2.3 SPECIALTY VALVES

- A. Oil Shutoff Valves: UL 842; metal-body ball valve with threaded ends according to ASME B1.20.1 for pipe threads.

- B. Oil Safety Valves: UL listed for fuel oil service. Include metal body; broken-line, oil shutoff feature; and 40-psig minimum pressure rating.

2.4 EMERGENCY SHUTOFF VALVE

- A. MSS SP-110 FM approved ball valve with quarter turn operation. API 607 firesafe two-piece carbon steel valve with 316 stainless steel trim and flanged ends, with torque-handle spring return handle and 165°F fusible link. Link to hold valve in the open position until the environment temperature exceeds 165°F when the fusible link melts and the spring returns and automatically closes the valve.

PART 3 - EXECUTION

3.1 SERVICE ENTRANCE PIPING

- A. Extend fuel oil piping and connect to fuel oil distribution for service entrance into station.

3.2 PIPING APPLICATIONS

- A. General: Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.
- B. Aboveground: All diesel piping between aboveground storage tanks and diesel dispensers and between aboveground storage tanks and fill boxes shall be welded pipe. Provide union between welded pipe and connection to equipment.
- C. Piping, NPS 1 and Smaller: Steel pipe, steel welding fittings, and welded joints.
- D. Piping, NPS 1-1/4 to NPS 2: Steel pipe, steel welding fittings, and welded joints.

3.3 VALVE APPLICATIONS

- A. Shutoff Valves, NPS 2 and Smaller: Use oil shutoff valve.
 - 1. Option: Gate valves may be used.
- B. Gate and Check Valves, NPS 2 and Smaller: Use general-duty valves that comply with MSS SP-80, Class 125, bronze body, suitable for fuel oil service, with "WOG" indicated on body. Refer to Division 15 Section "Valves" for selection.
 - 1. Gate Valves: With solid wedge.
 - 2. Swing Check Valves: With bronze disc.
 - 3. Lift Check Valves: Vertical pattern; two-piece construction with bronze disc.

- C. Drain Valves: Use hose-end drain valves that comply with MSS SP-110, bronze ball valve with outlet connection according to ASME B1.20.7 for garden-hose thread with cap. Refer to Division 15 Section "Plumbing Specialties" for selection.

3.4 PIPING INSTALLATION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.
- B. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- C. Install strainer on inlet side of control valves, pressure-reducing valves, fuel oil pumps, and oil burner connections.
- D. Connect fuel oil supply and return lines from AST to fuel dispenser.
- E. Install pressure gage[s] on suction and discharge piping of each fuel oil pump set.

3.5 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Fuel-Oil Piping Materials and Methods" for basic piping joint construction.

3.6 VALVE INSTALLATION

- A. Install valves in accessible locations, protected from possible damage.
- B. Install valves at branch connections to supply mains and at equipment.
- C. Install drain valves at piping low points.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 23 Section "Hangers and Supports" for pipe hanger and support devices.
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 1. NPS 1/2 and Smaller: Maximum span, 60 inches; minimum rod size, 3/8 inch.
 2. NPS 3/4 to NPS 1-1/4: Maximum span, 84 inches; minimum rod size, 3/8 inch.
 3. NPS 1-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- C. Support vertical steel pipes at each floor and at spacing not greater than 15 feet.

3.8 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Connect piping to equipment with oil shutoff valve and union. Install union between valve and equipment.
- C. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Electrical Connections: Wiring is specified in Division 26 Sections.

3.9 FIELD QUALITY CONTROL

- A. Inspect and test fuel oil piping according to NFPA 30, "Testing" Paragraph and NFPA 31, "Tests of Piping" Paragraph; and according to requirements of authorities having jurisdiction.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Test and adjust controls and safety. Replace damaged and malfunctioning controls and equipment.
- D. Report test results promptly and in writing to Architect.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining fuel oil pump sets.

END OF SECTION

SECTION 23 13 23.16

ABOVEGROUND FUEL STORAGE TANKS

PART 1 - GENERAL

1.1 REFERENCES

- A. American Society for Testing and Materials (ASTM):
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 30 - Flammable and Combustible Liquids Code.
 - 2. NFPA 30A - Automotive and Marine Service Station Code.
 - 3. NFPA 31 - Oil Burning Equipment.
 - 4. NFPA 70 - National Electric Code.
- C. Underwriters Laboratories Inc. (UL):
 - 1. UL 142 – Steel Above-ground Tanks for Flammable and Combustible Liquids.
 - 2. UL 2085 – Protected Above-ground Tanks for Flammable and Combustible Liquids.
- D. California Fire Code:
 - 1. Article 79 – Flammable and Combustible Liquids
- E. Environmental Protection Agency.

1.2 SUBMITTALS

- A. General: Refer to Section 01330 – Submittal Procedures
- C. Submit the following:
 - 1. Shop drawings of tanks, containment basins, pumps, valves, fittings, drains, vents and connections.
 - 2. Layout and connection diagram showing location of all equipment, vents, grounding requirements and pipe routing.
 - 3. Tank manufacturer's product data
 - 4. Certificates of Compliance: Manufacturer shall certify that tank will perform as specified.
 - 5. Test reports.

6. Installation instructions.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Tank Installation Contractor: The firm performing the Work of this Section shall have been regularly engaged in the installation and maintenance of above ground fuel storage tanks for a minimum of 5 years and shall have completed 3 similar projects.
2. Pipe Installer: Individual with a minimum of 5 years' experience in installing fuel piping, have worked on 3 similar projects, and shall be certified by pipe manufacturer of the type of pipe being installed.

- #### B. Listings: Components of the system(s) for which Underwriters' Laboratories, Inc. (UL) provides product listing service, shall be listed and bear the listing mark.

C. Regulatory Requirements:

1. Systems for storing diesel fuel for motor fuel dispensing systems shall comply with the applicable requirements of UL 58, NFPA 30 and NFPA 30A.
2. California Environmental Protection Agency (CEPA).
3. Certified Unified Program Agency (CUPA).

1.4 WARRANTY

- #### A. Warranty: Thirty-year manufacturer's warranty for each tank.

PART 2 - PRODUCTS

2.1 DOUBLE WALL STEEL PROTECTED FUEL STORAGE TANKS

- #### A. Tanks shall be listed as secondary containment in accordance with UL 2085, and shall be marked for fire resistance, and protected from vehicle impact and projectile hazards.
- #### B. Type: Double wall steel interior tank with minimum 3-inch interstitial space.
1. Exterior Protective Coating: Conforming to Steel Tank Institute Standards.
 - a. Surface Preparation: SSPC-SP6 grit blast.
 - b. Primer: Corrosion resistant epoxy or urethane in accordance with UL 2085 requirements.
 - c. Topcoat: Epoxy or urethane in accordance with UL 2085 requirements.

C. Acceptable Tanks:

1. Modern Custom Fabrication, Model MHC-D5-10000.
Fresno CA (559-264-4741)
2. or approved equal.

2.2 TANK ACCESSORY

A. Gaging Equipment:

1. Stick Gage Port (Furnished with all tanks): Accessible from ground level or stair/platform assembly.
2. Mechanical Gaging: Field adjustable float type gage with minimum 4-1/2 inch dia. display face, vapor tight construction, and stainless steel float; 818 Clock Gage by Morrison Bros., Dubuque, IA.
3. Electronic Gaging: Magnetostrictive probe which include temperature sensors and both product and water floats capable of sensing product level to nearest 0.001 inch.
 - a. Acceptable Manufacturers: Intelligent Controls Inc., Saco, ME, (800) 225-9787; Veeder Root, Simsbury, CT, (800) 873-3313 or OMNTEC, Ronkonkoma, NY, (516) 467-5787.
 - b. Upon demand, the system shall indicate water level, product level, and average product temperature.
 - c. System shall sense and alarm leakage rates greater than 0.2 gal/hr.

B. Venting:

1. Vent primary tank with normal and emergency venting (NFPA 30 and UL 2085 test configuration. Vent interstitial space with emergency venting only.
2. Vent Caps:
 - a. Fuel Oil or Diesel Fuel: Combination vent/overflow alarm, Morrison Bros. 922 or equal.
3. Emergency Vent: Morrison Bros. 244 or equal.
 - a. Conforming to NFPA 30, and UL 2085 test configuration.

D. Tank Identification:

1. Type: Two-layer etched plastic or metal permanently attached to the tank.
 - a. Decals or stenciling is not acceptable.
2. Signs shall include the following information:
 - a. Standards of Design by which tank was manufactured.
 - b. List of products and additives which may be permanently stored in tank.
 - c. Year in which tank was manufactured.

- d. Unique identification number.
 - e. Dimensions, working capacity, and tank model number.
 - f. Name of tank manufacturer and installer.
 - g. Tank manufacturer and date of tank installation.
- E. Fill Limiting Valve:
1. Clay & Bailey F-30, Morrison Bros. 9095A (includes adapter), EBW 709 Warden, or OPW 61FSTOP.
 - a. Drop tube as required.
 - b. Adapter: OPW 633-T, EMCO Wheaton A30; 2 inch size.
 - c. Cap: OPW 634-TT, EMCO Wheaton A97, EBW 774, or Morrison Bros. 305C.
- F. Fill Port Spill Container:
1. Type: Remote fill spill container with hand pump back to tank.
 - a. Minimum Size: 10 gallons.
 - b. Morrison Bros. 715715S-TT3-3QBB-0, AST 3"-10gal remote fill box, male threads, w/ hand pump, 90 female quick disconnect check, and ball valve.
- G. Stick Port:
1. Provide a port for manually gaging the tank including a lockable vapor tight twist off cap.
 2. All tanks shall be provided with a stick gage.
- 2.3 TANK GAGING, LEAK AND OVERFILL MONITORING
- A. Acceptable Companies:
1. Morrison 918AC-4400 AI.
- B. Type: Continuous operation tank gaging, leak detection, and overfill monitor system for double wall storage tanks.
1. Systems shall have system test capability and shall be UL listed and/or FM approved.
- C. Non-Discriminating Leak Sensors:
1. Detects leaks in the following:
 - a. Interstitial space between tank walls.
 - b. Piping system which drains into containment sump.
 2. Sensors: Non discriminating type not sensitive to condensation forming on the sensor surface or dripping across the sensor surface.

- D. Magnetostrictive Gage Probe:
 - 1. Includes temperature sensors, and both product and water floats capable of sensing product level to nearest 0.001 inch.
 - 2. Upon demand, the system shall indicate water level, product level, and average product temperature.
 - 3. System shall sense and alarm leakage rates greater than 0.2 gal/hr.
- E. Instrumentation Control Cable: Connect probe and sensor to alarm monitor panel, as recommended by manufacturer of leak and overfill monitor system.
- F. Audible Overfill Alarm Device: Weatherproof, surface mounted basic grille type, 120 V ac as manufactured by tank gaging, leak detection and overfill monitor system manufacturer.
- G. Overfill Alarm Device Sign: Constructed of 1/8 inch thick two color laminated plastic engravers stock, with the words "OVERFILL ALARM DEVICE" engraved in white on red background. Size sign and lettering for easy reading from ground level.

2.4 FUEL OIL AND DIESEL GENERATOR INSTALLATION

- A. Rotary Diaphragm Gear Vane pump: FILL-RITE FR313V or equivalent (strainer, anti-siphon, compatible with diesel fuel).
- B. Manual Shutoff Valve: Steel ball valve, Jomar T-2000, or Morrison Bros. 691BSS (stainless steel).
- C. Explosion Proof Solenoid Valve: Brass, ASCO 8210 with Viton seal, or stainless steel Morrison Bros. 710 with Teflon seal.
- D. Pressure Relief Valve: Steel, Morrison Bros. 77.
- E. Check Valve: Bronze body and disc; Crane 37, Nibco T413, or Morrison Bros. 246.
- F. Foot Valve: Double poppet with strainer, OPW 86, EBW 50-201, or Morrison Bros. 335A.
- G. External Emergency Valve: Spring loaded fusible link type; OPW 178S-6130 or Morrison Bros. 346DI.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Testing Prior to Installation:

1. Before placing the tank in place, plug all openings and pressure test tank in accordance with manufacturer's printed test instructions, unless otherwise specified.
2. Tanks should not be pressurized beyond the manufacturer's specified limits.
3. The tank must hold the test pressure for 30 minutes.
4. Check fitting connections, and seams in tank by applying a soap suds solution.
5. Reject any leaking tanks.

3.2 INSTALLATION

- A. Install the Work of this section in accordance with NFPA 30 and the manufacturer's installation instructions, unless otherwise shown or specified.

3.3 TANK ACCESSORIES

- A. Fuel Identification: Attach laminated plastic nameplate to each tank fill pipe to identify the fuel in the tank.
- B. Tank Identification: Affix tank identification label, or plate permanently to tanks and fill ports.
- C. Install padlocks on all lockable caps on fill and vapor recovery piping. All locks to be keyed alike.
- D. Terminate vent lines with vent caps.
- E. Overfill Alarm Device Sign: Mount sign adjacent to alarm horn in a location easily readable from ground level.
- F. Vent Caps:
 1. Install vent caps at end of vent piping minimum of 12 feet above finished grade.

3.4 FIELD QUALITY CONTROL

- A. Testing: After installation of tank and piping, test the system in the presence of the SBC's Representative and authority's having jurisdiction, as follows:
 1. Piping: Before painting or backfilling, plug ends and test with air at 5 psi and hold for two hours without leaking.
 2. Tanks: Pressure test tank in accordance with manufacturer's printed test instructions, unless otherwise specified.
 - a. Tanks should not be pressurized beyond the manufacturer's specified limits.
 - b. The tank must hold the test pressure for 30 minutes.

- c. Check fitting connections, and seams in outermost tank by applying a soap suds solution.
 3. Product Level and Overfill Protection:
 - a. The Facility through the Representative will arrange for delivery of product as needed to test high level alarm, and fill limiting valve.
 - b. During the filling process the SBC's Representative will monitor and record the low-level alarm, quantity of product as compared to reading on the Control Panel, the overfill alarm, and will test the overfill valve.
 - c. Make required repairs and final adjustments.
 4. Motor Fuel Dispensing System:
 - a. After reconnecting all piping, dispensers, and tanks, and when directed, perform a system acceptance test in the presence of the SBC's Representative to demonstrate that the fuel dispensing system is operating properly.
 - b. Make the required repairs and final adjustments.
 - c. Minimum flow rate for diesel systems without vapor recovery is 30.0 gpm,
 5. Fuel System for Diesel-Generators:
 - a. After reconnecting all piping, diesel-generator, and tanks, and when directed, perform a system acceptance test in the presence of the SBC's Representative to demonstrate that the fuel system is operating properly.
 - b. Make the required repairs and final adjustments.

END OF SECTION 13210

SECTION 26 01 20

GENERAL ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 - Specification sections, apply to the work of this section.

1.02 SCOPE

- A. The Construction Documents shall include the drawings and specifications covering all related work in addition to the electrical. The Contractor shall carefully examine all Construction Documents to acquaint himself with the responsibilities of the various Contractors regarding the supply, installation, and connection of the Components of the various electrical and other systems.
- B. It is intended that all systems shall be complete and shall include all components necessary for the operation of the system. If components are indicated on the drawings or inferred from the system requirements but not specified by catalogue number, such components shall be furnished by the manufacturer furnishing the remainder of the system.
- C. In the event of a conflict of the requirements detailed in the drawings and any sections of the specification the Contractor shall inform the Owner's Rep of such conflict in writing before ordering equipment. If such notification is not provided, the Contractor shall accept the Owner's Rep decision on the resolution of such conflict without any further compensation.

1.03 DEMOLITION, ALTERATION AND EXTENSION WORK IN AN EXISTING STRUCTURE.

- A. Contractor shall survey the entire project site and become thoroughly familiar with actual existing conditions. Check the locations of all existing structures, equipment, wiring, etc. The intent of the work is shown on the drawings and described hereinafter.
- B. While the existing facility is being altered, keep the present power service and necessary life safety systems intact.
- C. Provide and perform demolition, alteration, extension, preparatory and

miscellaneous work as indicated, specified, or as required, complete. The work shall include:

1. Demolition and removal of existing electrical conduit, wiring and equipment required to complete the project.
 2. Preparation of the existing building and electrical distribution to receive or connect the new work including relocation of existing electrical conduit, wiring, equipment, etc. where new work interferes with existing conditions.
 3. Miscellaneous demolition, cutting, patching, alteration, and repair work in the existing building necessary for the completion of the entire project while maintaining electrical circuit continuity to all equipment, outlets, fixtures, etc. scheduled to remain.
 4. Disconnecting, relocating, and reconnecting of electrical equipment as required by the construction modifications.
 5. Coordination of power interruption with the Owner's representative or utility company where necessary.
- D. Salvage and Disposal: All removed material other than items to be reused shall be returned to the Owner or disposed of in accordance with instructions from the Owner's representative. Dispose of all hazardous materials per guideline of State of California Department of Health Services and other agencies having jurisdiction.

1.04 ELECTRICAL SPECIFICATIONS AND DRAWINGS

- A. The documents are written in a brief form for the purpose of work economy. For example: "Motor starters" is used in place of "The Contractor shall provide all motor starters". Omitted words shall be determined by inference.
- B. It should be particularly noted that the terms "furnish", "provide", and "install" are interchangeable and that each of these terms means to furnish, install, and connect, unless otherwise stated.
- C. When a catalog or series numbers are shown, they are intended to indicate the type and quality of product. The product furnished shall meet all specification requirements even if the product conforming to the given catalog number does not.
- D. In the event of conflict between requirements, whether shown on drawings or in specifications the most stringent requirements shall govern.

- E. Wherever tables or schedule show quantities of materials they shall not be used as the final count. These figures serve only as an aid to Contractor. Each Contractor shall be responsible for furnishing all material noted on drawings or specified.
- F. A minimum size or performance requirement specified shall be superseded by requirements specified in other technical specification sections or shown on drawings. For example: A minimum control wire size specified for an alarm system shall take precedence over the minimum wire sizes listed in Section 16120 - Conductors.
- G. When short circuit currents or interrupting capacities are indicated on drawings or specified, they shall be considered as minimum R.M.S. symmetrical unless otherwise stated.
- H. The electrical drawings are diagrammatic and show the general arrangement of all raceways, equipment, and appurtenances. They shall be followed as closely as actual building construction; field conditions and the work of other trades will permit. The electrical work shall conform to the requirements shown on the drawings.
- I. Architectural drawings shall take precedence over electrical drawings, because of the small scale of the electrical drawings it is not possible to indicate all offsets, fittings, and accessories which may be required. The Contractor shall investigate the existing conditions affecting the work and shall arrange his work accordingly, providing such fittings and accessories as may be required to meet such conditions.

1.05 CODE AND STANDARDS

- A. Code Compliance
 - 1. Installation must conform to all applicable National, State, and local codes, rules, ordinances, regulations and manufacturer's recommendations which will govern the quality and the character of work, style and size of materials.
 - 2. In case of difference between building codes, state laws, local ordinances, industry standards and utility company regulations the Contractor shall bear all costs arising in correcting the deficiencies.
 - 3. Should the Contractor perform any work that does not comply with the requirements, ordinances, industry standards and utility company regulations he shall bear all costs arising in correcting the

deficiencies.

B. Building Codes

1. Comply with the latest editions of the following Codes promulgated by governing authority for the specific job site:
 - a. California State Safety Orders
 - b. California State Fire Prevention Commission Official Regulations
 - c. California Electrical Code – CEC
 - d. California Energy Regulations, Title 24
 - e. National Electrical Code - NFPA 70
 - f. Life Safety Code NFPA 101

C. Industry Codes

1. All electrical equipment shall be listed by Underwriters' Laboratories, Inc. and shall meet all requirements established by NEC, NEMA and ANSI, and as specified hereinafter.
2. Materials and installation procedures shall comply with all applicable requirements of the following nationally accepted codes and standards.

ANSI	American National Standards Institute, Inc.
ASTM	American Society of Testing Materials
ETL	Electrical Testing Laboratories
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
ITL	Independent Testing Laboratories
NBS	National Bureau of Standards
NECA	National Electrical Contractor Association
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NRTL	Nationally Recognized Testing Laboratory
UL	Underwriters' Laboratories
USASI	United States of America Standards Institute

1.06 WORK AND WORKMANSHIP

A. General

1. These specifications may not include every detail or operation considered to be standard high grade installation procedure as it is

assumed that the Contractor is familiar with these procedures. In the absence of specified details in the Contract Documents regarding installation procedure, the National Electrical Contractors Association "Standard of Installation" manual and the latest edition of Crofts "American Electricians, Handbook" shall be considered as minimum requirements.

2. The Contractor shall comply with all applicable provisions of NFPA-70, National Electrical Code.
3. Locations of all equipment connections are shown for bidding purposes only. Contractor shall verify erection and connection requirements and details.
4. The Contractor shall read the specifications and drawings of all other trades and verify erection and connection requirements and details.
5. The Contractor shall take all field measurements as necessary for his work and shall be responsible for the accurate location and size of all openings, recesses, slots, ferrules, and the like.
6. Should any structural difficulties prevent the setting of cabinets, running of conduit, etc., at points shown on drawings, necessary minor deviations as determined by the Owner's Rep may be permitted only if authorized in writing.
7. Specific emphasis must be made that if the equipment other than that which the drawings were designed around does not properly adapt to the space allotted or is not easily accessible for repair and maintenance the Contractor is responsible for providing all additional access panels, pipe, fittings, all materials, labor, etc. to achieve the desired result.
8. Any extra costs which might result from deviations from the drawings to avoid interference shall be considered a "job condition" and no additional compensation will be considered applicable. If any such interference occurs in the course of the work due to an error, omission or oversight by the Contractor, no additional compensation shall be allowed.
9. Interference which may occur during construction shall be brought to the immediate attention of the Owner's Rep and his decision confirmed in writing shall be final as to which trade shall take preference.
10. The finished job shall be functional and complete in every detail including all such items required for a complete system whether these items be specified or shown on drawings.
11. Special attention shall be given to the accessibility of working and controlling parts. Adjustable parts shall be within easy reach. Removable parts shall have space for removal.
12. Underground utilities: Known underground services are shown at approximate locations in the drawings. Contractor shall exercise

extreme care to avoid damage in exposing underground services:

- a. Where an underground facility is encountered which is not shown on drawings or mentioned in any other contract document, Contractor shall immediately notify the Owner and Architect and responsible utility agency for direction.
- b. Do not proceed with Work until direction is received.

B. Quality Assurance:

1. Perform work in accordance with NECA Standard of Installation.
2. Manufacturer to be a company specialized in fabrication of respective production with a minimum of 10 years documented experience, or as indicated in the respective spec section.
3. Manufacturer to provide quality control production testing for each unit of major equipment in accordance with applicable standards.
4. Maintain one copy of each testing document on site.

1.07 COORDINATION BETWEEN CONTRACTORS

- A. The Contractor shall acquaint himself with details of all work to be performed by other trades and take necessary steps to integrate and coordinate his work with these trades.
- B. Special attention shall be given to points where ducts cross other ducts or piping, where lighting fixtures fit into ceilings and where pipes, ducts and conduit pass through walls and columns.
- C. Each Contractor shall be responsible for informing himself of the nature and arrangement of the materials and construction to which his work attaches or passes through.

1.08 PROTECTION AND REPAIR

- A. In addition to the provisions and stipulations of the General and Supplementary General Conditions of the Contract each Contractor and Subcontractor shall provide various types of protection as follows:
 1. Protect finished floors from chips and cutting oil by the use of metal receiving pans and an oil proof floor covering.
 2. Protect equipment and finished surfaces from welding and cutting spatters with baffles and spatter blankets.
 3. Protect equipment and finished surfaces from paint droppings, insulation adhesive and size droppings, etc. by use of drop cloths.
 4. Maintain fire rating of walls and structures; provide fire proof enclosure where required.

1.09 RUBBISH

- A. All rubbish resulting from the work herein specified shall be removed from the premises by the trade which produced it, as fast as it accumulates.
- B. On completion of his work each Contractor shall remove and see that each of his Subcontractors removes from the site all tools, equipment, surplus material and rubbish pertaining to his own operations. Each Contractor or Subcontractor shall pay all costs for such removal and disposition and shall cooperate with the General Contractor in final cleaning.
- C. Disposal of hazardous material shall be per guideline of the state of California, Department of Health Services and other authorities having jurisdiction.

1.10 ELECTRICAL CONNECTIONS TO EQUIPMENT

- A. Connections and wiring diagrams shown on drawings or described in the specifications are typical and are for reference purposes only. Detailed diagram instructions and construction shop drawings will be required from the Contractor supplying the equipment.

1.11 PRODUCTS AND MATERIAL

- A. General
 - 1. Electrical equipment shall be new, listed by Underwriters' Laboratories and shall conform to the standard of the National Electrical Manufacturer's Association.
 - 2. Materials used for like service shall be by the same manufacturer, e.g., all motor starters to be from the same manufacturer.
- B. Prefabricated Equipment: Unless noted as field fabricated all equipment shall be delivered completely factory assembled and wired.
- C. Approval: A specification followed by one or more manufacturers "or approved equal" is open to all equal products or materials unless otherwise noted. However, the Contractor shall supply one of the listed manufacturers at no additional cost if the Engineer finds the substituted product unsatisfactory.
- D. Material: The Contractor shall submit to the Owner's Rep, for his approval

within 48 hours after request, a list of all materials he proposes to use.

E. Storage

1. Provide suitable protection from weather and vandalism for all materials and equipment to be installed. Storage shall be dry, clean, and safe. Any materials or equipment damaged, deteriorated, rusted, or defaced due to improper storage shall be fully repaired, refinished or replaced as directed by the Engineer.
2. Cover and protect all equipment, materials, raceways, etc., before and after installation to prevent injury and to prevent entrance of grit, dirt and foreign matter.

1.12 SHOP DRAWINGS

A. General

1. Drawings shall be accurately drawn large scale drawings, adequately dimensioned, showing external and internal features, mechanical provisions, materials, gauges, electrical characteristics, wiring diagrams and such other information necessary to show compliance with the intent of the specifications and drawings.
2. Generalized diagrams having several alternate methods of connection will not be acceptable.
3. Catalog data in lieu of certified prints shall be submitted for standard specialties, wire and cable, switches, starters, insulation and similar items.
4. Contractor's responsibility includes coordination of his work with all other trades, fabrication process and technique of construction. Contractor shall check all shop drawings for correct performance, size, capacity, clearance, and finish prior to submittal to Engineer. Drawings must be stamped or marked to indicate Contractor has reviewed these drawings.
5. Contractor review shall insure that equipment will fit into available space.
6. The Engineer will review the submitted shop drawings as a further check and as a service to the Contractor. Such review does not relieve the Contractor of responsibility for correct ordering of material and equipment.

B. Shop Drawings

1. Contractor shall submit shop drawings of the following systems or equipment and other equipment requested by Owner's Rep within ten days after the award of Contracts:

- a. Switchboards and Panelboards
 - b. Cabinets and Pull Boxes
 - c. Devices and Conductors
 - d. Transformers
2. Each submitted item shall refer to the specification section and paragraph number in which the item is specified.
 3. Approval of a specific item does not include approval of the assembly of which the item is a component.

1.13 DELIVERY SCHEDULE

- A. The Contractor shall submit, upon request, a schedule listing the equipment and materials required to complete the installation, quantity ordered, the date of placing the order and the promised delivery date.

PART 2 - PRODUCT

2.01 GENERAL

- A. All equipment and materials shall be new, and the current model or type of manufacturer regularly engaged in their production. Where two or more units of the same class of equipment are required, they shall be products of the same manufacturer.
- B. Equipment shall fit into the space allotted and shall have adequate and acceptable clearances for entry, servicing, and maintenance. The work shall be provided in an arrangement which will not necessitate cutting of structural members which will not interfere with lighting, HVAC equipment or doors, and which will present the best appearance possible.
- C. Where equipment or materials are specified to be approved by and constructed and/or tested in accordance with the published standard of the UL, NRTL, ANSI, ASTM, ETL or any similar nationally recognized agency, the Contractor shall submit proof that the items furnished under this specification conform to such requirements.

2.02 COLOR SCHEDULE AND SAMPLES

- A. The Contractor shall submit, upon request, a list of available finishes, together with color samples, for all equipment where color finishes are requested by the Architect. The list of equipment will be made available to the Contractor before equipment delivery authorization is required.

PART 3 - EXECUTION

3.01 PROJECT CLOSE-OUT

A. AC Switchgear Test and Inspection

1. New breakers in the main switchboard shall be tested and inspected as follows:
 - a. Circuit breakers shall be tested and inspected for proper trip operations on long delays, short delay, and instantaneous trip. Test current for long delay tripping shall be 300% of rate trip. All circuits shall have Ductor readings made where possible.
 - b. All bolted connections shall be checked and tightened for proper torque.
 - c. A written report showing test results shall be submitted to Architect.

B. Tests

1. The Contractor shall furnish all necessary instruments and equipment required for doing tests and shall make test of all wiring for shorts, open circuits, grounds, etc., and shall immediately correct any defective work.
2. When the entire installation has been completed and all lighting fixtures installed, test out all circuits and switching and demonstrate that the operation of the system is in accordance with the Contract Documents.

C. Spares

Fuses-Provide Owner with three (3) fuse refills for each size fuse used in the installation. Mount fuse clip in spare fuse cabinet. Locate in main electrical room or maintenance shop.

D. Cleaning and Touch-Up

1. All panelboards, cabinets, switchboards, motor controllers, control panels and other enclosures shall be cleaned, and the paint touched up as necessary to duplicate a factory finished appearance. Touch-up paint shall match the color, composition and quality of the factory applied finish.
2. Label all electrical equipment or controls by means of engraved

laminated plastic plates screwed or riveted to device. Height of letters to be not less than 1/4" unless otherwise specified or directed. Items to be labeled include the following:

- a. Main circuit breakers and switches
 - b. All circuit breakers and switches in switchboards and distribution panels
 - c. All panel boards (labeled on inside)
 - d. Printed card labels may be used on items of equipment furnished with plastic windows. The labeling of the cards shall be neatly printed using a lettering device such as a "KROY" instrument.
 - e. Directories on inside of panelboards shall be type-written and shall show list of circuits and points, equipment of areas supplied (1/8" letter height acceptable).
 - f. Labels or tags inside the covers of safety switches or motor starters noting interlocks, conductor sizes, etc., may be of the embossed adhesive type.
- E. Record Drawings - At the end of the project the Contractor's working drawings shall be brought up to date and a set of prints delivered to the Owner's Rep with written material certification that all corrections are true and accurately noted installed thereon. Each drawing shall be labeled Record Drawings, dated, and signed by the Contractor.
- F. Operation and Maintenance (O&M) Manuals
1. These requirements are supplemental to those listed or referred to in any foregoing sections of these specifications.
 2. Contractor shall prepare suitable bound volumes pertaining to his systems and equipment. Submit one (1) copy to the Owner's Rep for approval. After approval, submit three (3) copies to the Owner's Rep for delivery to the Owner.
 3. Volumes shall be properly bound, indexed, and contained in hard, heavy duty 3 ring binders. The following shall be clearly printed on the front cover:
 - a. Project name, address, and date
 - b. Name and address of Architect-Engineer
 - c. Telephone number of Contractor, including night or emergency
 4. Bind the written operating instructions, shop drawings, equipment catalog cuts and manufacturer's instructions into the binder. Material to be assembled as follows:

- a. First page - Title of job, Owner, address, date of submittal, name of Contractor and name of Owner's Rep. Emergency operating instructions and/or list of service organizations (including address and telephone numbers) capable of rendering emergency service on 24-hour calls.
 - b. Second page - Table of Contents.
5. Material shall be assembled in divisions according to the systems which are on the project (e.g., emergency distribution system, etc.). Each division shall include the following sections:
- a. First Section - Written description of system contents, where located in building, how each part functions individually and how system works as a whole. Conclude with a list of items requiring services and either state the service needed or refer to the manufacturer's data in the binder that describes the proper service.
 - b. Second Section - A copy of each approved shop drawing (clearly marked for item furnished) with an index at the beginning of the section.
 - c. Third Section - A copy of each manufacturer's operating instructions with an index at the beginning of the section.
 - d. Fourth Section - A list of all equipment used in the system, Contractor's purchase order numbers, suppliers name and address.
 - e. Field replacement parts list.
- G. Guarantee and Warranty
1. These requirements are supplemental to those listed or referred to in any foregoing section of these specifications.
 2. All wiring and conduit systems provided under Division 16 shall be guaranteed for a period of three (3) years.
 3. Warranty period shall also apply to services, including instruction, adjustment, testing, noise control, etc.
- H. Special Requirements
1. No work shall be performed "HOT".
 2. Any power outages shall be performed on an after-hours on an overtime basis, generally after midnight on weekends between the hours of 12.01 a.m. and 6:00 a.m. The Contractor shall coordinate the outage with the Owner, giving at least twenty (20) days notice. All overtime costs shall be included in the Contractors Bid.

3. Temporary service or service jumper to be provided when outage will be expected to last more than three hours. The cost of this service shall be addressed and shall be included in contract.

END OF SECTION 26 01 20

NOT FOR BID

SECTION 26 05 19

CONDUCTORS

PART 1- GENERAL

1.1 SECTION INCLUDES

- A. Building wires and cables.
- B. Underground power and control wires and cables.
- C. Wiring connectors and connections.

1.2 RELATED SECTIONS

- A. Section 26 05 33.13 - Conduits.
- B. Section 26 05 33.16 - Boxes.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years experience.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI / NFPA 70.

1.6 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.7 COORDINATION

- A. Determine required separation between cable and other work.
- B. Determine cable routing to avoid interference with other work.

PART 2- PRODUCTS

2.1 BUILDING WIRE AND CABLE

- A. Description: Single conductor insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI / NFPA 70, Type THHN/THWN.

2.2 EXTERIOR AND UNDERGROUND WIRE AND CABLE

- A. Description: Single conductor insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI / NFPA 70, Type XHHW-2/XHWN-2.

PART 3- EXECUTION

3.1 EXAMINATION

- A. Verify that the interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab the raceway before installing wires.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

- B. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- C. Use stranded conductors for control circuits.
- D. Use conductor not smaller than 12 AWG for power and lighting circuits.
- E. Use conductor not smaller than 16 AWG for control circuits.
- F. Use #10 AWG conductors for 20 amperes, 120-volt branch circuits longer than 75 feet (23 m).
- G. Use #10 AWG conductors for 20 amperes, 277-volt branch circuits longer than 200 feet (61 m).
- H. Pull all conductors into the raceway at same time.
- I. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- J. Match existing wiring color scheme.
- K. Protect exposed cable from damage.
- L. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest the cable on ceiling panels.
- M. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- N. Clean conductor surfaces before installing lugs and connectors.
- O. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- P. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, #8 AWG and smaller.
- Q. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, #10 AWG and smaller.
- R. Wiring connections to terminal blocks shall be made with crimp type locking-fork terminals for conductors #8 AWG or smaller.
- S. All conductors #6 AWG or larger shall be terminated with compression type lugs.
- T. Fixture wire terminations for a LED fixture shall utilize type THHN wire.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.5 FIELD QUALITY CONTROL

- A. Inspect wire and cable for physical damage and proper connection.
- B. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- C. Verify continuity of each branch circuit conductor.
- D. Verify that all circuits are free from grounds and short circuits.

END OF SECTION 26 05 19

SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

0.1 SECTION INCLUDES

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.

1.2 RELATED SECTIONS

- A. Section 26 01 20 - General Electrical Provisions.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Product Data: Provide data for grounding electrodes and connections.
- B. Test Reports: Indicate overall resistance to ground.
- C. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of exothermic connectors.

1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of grounding electrodes.

1.6 GROUNDING ELECTRODE SYSTEM

- A. Metal underground water pipe.
- B. Concrete-encased electrode.
- C. Rod electrode.

1.7 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 25 ohms maximum.

PART 1 - PRODUCTS

1.1 ROD ELECTRODE

- A. Material: Copper.
- B. Diameter: 3/4 inch.
- C. Length: 10 feet.

1.2 MECHANICAL CONNECTORS

- A. Material: Bronze.

1.3 WIRE

- A. Material: Stranded copper.
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 2 - EXECUTION

2.1 EXAMINATION

- A. Verify that final backfill, and compaction has been completed before driving rod electrodes.

2.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install rod electrodes in addition to other required ground electrodes where required to achieve specified resistance to ground.
- C. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder circuit raceway. Terminate each end on suitable lug, bus, or bushing.

2.3 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.
- C. Provide the owner with one copy of the test results

END OF SECTION 26 05 26

SECTION 26 05 29

SUPPORT DEVICES AND SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment support.
- B. Anchors and fasteners.

1.2 REFERENCES

- A. NECA - National Electrical Contractors Association.
- B. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog data for fastening systems.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Conform to SMACNA - Guidelines for seismic restraints of mechanical systems.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners, supports and seismic supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Anchors and Fasteners:

1. Concrete Structural Elements: Use Epoxy stainless steel anchors.
2. Steel Structural Elements: Use stainless steel beam clamps, ramset fasteners and welded fasteners.
3. Concrete Surfaces: Use Epoxy stainless steel anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use stainless steel toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Use Epoxy anchors.
6. Sheet Metal: Use stainless steel sheet metal screws.
7. Wood Elements: Use stainless steel wood screws.

2.2 STEEL CHANNEL

- A. Description: Stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide stainless steel anchors, fasteners, and support in accordance with NECA "Standard of Installation".
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Do not use spring steel clips and clamps.
- E. Do not use powder-actuated anchors.
- F. Do not drill or cut structural members.
- G. Fabricate supports from structural stainless-steel beam, angle or channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength, flexibility and/or rigidity. Use spring lock washers under all nuts.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- I. In wet and damp locations use stainless steel channel supports to stand cabinets and panelboards one inch off wall.
- J. Use stainless steel sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

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- K. Use neoprene washers, vibration isolators and seismic restraints where required.

END OF SECTION 26 05 29

SECTION 26 05 33.13

CONDUITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal conduit.
- B. Liquid tight flexible metal conduit.
- C. Electrical metallic tubing.
- D. Nonmetal conduit.
- E. Fittings and conduit bodies.

1.2 RELATED SECTIONS

- A. Section 26 05 33.16 - Boxes.
- B. Section 26 05 26 - Grounding.
- C. Section 26 05 29 - Support Devices.

1.3 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- D. ANSI/NFPA 70 - National Electric Code.
- E. NECA "Standard of Installation".

1.4 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70.

1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual routing of conduits larger than 2 inches (51 mm).

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.

1.7 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

- A. Minimum Size: 1 inch (19 mm) unless otherwise specified.
- B. Underground Installations:
 - 1. More than Five Feet from Foundation Wall: Use Schedule 80 PVC
 - 2. Within Five Feet from Foundation Wall: Use Schedule 80 PVC
 - 3. In or Under Slab on Grade: Use Schedule 80 PVC
 - 4. Minimum Size: 2 inch (25 mm).
- C. Outdoor Locations, Above Grade: Use rigid steel.
 - 1. Roof location: Refer to Section 3.2-part Y.
- D. Wet and Damp Locations: Use Schedule 80 PVC conduit.
- E. Dry Indoor Locations:
 - 1. Concealed: Use rigid galvanized steel conduit (RGS).
 - 2. Exposed: Use rigid galvanized steel conduit (RGS).

2.2 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit. Conduit fittings shall be zinc coated and shall be of the threaded type. Double lock nuts with bushing caps shall be used on all conduit termination except where threaded hubs exist. For PVC coated conduit use plastic jacketed fittings.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction with PVC jacket.
- B. Fittings: ANSI/NEMA FB 1. Zinc coated steel type with insulated bushings by Burndy, Condulet, Steel City or Thomas & Betts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install conduit in accordance with NECA "Standard of Installation."
- B. Install nonmetallic conduit in accordance with manufacturer's instructions.
- C. Arrange supports to prevent misalignment during wiring installation.
- D. Support conduit using stainless steel or Aluminum straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- E. Group related conduits; support using conduit rack. Construct rack using stainless steel or Aluminum channels; provide space on each for 25 percent additional conduits.
- F. Fasten conduit supports to building structure and surfaces under provisions of Section 16190.
- G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports
- H. Do not attach conduit to ceiling support wires.
- I. Arrange conduit to maintain headroom and present neat appearance.
- J. Route conduit parallel and perpendicular to walls.
- K. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- L. Maintain adequate clearance between conduit and piping.
- M. Maintain 12-inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.

- P. Use conduit hubs to fasten conduit.
- Q. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 2-inch (50 mm) size.
- R. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- S. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control and expansion joints.
- T. Provide suitable pull string and caps on both ends in each empty conduit except sleeves and nipples.
- U. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- V. Ground and bond conduit under provisions of Section 26 05 26.
- W. All equipment connections shall be made with a short section (18" minimum - 36" maximum) length of flexible conduit. These connections shall be made with Seal-Tight conduit and be kept as short as possible.
- X. Ceiling and roof penetrations shall be installed with rigid steel per description below:
 - 1. Install rubber grommet at ceiling/roof penetration for rigid steel conduit.
 - 2. Provide and install outdoor flexible conduit per section 3.1-part X from rigid steel conduit ceiling/roof penetration to equipment connection.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Section 07900.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.

END OF SECTION 26 05 33.13

SECTION 26 05 33.16

BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.

1.2 RELATED SECTIONS: NONE

1.3 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- D. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.5 REGULATORY REQUIREMENTS Conform to requirements of NFPA 70.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2-inch male fixture studs where

required.

- B. Nonmetallic Outlet Boxes: NEMA OS 2, PVC. Provide gasketed cover by box manufacturer. Applicable to all outlet boxes for damp, wet and outdoor installations.
- C. Cast Boxes: NEMA FB 1, Type FS or FD, cast ferroalloy. Provide gasketed cover by box manufacturer. Applicable to all outlet boxes for damp, wet or outdoor installations.
- C. Wall Plates for Finished Areas: As specified in Section 26 14 00.

PART 3 - EXECUTION

3.1 EXAMINATION Verify locations of outlets prior to rough-in.

3.2 INSTALLATION

- B. Install boxes in accordance with NECA "Standard of Installation."
- C. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 (3 m) feet if required to accommodate intended purpose.
- D. Orient boxes to accommodate wiring devices oriented as specified in Section 16140.
- E. Maintain headroom and present neat mechanical appearance.
- F. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- G. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07900.
- H. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- I. Use adjustable steel channel fasteners for hung ceiling outlet box.
- J. Do not fasten boxes to ceiling support wires.

- K. Support boxes independently of conduit.
- L. Use gang box where more than one device is mounted together. Do not use sectional box.
- M. Use gang box with plaster ring for single device outlets.
- N. Use cast or PVC outlet box in exterior locations and wet locations.
- O. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.3 ADJUSTING Install knockout closures in unused box openings.

3.4 CLEANING

- D. Clean interior of boxes to remove dust, debris, and other material.
- E. Clean exposed surfaces and restore finish.

END OF SECTION 26 05 33.16

SECTION 26 05 53
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.
- D. Conduit color-coding.
- E. Panelboard directories.
- F. Wiring diagrams.

1.2 RELATED SECTIONS

- A. Section 26 01 20 - General Electrical Provisions.

PART 2 - PRODUCTS

2.1 NAMEPLATES AND LABELS

- C. Type NP Nameplates: Engraved three-layer laminated plastic with white letters on black background.
- D. Locations:
 - 1. Each electrical distribution and control equipment enclosure.
 - 2. Communication cabinets.
- E. Letter Size:
 - 1. Use 1/8-inch (3 mm) letters for identifying individual equipment and loads.
 - 2. Use 1/4-inch (6 mm) letters for identifying grouped equipment and loads.

2.2 LEGEND PLATES

- A. Type LP: Die-stamped metal legend plate with mounting hole and positioning key.
- B. Paint-fill engraved characters.

2.3 WIRE AND TERMINAL MARKERS

- A. Self-adhering, pre-printed, self-laminating vinyl wrap-around strips.
- B. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
- C. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
 - 2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings.

2.4 CONDUIT MARKERS

- A. Description: High performance snap-on or pressure sensitive precoiled, preprinted suitable for indoor and outdoor conditions.
- B. Location: Furnish markers for each conduit longer than 10 feet.
- C. Spacing: 20 feet on center.
- D. Color:
 - 1. 480 Volt System: Yellow.
 - 2. 208 Volt System: Green.
 - 3. Fire Alarm System: Red.
 - 4. Telephone System: Brown.
 - 5. Data System: Blue.
- E. Legend:
 - 1. 480 Volt System: 480 V.
 - 2. 208 Volt System: 208 V.
 - 3. Fire Alarm System: FA.
 - 4. Telephone System: TEL.
 - 5. Data System: DATA.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION

- A. Install nameplate and label parallel to equipment lines.
- B. Secure nameplate to equipment front using two screws or adhesive.
- C. Secure nameplate to inside surface of recessed panelboard doors in finished locations.
- D. Secure clear plastic-laminated wiring diagrams on the inside of cabinets, enclosures, panelboards, and switchboards.

3.3 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.
- B. Provide conductor phase color coding as per Section 16120.

3.4 NAMEPLATING ENGRAVING

- A. Provide type "NP" nameplates of minimum letter height as noted below.
 1. Panelboards, Switchboards and Motor Control Centers: 1/4-inch to identify equipment designation. 1/8-inch to identify voltage rating and source.
 2. Individual Circuit Breakers, Switches and Motor Starters in Panelboards, Switchboards, and Motor Control Centers: 1/8-inch to identify circuit and load served, including location.
 3. Individual Circuit Breakers, Enclosed Switches, and Motor Starters: 1/8-inch to identify voltage rating and load served.
 4. Transformers: 1/4-inch to identify equipment designation. 1/8-inch to identify primary and secondary voltages, primary source, and secondary load and location.
 5. Equipment Cabinets, Terminal Cabinets, Control Panels, and other Cabinets enclosing apparatus: 3/8-inch to identify equipment and designation.

- B. Provide type "LP" metal legend plates for attachment to panel mounted operator's devices such as pilot lights, push buttons, selector switches, etc.

3.5 CONDUIT COLOR CODING SCHEDULE

- A. Coordinate color of paint with Section 09900 - Painting to identify conduit by system.
- B. Fire Alarm System: Red.

3.6 PANELBOARD DIRECTORIES

- A. Provide typewritten directories arranged in numerical order showing number of rooms in which each device served by each panelboard circuit is located.
- B. Verify room numbers to be used with Owner. Room number will not necessarily be those used on the Drawings.
- B. Mount directories in a 6 inch by 8-inch metal frame under a clear plastic cover inside each panelboard door.

3.7 PLASTIC-LAMINATED WIRING DIAGRAMS

- A. Provide clear plastic-laminated wiring diagrams for cabinets, enclosures, panelboards, and switchboards.
- B. Secure clear plastic-laminated wiring diagrams to the inside surface of metal cabinets, enclosures, panelboards, and switchboards with adhesive.
- C. Mount diagrams clear of latches, hinges, and viewports.

END OF SECTION 26 05 53

SECTION 26 06 50
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED SECTIONS: RELATED REQUIREMENTS

- A. Section 26 01 20 - General Electrical Provisions

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- A. AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)
 - 1. ANSI/NFPA 101 - National Electrical Safety Code
 - 2. ANSI c78.1535 - 981 High-Pressure Sodium Lamps
- B. ILLUMINATING ENGINEERING SOCIETY (IES)
 - 1. IES LHBK - Lighting Handbook
- C. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
 - 1. NFPA 70 - National Electrical Code
- D. UNDERWRITERS LABORATORIES, INC. (UL)
 - 1. UL 1029 - 1994 High-Intensity-Discharge Lamp Ballasts, Fifth Edition

1.3 DEFINITIONS

- A. Average Life: Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
- B. Ground line Section: That portion between one foot above and 2 feet below the ground line.

1.4 SUBMITTALS

A. Manufacturer's Catalog Data

1. Luminaries
2. LED
3. Photocell
4. Brackets and NEMA 3R J-box
5. Four (4) Hour Time switch

B. Drawings

1. Luminaries

Luminaries: Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and computerized candlepower distribution data shall accompany shop drawings.

- 1.6 Quality Assurance: Operate each Luminaire after installation and connection. Inspect for proper connection and operation.

PART 2 - PRODUCTS

2.1 LUMINARIES

A. Acceptable Manufacturers:

1. ATLAS.
2. Lithonia.
3. Eaton.

B. Provide luminaries as indicated. Provide luminaries complete with lamps of number, type, and wattage indicated.

C. Details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaries of a particular manufacturer. Luminaries of similar designs and equipment, light distribution brightness

characteristics, and of equal finish and quality shall be submitted as an alternative for review and approval.

2.2 OPTICS

- A. Description: High performance LED, 4000K and 5000K, 50,000 hours of service based on IESNA LM-80-08.
- B. Provide dusk-to-dawn photocell that automatically turns on at dusk and off at dawn for convenience and energy savings.
- C. Provide a four (4) hour timer switch as a bypass switch to allow for lighting operation during maintenance and testing.
- D. Voltage: 120 V

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install surface mounted luminaries plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- C. Install wall mounted luminaries as minimum 8ft height above finished floor.
- D. Make wiring connection to branch circuit using building wire with insulation suitable for temperature conditions within Luminaries.

3.2 GROUNDING

- A. Ground non-current-carrying parts of equipment including metal poles, luminaries, mounting arms, brackets, and metallic enclosures. Where copper ground conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.3 FIELD QUALITY CONTROL

- A. Upon Completion of installation, conduct an operating test to show that the equipment operates in accordance with the requirements of this section.

END OF SECTION – 26 06 50

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 THIS SECTION INCLUDES:

- A. NEMA Type 3R, 120/208 V, 1 phase, 3 wires, circuit breaker type, distribution panelboards in stainless steel enclosures.

1.2 RELATED SECTIONS

- A. Section 26 01 20 - General Electrical Provisions.
- B. Section 26 05 19 – Conductors.
- C. Section 26 05 26 – Grounding.
- D. Section 26 05 29 - Support Devices.
- E. Section 26 05 53 – Electrical Identification

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. UL 67 – Standard for Panelboards
- C. UL 50 – Enclosures for Electrical Equipment
- D. NEMA AB 1 - Molded Case Circuit Breakers.
- E. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- F. NEMA KS 1 - Enclosed Switches.
- G. NEMA PB 1 - Panelboards.
- H. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- I. NFPA 70 - National Electrical Code.
- J. ASCE7-05, ASCE7-10, IBC2009, IBC2012, CBC 2019, BBCC 2015 Seismic

Qualification, and OSHPD Special Seismic Certification Pre-approval OSP-0016-10.

1.4 MAINTENANCE MATERIALS

- A. Provide two of each panelboard key.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. General Electric (GE) / ABB.
- B. Eaton.
- C. Schneider Electric Square "D".
- D. Siemens.
- E. Or Approved Equal.

2.2 BRANCH CIRCUIT PANELBOARDS

- A. Branch Circuit Panelboard: NEMA 3R 120/240 V, 1 phase, 3 wires, circuit breaker type.
- B. Panelboard Bus: Copper, ratings as indicated.
- C. Minimum short circuit rating: As noted on drawings.
- D. Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
- E. Enclosure: NEMA Type 3R stainless steel.
- F. Cabinet Front: Gasketed door with lockable vault handle.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboard in accordance with NEMA PB 1.1.
- B. Install panelboard plumb. Provide support in accordance with Section 26 05 29.

- C. Height: 6 ft to top of panelboard.
- D. Provide filler plates for unused spaces in panelboards.
- D. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

3.2 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION 26 24 16

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Device plates and decorative box covers.

1.2 RELATED SECTIONS

- A. Section 26 01 20 - General Electrical Provisions.
- B. Section 26 05 33.16 - Boxes.

1.3 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA WD 1 - General Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
- D. NFPA 70 - National Electrical Code.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years of experience.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Manufacturers:

1. Hubbell.
 2. General Electric.
 3. Leviton.
 4. Bryant
- B. Description: NEMA WD 1, Heavy-Duty, AC only general-use switch.
- C. Body and Handle: Plastic with rocker handle. Finish: as required by Architect.
- D. Ratings:
1. Voltage: 120-277 volts, AC.
 2. Current: 20 amperes.

2.2 WALL DIMMERS

- A. Manufacturers:
1. Lutron
 2. Lightolier
 3. Prescolite
 4. Leviton
 5. or approved equal.
- B. Description: NEMA WD1 and as specified on drawings.
- C. Body and Handle: as indicated on drawings.
- D. Finish: Per Architect requirements.
- E. Voltage: 120V.
- F. Power rating: Match load shown on drawings; 600 watts minimum.

2.3 RECEPTACLES

- A. Manufacturers:
1. Hubbell.
 2. General Electric.
 3. Leviton
 4. Bryant
- B. Description: NEMA WD 1, Heavy-duty general use receptacle. Finish: as required by Architect.
- C. Configuration: NEMA WD 6, type as specified and indicated.
- D. Convenience Receptacle: Type 5-20.

- E. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.4 WALL PLATES

- A. Decorative Cover Plate: Plastic. Finish: as required by Architect.
 - 1. Hubbell.
 - 2. Or equivalent.
- B. Weatherproof Cover Plate: Gasketed cast metal with hinged gasketed device cover.
 - 1. Hubbell.
 - 2. Or equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that outlet boxes are installed at proper height.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- E. Do not share neutral conductor on load side of dimmers.

- F. Install receptacles with grounding pole on bottom.
- G. Connect wiring device grounding terminal to outlet box with bonding jumper.
- H. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- I. Connect wiring devices by wrapping conductor around screw terminal.
- J. Use jumbo size plates for outlets installed in masonry walls.
- K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install wall switch 48 inches above finished floor.
- B. Install convenience receptacle 18 inches above finished floor.
- C. Install convenience receptacle 6 inches above backsplash of counter.
- D. Install dimmer 48 inches above finished floor.
- E. Install telephone jack 18 inches above finished floor.
- F. Install telephone jack for side-reach wall telephone to position top of telephone at 54 inches above finished floor.
- G. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 above finished floor.
- H. Coordinate the installation of wiring devices with underfloor duct service fittings provided under Section 26 01 20.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

- F. Verify that each telephone jack is properly connected, and circuit is operational.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 26 27 26

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Enclosed circuit breakers.

1.2 RELATED SECTIONS

- A. Section 26 0120 - General Electrical Provisions.
- B. Section 26 0529 - Support Devices.

1.3 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers.

1.4 EXTRA MATERIALS

- A. Provide three of each size and type current limiter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Siemens.
- B. Square "D".
- C. Eaton.
- D. ABB/General Electric or approved equal.

2.2 MOLDED CASE CIRCUIT BREAKER

- A. Circuit Breaker: NEMA AB 1.
- B. Service Conditions
 - 1. Temperature: -5°C to + 60°C.
 - 2. Altitude: up to 2000 meters above sea level.

2.3 TRIP UNIT CIRCUIT BREAKERS

- A. Field - adjustable trip circuit breaker: Provide circuit breakers with frame sizes 200 amperes and larger with mechanism for adjusting setting for automatic operation.
- B. Current limiting circuit breaker: Provide circuit breaker with automatically - resetting current limiting elements in each pole. Let - through current and energy: Less than permitted for same size class RK-5 fuse.
- C. Solid - State circuit breaker: Provide circuit breaker with electronic sensing, timing, and tripping circuits for adjustable current settings instantaneous trip and adjustable short time trip.

2.4 CURRENT LIMITERS

- A. Current Limiter: Designed for application with molded case circuit breaker.
- B. Coordinate limiter size with trip rating of circuit breaker to prevent nuisance tripping and to achieve interrupting current rating specified for circuit breaker.
- C. Provide interlocks to trip circuit breaker and to prevent closing circuit breaker when limiter compartment cover is removed or when one or more limiter is not in place or has operated.

2.5 PRODUCT OPTIONS AND FEATURES

- A. Provide accessories as needed.
- B. Handle Lock: Include provisions for padlocking.
- C. Provide mechanical trip device.
- D. Provide grounding lug in each enclosure.
- E. Provide Products suitable for use as service entrance equipment where so applied.

2.6 ENCLOSURE

- A. Enclosure: NEMA AB 1: Type 1 for indoor installation.
Type 4 for outdoor installation.
- B. Fabricate enclosure from steel.
- C. Finish using manufacturer's standard enamel finish: color per Architect requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 16190.
- C. Height: 5 ft to operating handle.
- D. Provide engraved plastic nameplates.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 014000.
- B. Inspect and test each circuit breaker to NEMA AB 1.
- C. Inspect each circuit breaker visually.
- D. Perform several mechanical ON-OFF operations on each circuit breaker.
- E. Verify circuit continuity on each pole in closed position.
- F. Determine that circuit breaker will trip on overcurrent condition, with tripping time to NEMA AB 1 requirements.
- G. Include description of testing and results in test report.

3.3 ADJUSTING

- A. Adjust trip settings so that circuit breakers coordinate with other overcurrent protective devices in circuit.
- B. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

END OF SECTION 26 28 16

SECTION 26 32.13.13

STANDBY POWER DIESEL ENGINE-DRIVEN GENERATOR SET

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets suitable for use in transit facilities with the features as specified and indicated. Engine generators shall be used as the Standby power source certified by SCAQMD at minimum in Tier 2 but shall be capable of providing reliable power with no run-time limitations while the primary source of power is unavailable.

1.3 DEFINITIONS

- A. Standby Power (SP): Per ISO 8528 - The maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage or under test conditions for up to 200 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 70 percent of the ESP unless otherwise agreed by the RIC engine manufacturer.
- B. Prime Power (PRP): Per ISO 8528: The maximum power which a generating set is capable of delivering continuously whilst supplying a variable electrical load when operated for an unlimited number of hours per year under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 70 percent of the PRP unless otherwise agreed by the RIC engine manufacturer.
- C. Limited Time running Power (LTP): Per ISO 8528: The maximum power available, under the agreed operating conditions, for which the generating set is capable of delivering for up to 500 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers.
- D. Continuous Operating Power (COP): Per ISO 8528: The maximum power which a generating set is capable of delivering continuously whilst supplying a constant electrical load when operated for an unlimited number of hours per

year under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer.

- E. Data Center Continuous (DCC): The maximum power which a generating set is capable of delivering continuously whilst supplying a variable or constant electrical load when operated for an unlimited number of hours in a data center application under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 100 percent of the DCC rating.
- F. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
 - 3. Sound test data, based on a free field requirement.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Wiring Diagrams: Control interconnection, Customer connections.
- C. Certifications:
 - 1. Submit statement of compliance which states the proposed products are certified to the emissions standards required by SCAQMD in Tier 2 at minimum, stationary emergency application.
 - 2. Submit statement of compliance which states the proposed products are seismically certified in compliance with local requirements signed and sealed by a California licensed professional engineer.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that the 28-hours fuel tank for Standby Power Generator, the Sound Attenuated enclosures, engine-generator set, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Source quality-control test reports.
1. Certified summary of prototype-unit test report. See requirements in Part 2 "Source Quality Control" Article Part A. Include statement indicating torsional compatibility of components.
 2. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA110 level 1.
 3. List of factory tests to be performed on unit to be shipped for this Project.
 4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.
- C. Warranty:
1. Submit manufacturer's warranty statement to be provided for this Project.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Comply with NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
- E. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance with Article 700, 701, and 702).

- F. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.
- G. Comply with UL 2200.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 0.0 deg C (32.0 deg F) to 40.0 deg C (104.0 deg F).
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 100.0 feet (30.0 m).

1.8 WARRANTY

- A. Base Warranty: Manufacturer shall provide base warranty coverage on the material and workmanship of the generator set for a minimum of twenty-four (24) months for Standby product and twelve (12) months for Prime / Continuous product from registered commissioning and start-up.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Generac Power Generation equipment and approved equal shall be considered if equipment performance meets the requirements herein.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set certified for SCAQMD Tier 2 at minimum:
 - 1. PM = 0.15 g/bhp-hr;
 - 2. NMHC+NO_x = 4.8 g/bhp-hr;
 - 3. CO = 2.6 g/bhp-hr.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.

C. Capacities and Characteristics:

1. Power Output Ratings: Electrical output power rating for Standby operation of not less than as indicated on the plans.
2. The alternator shall be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components. The engine-generator nameplate shall include information of the power output rating of the equipment.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.
3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Not more than 15 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.
6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
7. Sustained Short-Circuit Current: For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases. For a 3-phase, bolted short circuit at system output terminals, system shall

supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components.

8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.
9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.
10. Load Sharing: Engine generator shall share real and reactive load proportionally within plus or minus 3 percent with all other engine generators in the system.

2.3 ENGINE

- A. Fuel: ASTM D975 #2 Diesel Fuel
- B. Rated Engine Speed: 1800RPM.
- C. Lubrication System: The following items are mounted on engine or skid:
 1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
 2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Engine Fuel System: The engine fuel system shall be installed in strict compliance with the engine manufacturer's instructions.
- E. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.
 1. Designed for operation on a single 240 VAC, single phase, 60Hz power connection. Heater voltage shall be shown in the project drawings.

2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.
 3. Provided with a 24VDC thermostat, installed at the engine thermostat housing.
- G. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnecting speed, accelerating to rated speed, and operating in various isochronous states.
- H. Cooling System: Closed loop, liquid cooled.
1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 deg C.
 2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.
- I. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.
- J. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.

- K. Starting System: 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
 3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
 4. Battery Compartment: Factory fabricated metal with acid-resistant finish.
 5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
 6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:
 - a. Operation: Equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. The unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate

charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.

f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Subbase-Mounted Fuel Oil Tank: Provide a double wall secondary containment type subbase fuel storage tank. The tank shall be constructed of corrosion resistant steel and shall be listed and labeled. The fuel tank shall include the following features:

1. Capacity:

a. 132 gallons of fuel for 33 hours continuous operation at 100 percent rated power output.

2. Tank rails and lifting eyes shall be rated for the full dry weight of the tank, genset, and enclosure.

3. Electrical stub ups.

4. Normal & emergency vents.

5. Lockable fuel fill.

6. Mechanical fuel level gauge.

7. High- and low-level switches to indicate fuel level.

8. Leak detector switch.

9. The subbase tank shall include a welded steel containment basin, sized at a minimum of 110% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.

10. Fill port with overfill prevention valve (OFPV).

11. 5-gallon fill/spill dam or bucket.

12. Tank design shall meet the regional requirements for the Project location.

2.5 CONTROL AND MONITORING

A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection, and control functions for the unit.

- B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When the mode-selector switch is switched to the on position, generator set starts. The off position of the same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When the generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of the same switch initiates generator-set shutdown. When the generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. The mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.
- E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
1. AC voltmeter (1-phase, line to line and line to neutral values).
 2. AC ammeter (1-phase).
 3. AC frequency meter.
 4. AC kW output (total and for each phase). Display shall indicate power flow direction.
 5. AC kVA output (total and for each phase). Display shall indicate power flow direction.
 6. AC Power factor (total and for each phase). Display shall indicate leading or lagging condition.
 7. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.

8. Emergency Stop Switch: Switch shall be a red “mushroom head” pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
9. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
10. DC voltmeter (alternator battery charging).
11. Engine-coolant temperature gauge.
12. Engine lubricating-oil pressure gauge.
13. Running-time meter.
14. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjust these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.) The voltage and frequency adjustment functions shall be disabled when the paralleling breaker is closed.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR, reverse kW, overload (kW) short circuit, over current, loss of voltage reference, and over excitation shut down protection. There shall be a ground fault alarm for generator sets rated over 1000 amps, overload warning, and overcurrent warning alarm.
18. Status LED indicating lamps indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.
19. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
20. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.

21. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.
 22. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).
 23. Paralleling Breaker control switches: The control shall include manual open and close provisions for the paralleling breaker, and LED status lamps indicating whether the breaker is open or closed.
- F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Over-crank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.
- G. Remote Alarm Annunciator: Comply with NFPA 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition.
- H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Overcurrent Protection: The generator set shall be provided with a UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective device shall be listed as a utility grade protective device under UL category NRGU. The control system shall be subject to UL follow-up service at the manufacturing location to verify that the protective system is fully operational as manufactured. Protector shall perform the following functions:

1. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
2. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm condition when the current flow is in excess of 110% of rated current for more than 10 seconds.
3. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.
4. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.
5. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 120% of nominal voltage.
6. The protective system provided shall not include an instantaneous trip function.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H
- D. Temperature Rise: 105 / Class F environment.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.
- G. Enclosure: Drip-proof.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.

- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- J. Subtransient Reactance: 12 percent maximum, based on the rating of the engine generator set.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Sound Attenuated Steel housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.

B. Construction:

- 1. Louvers: Equipped with bird screen to permit air circulation when engine is not running while excluding birds and rodents.
- 2. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.
- 3. Exhaust System:
 - a. Muffler Location: Within enclosure.
- 4. Hardware: All hardware and hinges shall be stainless steel.
- 5. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
- 6. A weather protective enclosure shall be provided which allows the generator to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.
- 7. Inlet ducts shall include rain hoods.

C. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.

- 1. Louvers: Fixed-engine, cooling-air inlet, and discharge.

D. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 70 dBA measured at the engine generator acoustic enclosure in a free field environment.

E. Site Provisions:

1. Lifting: Complete assembly of engine generator, enclosure, and subbase fuel tank shall be designed to be lifted into place as a single unit, using spreader bars.

2.9 VIBRATION ISOLATION DEVICES

- A. Vibration Isolation: Generators installed on grade shall be provided with California approved seismic spring isolators integral to the generator.

2.10 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer's standard color or as directed on the drawings.

2.11 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components, and equipped with identical or equivalent accessories.
 1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.
 2. Full load run.
 3. Maximum power.
 4. Voltage regulation.
 5. Steady-state governing.
 6. Single-step load pickup.
 7. Simulated safety shutdowns.
 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.
- B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections, under the supervision of the equipment supplier.
- D. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
- E. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the Engineer.
- F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- G. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

3.2 ON-SITE ACCEPTANCE TEST

- A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:

- B. Prior to the start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.
- C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two-hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.
- D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.4 SERVICE AND SUPPORT

- A. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of \$3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.
- B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within 100 miles of the site.
- C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.5 SERVICE AGREEMENT:

- A. The supplier shall include in the base price a one-year service agreement. The maintenance shall be performed by factory authorized service technicians capable of servicing both the engine generator set and the transfer switch. This agreement shall include the following:

1. The generator supplier must have an in-house rental fleet with equipment sized to back up this project site.
2. All engine maintenance as recommended by the service manual.
3. All electrical controls, maintenance, and calibrations as recommended by the manufacturer.
4. All auxiliary equipment as a part of the emergency systems.
5. The supplier shall guarantee emergency service.
6. All expendable maintenance items are to be included in this agreement.
7. A copy of this agreement and a schedule shall be given to the Owner at the time of his acceptance, showing what work is to be accomplished and when.

END OF SECTION 26 32 13.13

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 SCOPE

Furnish and install NEMA 3R automatic transfer switches (ATSs) with number of poles, amperage, voltage, and withstand current ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch unit and a microprocessor controller, interconnected to provide complete automatic operation. All transfer switches and control panels shall be the product of the same manufacturer.

1.2 RELATED SECTIONS

A. Section 26 01 20 - General Electrical Provisions.

1.3 REFERENCES

- A. UL1008 – Standard for Transfer Switch Equipment
- B. CSA certified to CSA 22.2 No. 178 – 1978 Automatic Transfer Switches
- C. IEC 60947-6-1 Low-voltage Switchgear and Control Gear; Multifunction equipment; Automatic Transfer Switching Equipment
- D. NFPA 70 - National Electrical Code.
- E. NFPA 110 – Emergency and Standby Power Systems
- F. IEEE Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
- G. NEMA Standards ICS10-1993 (formerly ICS2-447) – AC Automatic Transfer Switches
- H. UL 508 Industrial Control Equipment

1.4 SUBMITTALS

- A. Product Data: Provide catalog sheets showing voltage, switch size, ratings, and size of switching and overcurrent protective devices, operating logic,

short circuit ratings, dimensions, and enclosure details.

- B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 OPERATION AND MAINTENANCE DATA

- A. Operation Data: Include instructions for operating equipment. Include instructions for operating equipment under normal and emergency conditions when engine generator is running.
- B. Maintenance Data: Include routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure, and finish.

1.7 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.8 MAINTENANCE SERVICE

- A. Furnish service and maintenance of transfer switch for one year from Date of Substantial Completion.

1.9 MAINTENANCE MATERIALS

- A. Provide two of each special tool required for maintenance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. General Electric (GE) / ABB.
- B. ASCO.

- C. Or approved equal.

2.2 MECHANICALLY HELD TRANSFER SWITCH

- A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include overcurrent disconnect devices will not be accepted. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
- B. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.
- C. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand current capability and be protected by separate arcing contacts.
- D. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.
- E. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching, or transfer between two active power sources are not acceptable.
- F. Where neutral conductors must be switched, the ATS shall be provided with fully rated neutral transfer contacts.
- G. Where neutral conductors are to be solidly connected, a neutral terminal plate with fully rated AL-CU pressure connectors shall be provided.

2.3 MICROPROCESSOR CONTROLLER WITH MEMBRANE INTERFACE PANEL

- A. The controller's sensing and logic shall be controlled by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
- B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to $\pm 1\%$ of nominal voltage. Frequency sensing shall be accurate to $\pm 0.2\%$. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.
- C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.

Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.

- D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
- C. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 - 1. EN 55011:1991 Emission standard - Group 1, Class A
 - 2. EN 50082-2:1995 Generic immunity standard, from which:
 - EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity
 - ENV 50140:1993 Radiated Electro-Magnetic field immunity
 - EN 61000-4-4:1995 Electrical fast transient (EFT) immunity
 - EN 61000-4-5:1995 Surge transient immunity
 - EN 61000-4-6:1996 Conducted Radio-Frequency field immunity

2.4 ENCLOSURE

- A. The ATS shall be furnished in a NEMA type 3R enclosure unless otherwise shown on the plans.
- B. Provide strip heater with thermostat for Type 3R enclosure requirements.
- C. Controller shall be flush-mounted display with LED indicators for switch position and source acceptability. It shall also include test and time delay bypass switches.

PART 3 - OPERATION

3.1 CONTROLLER DISPLAY and KEYPAD

- A. A four-line, 20-character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:
 - 1. Nominal line voltage and frequency
 - 2. Single or three phase sensing
 - 3. Operating parameter protection
 - 4. Transfer operating mode configuration

(Open transition, Closed transition, or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

3.2 VOLTAGE, FREQUENCY and PHASE ROTATION SENSING

- A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

<u>Parameter</u>	<u>Sources</u>	<u>Dropout / Trip</u>	<u>Pickup / Reset</u>
Undervoltage	N&E, 3 ϕ	70 to 98%	85 to 100%
Overvoltage	N&E, 3 ϕ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

- B. Repetitive accuracy of all settings shall be within $\pm 0.5\%$ over an operating temperature range of -20°C to 60°C .
- C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
- D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
- E. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.
- F. The controller shall include a user selectable algorithm to prevent repeated transfer cycling to a source on an installation which experiences primary side, single phase failures on a Grounded Wye – Grounded Wye transformer which regenerates voltage when unloaded. The algorithm shall also inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD.

3.3 TIME DELAYS

- A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.
- B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

- C. Two-time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails, and the normal source is acceptable.
- D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
- E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0-to-5-minute time delay in any of the following modes:
 - 1. Prior to transfer only.
 - 2. Prior to and after transfer.
 - 3. Normal to emergency only.
 - 4. Emergency to normal only.
 - 5. Normal to emergency and emergency to normal.
 - 6. All transfer conditions or only when both sources are available.

3.4 ADDITIONAL FEATURES

- A. A three-position momentary-type test switch shall be provided for the **test / automatic / reset** modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.
- B. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
- C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
- D. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
- E. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
- F. An In-phase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting

currents and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer.

- G. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
- H. **Engine Exerciser** - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
1. Enable or disable the routine.
 2. Enable or disable transfer of the load during routine.
 3. Set the start time.
 - time of day
 - day of week
 - week of month (1st, 2nd, 3rd, 4th, alternate or every)
 4. Set the duration of the run.

At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

- I. **System Status** - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example,

Normal Failed
Load on Normal
TD Normal to Emergency
2min15s

Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.

- J. **Self-Diagnostics** - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may prevent load transfer commands from being completed..
- K. **Data Logging** – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
1. Event Logging
 1. Data and time and reason for transfer normal to emergency.
 2. Data and time and reason for transfer emergency to normal.

3. Data and time and reason for engine start.
 4. Data and time engine stopped.
 5. Data and time emergency source available.
 6. Data and time emergency source not available.
2. Statistical Data
1. Total number of transfers.
 2. Total number of transfers due to source failure.
 3. Total number of days controller is energized.
 4. Total number of hours, both normal and emergency sources are available.
- L. Communications Module – Shall provide remote interface module to support monitoring of vendor’s transfer switch, controller, and optional power meter. Module shall provide status, analog parameters, event logs, equipment settings & configurations over embedded webpage and open protocol. Features shall include:
1. Email notifications and SNMP traps of selectable events and alarms may be sent to a mobile device or PC.
 2. Modbus TCP/IP, SNMP, HTTP, SMTP open protocols shall be simultaneously supported.
 3. Web app interface requiring user credentials to monitor and control the transfer switch supporting modern smart phones, tablets, and PC browsers. Users will be able to view the dynamic one-line; ATS controls status, alarms, metering, event logging as well as settings.
 4. Secure access shall be provided by requiring credentials for a minimum of 3 user privilege levels to the web app, monitor (view only), control (view and control) and administrator (view, control, and change settings). 128-Bit AES encryption standard shall be supported for all means of connectivity.
 5. Allowing for the initiating of transfers, retransfers, bypassing of active timers and the activating/deactivating of engine start signal shall be available over the embedded webpage and to the transfer switch vendor’s monitoring equipment.
 6. An event log displaying a minimum of ninety-nine (99) events shall be viewable and printable from the embedded webpages and accessible from supported open protocols.
 7. Four (4) 100 Mbps Ethernet copper RJ-45 ports, five (5) serial ports, Termination dipswitches and LEDs for diagnostics.
 8. DIN rail mountable.
- O. External DC Power Supply – An optional provision shall be available to connect an external 24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead. This option shall be equivalent to ASCO accessory 1G.

PART 4 - ADDITIONAL REQUIREMENTS

4.1 WITHSTAND AND CLOSING RATINGS

- A. The ATS shall be rated to close on and withstand the available rms symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans. WCR ATS ratings as be as follows when used with specific circuit breakers:

ATS Size	Withstand & Closing Rating MCCB	W/CLF
30	22,000A	100,000
70 - 200	22,000A	200,000
230	22,000A	100,000
260 - 400	42,000A	200,000
600 - 1200	65,000A	200,000
1600 - 2000	85,000A	200,000
2600 - 3000	100,000A	200,000

4.2 TESTS AND CERTIFICATION

- A. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency, and time delay settings are in compliance with the specification requirements.
- B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all the requirements of this specification including compliance with the above codes and standards and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
- C. The ATS manufacturer shall be certified to ISO 9001: 2000 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation, and servicing in accordance with ISO 9001: 2000.

4.3 SERVICE REPRESENTATION

- A. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
- B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.
- C. For ease of maintenance, the transfer switch nameplate shall include drawing numbers and serviceable part numbers.

END OF SECTION

SECTION 31 20 00

EARTHWORK

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Section 02 41 00 "Demolition"

1.2 REFERENCE STANDARDS

- A. The following is a list of standards which may be referenced in this section:
 - 1. Standard Specifications for Public Works Construction ("Standard Specifications"), 2022 Edition
 - 2. American Society for Testing and Materials

1.3 SUBMITTALS

- A. Contractor shall submit a job mix design for all rock and import fill material to be used on project as required in these Special Provisions:
 - 1. Provide copies of gradation reports and material certificates signed by material producer and Contractor, certifying that each material complies with, or exceeds, specified requirements.
 - 2. Provide samples upon request.
- B. Traffic and Safety Plan: Contractor shall prepare a Traffic and Safety Plan showing barricades, traffic cones and striping for construction equipment entering the project site and using the public roads.

1.4 QUALITY ASSURANCE

- A. Contractor shall hire an independent Geotechnical Testing Agency for daily on-site monitoring and testing during earthwork and compaction efforts.
- B. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- C. Geotechnical Testing Agency shall monitor and test the following:
 - 1. Inspect and test Class A Topsoil material and confirm that it complies with the Project requirements.

2. Inspect and test placement of Class A Topsoil and confirm that the maximum lift thickness, placement, and compaction of engineering fill complies with the Project requirements
3. Inspect and test all subgrades and confirm that compaction and bearing capacities comply with the Project requirements

1.5 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Engineer.
 2. Provide alternate routes around closed or obstructed traffic ways if required by the Engineer.
 3. Coordinate work with phasing plan.
- B. Utility Locator Service: Notify local "811" before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures.
- D. The Engineer shall be present during grading operations to evaluate the suitability of the various soil types exposed during excavation at the site for use as Class A Topsoil. Do not commence earth moving operations without the presence of the Engineer.
- E. Blasting shall not be permitted.

1.6 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Class A Topsoil: Imported satisfactory soil material for landscaping and planting.
- C. Structures: Footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

- D. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill, drainage fill, drainage structure, drainage course, or topsoil materials.
- E. Utilities: On-site underground pipes, conduits, ducts, and cables.
- F. Clearing and Grubbing: Trimming and removal of trees, brush, weeds, stumps, trash, sod, grass, stumps, roots, other vegetation on or below the ground surface, and other debris.

PART 2 - PRODUCTS

2.1 CLASS A TOPSOIL

- A. Provide Class A Topsoil materials only when satisfactory soil materials are not available from excavations.
- B. Material shall be evaluated by the Engineer for its suitability as Class A Topsoil prior to importation to the project site.
- C. Material shall conform to Section 800-1.1.2 of the Standard Specifications for Public Works Construction ("Standard Specifications"), 2018 Edition.

2.2 SUBGRADE BRIDGING MATERIAL, 3 IN. MINUS

- A. Imported Subgrade Bridging Material, 3 in. minus or crushed PCC pavement to be used as stabilization layer shall conform to the following gradations:

<u>Sieve Size</u>	<u>Percent Passing (by weight)</u>
125mm (5")	100
100mm (4")	100
75mm (3")	100
62.5mm (2-1/2")	89
50mm (2")	55
37.5mm (1-1/2")	24
25mm (1")	4
19mm (3/4")	1
12.5mm (1/2")	1
9.5mm (3/8")	1
4.75mm (No.4)	1

2.3 3/4" MINUS ROCK

- A. For gradation refer to Table 200-1.2 (A) of the Standard Specifications as specified in Geotechnical Report (latest revision) recommendations.

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. The work includes implementation and maintenance of a Storm Water Pollution Prevention Plan (SWPPP), including QSP and QSD services, and implementation and maintenance of SWPPP Best Management Practices (BMPs) required to prevent and control discharges of dust, soil, sediment, debris, and other pollutant from the project site onto adjacent areas and/or into the storm water conveyance system from construction activities shown on the project drawings.

The SWPPP and BMPs shall apply to all construction related areas and activities associated with the project, such as staging areas, equipment and material storage sites, waste management areas, temporary plant sites, and borrow pit operations which may be outside the construction limits.

- B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent condition has been established.
- C. When permanent conditions are established, remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Prevent sediment inundation from construction activities into infiltration and rock gallery trenches.

3.2 PROTECTION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- D. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted,

settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by the Engineer; reshape and recompact.
- E. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration.

3.3 DEWATERING AND FLOW CONTROL

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.4 UNCLASSIFIED EXCAVATION

- A. Unclassified excavation shall consist of excavation of all earth, rock, and buried recycled concrete or asphalt pavement within the project limits that is required for the construction of the parking lot as shown on the plans.
- B. Excavation not designated as unclassified excavation include the following: structure excavation, utility trench excavation, PCC concrete pavement removal, AC pavement removal, temporary or back cut excavations, minor excavations to remove existing site elements, excavations for new footings and foundations, and any excavation separately designated in these Special Provisions.
- C. Excavate, shape and finish all earthwork to new subgrade and top of slopes in conformance with the lines and grades shown on the plans. Slopes shall be excavated per Section 300-2.5 "Slopes" of the Standard Specifications.
- D. No excavation beyond the limits shown on the plans shall take place without authorization of the Engineer.
- E. Excavated material that meets the criteria for Import Fill Material per this 2.1 "Import Fill Material" and is deemed acceptable by the Engineer shall be reused on-site in applicable Work.

- F. It is anticipated that a portion of the excavated material will be unsatisfactory due to high moisture content and/or unsuitable soils characteristics

3.5 EXCAVATION FOR NON-BUILDING STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Non-Building Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Excavation for Underground Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.6 PLACEMENT OF CLASS A TOPSOIL

- A. Grading and placement of Class A Topsoil shall conform to Section 801-2 of the Standard Specifications for Public Works Construction ("Standard Specifications"), 2018 Edition.

3.7 GRADING

- A. Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

3.8 SUBGRADE PREPARATION

- A. Finish subgrades to required elevations within the following tolerances:
 - 1. Subgrade for pavement, curb and gutter, driveways, or other roadway structures shall not vary more than 0.02 feet from the specified grade and cross section.

2. Subgrade for subbase or base material shall not vary more than 0.04 feet from the specified grade and cross section.
- B. Subgrade stabilization indicated on plans and within these special provisions are based upon limited geotechnical data and are subject to change. Unstable subgrade soils shall be identified during the initial grading by the Engineer. After the existing AC, concrete and other construction debris have been removed, the bottom of the excavations shall be proof rolled with heavy grading equipment or loaded water truck, to check for yielding or soft areas that flex or pump under load. Engineer shall make the final determination of the subgrade stabilization method after reviewing the soil types exposed at the site during demolition and excavation operations.

3.9 CLEARING AND GRUBBING

- A. Contractor shall remove all trees, brush, weeds, stumps, trash, sod, grass, stumps, roots, other vegetation on or below the ground surface, and other debris. Removal limits shall extend to grading limits. Any vegetation damaged or removed outside the grading limits shall be replaced in kind at no additional expense to P&FMD.

END OF SECTION 31 20 00

SECTION 31 2313

EXCAVATION AND FILL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Excavating, filling, backfilling, and compacting for Project site pavement, planting areas, buildings, and other structures.
 2. Trenches for utility lines such as water, gas, irrigation, storm drain and sewer lines, concrete-encased conduits, manholes, vaults, valve boxes, catch basins, underground tanks, thrust blocks, yard boxes, pull boxes, and other utility appurtenances.
- B. Related Requirements:
1. Division 01 - General Requirements.
 2. Section 01 4524 - Environmental Import/Export Materials Testing.
 3. Section 31 1000 - Site Clearing.
 4. Section 31 2200 - Grading.
 5. Section 31 2326 - Base Course.
 6. Section 32 0117 - Pavement Repair.
 7. Section 32 1313 - Site Concrete Work.
 8. Section 32 3113 - Chain Link Fences and Gates.
 9. Section 32 8413 - Potable Water Irrigation.
 10. Section 32 8426 - Reclaimed Water Irrigation.
 11. Section 32 9000 - Planting.
 12. Section 33 1100 - Site Water Distribution Utilities.
 13. Section 33 3000 - Site Sanitary Sewer Utilities.
 14. Section 33 4000 - Storm Drainage Utilities.
 15. Division 22 - Plumbing.
 16. Division 26 - Electrical.

1.2 PROJECT REQUIREMENTS

- A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.3 SUBMITTALS

- A. Shoring calculations as required in Article 3.03 of this Section.

1.4 QUALITY ASSURANCE

- A. Comply with the Standard Specifications for Public Works Construction, current edition, except as modified herein.
- B. Sampling, testing, and certification of imported and exported soils shall be performed in accordance with Section 01 4524, Environmental Import/Export Materials Testing.

1.5 TESTING

- A. OWNER will retain a Geotechnical Engineer as an OWNER Consultant who will provide observations, tests, inspections, and approvals identified in the Contract Documents as being the responsibility of OWNER.
- B. Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.05 of this Section.

1.6 PROJECT CONDITIONS

- A. Information on Drawings or in soil investigation report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

PART 2 - PRODUCTS

2.01 FILL AND BACKFILL MATERIALS

- A. Fill and backfill material shall be a granular material previously removed from excavation or imported fill material, free of clods and stones larger than 3 inches, (2½ inches for utility trenches) foreign materials, vegetable growths, sod, expansive soils, rubbish, and debris. Material shall conform to these specified requirements and related sections.
- B. Fill material exhibiting a wide variation in consistency and moisture content shall be blended and aerated to stabilize and upgrade the material.
- C. Bedding material from trench bottom to one foot above the pipe:
 1. Sand, gravel, crushed aggregate or native free-draining granular material providing a sand equivalent of at least 30 or a coefficient of permeability greater than 1.4 inches per hour.

2. Sand complying with the Specifications for cement concrete aggregates.
- D. Brick rubble and broken concrete originating from the Project site shall be legally disposed of off the Project site No such material shall be imported from outside the Project site.
- E. Permeable Backfill:
 1. Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations of these materials conforming to the following gradations:

<u>Sieve Size:</u>	<u>Percentage Passing:</u>
3/4 inch (19mm)	100
3/8 inch (10mm)	80 to 100
No. 100	0 to 8
No. 200	0 to 3
 2. Those portions of fill material passing a No. 4 sieve shall provide a sand equivalent of at least 60.
 3. Provided backing for weepholes shall consist of two cubic feet of aggregate in burlap sacks, securely tied. Aggregate shall conform to requirements for No. 3 concrete aggregate as specified in subsection 200-1.4 of the Standard Specifications for Public Works Construction.
 4. Permeable Backfill Alternate Materials: Instead of the materials specified for retaining structures backfill, a drainage matting system Miradrain by Mirafi, Inc., American Wick Drain, JDR Enterprises, or equal, may be provided if reviewed and approved by the ENGINEER.
- F. Cement-sand slurry shall be provided with one sack of cement per cubic yard of the mixture.

2.2 BASE MATERIALS

- A. Concrete Slabs on Grade: Provide "Crushed Aggregate Base" as specified in Standard Specifications for Public Works Construction, Section 200 - Rock Materials, with 3/4 inch maximum size aggregates. Provide 3-inch-thick base, unless noted otherwise.
- B. Bituminous Surfacing: Provide as indicated on Drawings and specified in Section 31 2326 Base Course.

PART 3 - EXECUTION

3.01 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be

forwarded to the OWNER. For on-site utilities, retain a state-licensed third party underground utility locating service.

- B. Where the Work includes a building extension or addition on an occupied Project site, perform Work in such a manner, and at such times, as not to disrupt performance of existing utility services to existing Project site facilities. Where an interruption is necessary, obtain review from the OAR before proceeding.
- C. Remove concrete or bituminous pavement to straight lines by saw cutting.

3.02 PROTECTION

- A. Protect and guard excavations against danger to life, limb, and property as required by, but not limited to, OSHA regulations.
- B. Protect existing improvements including landscaping against damage. Repair or replace damaged items.
- C. Protect existing utility services and distribution systems from damage or displacement.
- D. Remove conduits or pipes not in service, exposed during Work, unless a minimum cover of two feet is provided. Remove concrete, clay or other non-metallic pipe over 8 inches in diameter, unless otherwise indicated.
- E. Shore, crib, or lag excavations and earthen banks as necessary to prevent cave in, erosion or gulying of sides.
- F. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed earth and fill as required. Slope adjacent grades away from excavations to minimize entry of water.

3.03 SHORING

- A. Provide shoring as necessary to properly and safely support earth sides of excavations, and existing curbs, sidewalks, gutter, drives and stairs, against movement and collapse.
- B. Design and Calculations: Provide in accordance with requirement of governing Cal-OSHA requirements.
- C. Remove shoring upon completion of the Work of this Section or when no longer needed unless required otherwise by authorities having jurisdiction.

3.04 EXCAVATION

- A. Unclassified Excavations: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork", except as modified herein.
- B. Form sides of footings, pads, grade beams, and slab foundations, unless otherwise indicated. Provide excavations of sufficient size to permit installation and removal of forms and other required Work.

- C. Machine-drill excavation for round footings to size and depth indicated. Provide a collar or casing, or other adequate protection, to exclude dirt and debris. Protect excavations with plank covers until concrete is placed.
- D. Provide excavation bottoms level and free from loose material. Excavate to indicated or required elevations of undisturbed earth.
- E. Barricade trenches, ditches, pits, sumps, and similar Work outside the barricaded working area with chain link fence as specified in Section 01 5000 - Construction Facilities and Temporary Controls, and in accord with Cal-OSHA standards and requirements.
- F. Trenches over five feet in depth shall comply with the Construction Safety Orders of the California Division of Industrial Safety.
- G. Where indicated or required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.
- H. For Structures:
1. Calculate excavation quantities based on elevations or depths indicated on Drawings.
 2. Provide 2,000 psi concrete for backfill of over-excavated areas to indicated or required elevations.
 3. Special preparation of bottom of excavated planes areas: Excavate areas shown on Drawings as bottom of excavated planes (B.E.P.), by excavating and filling to indicated grades and elevations.
- I. For Utilities:
1. Excavate trenches to required depth for utility lines, such as pipes, conduits, and tanks, with minimum allowance of 6 inches at the bottom and 6 inches at the sides for bedding or concrete encasement as indicated on Drawings. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before placing sand bedding or concrete encasement.
 2. Do not install piping lengthwise under concrete walks without review by the ENGINEER.
 3. Do not excavate trenches parallel to footings closer than 18 inches from the face of the footing or below a plane having a downward slope of two horizontal to one vertical, from a line 9 inches above bottom of footings.
 - a. Unless otherwise indicated on Drawings, depth of excavations outside buildings shall provide for a minimum coverage above top of piping, tank or conduit measured from the lowest adjoining finished grade, as follows:

Steel Pipe	24 inches below finish grade
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Copper Water Tube	18 inches below finish grade
Cast-Iron, Pressure Pipe	36 inches below finished grade
Plastic Pipe (other than waste)	30 inches below finished grade
Tanks or other structure	36 inches below finished grade
Soil, sewer and storm drain	minimum 18 inches below finished grade, and as required for proper pitch and traffic load. Install polypropylene sewer pipe with at least 24 inches of coverage.
Irrigation Pipe:	Non-pressure pipe - 12 inches, pressure pipe - 24 inches.

- b. Trench width shall provide space for fitting and joining. Excavate for piping bells and fittings, bell and spigot pipe and other fittings.
- 4. Where portions of existing structures, walks, paving, or other improvements are removed or cut for piping or conduit installation, replace the material with equal quality, finished to match adjoining existing improvements. Repair pavement as specified in Section 32 0117 - Pavement Repair.
- 5. Provide a minimum clear dimension of 2 inches from sides of wall excavation to outer surfaces of buried pipes or conduits placed in the same trench or outside surfaces of containers and tanks.

3.05 IMPORT/EXPORT OF MATERIALS

- A. Unclassified Fill and Compaction: Comply with the Standard Specifications for Public Works Construction, Section 300 - Earthwork, except as modified herein. Install and compact fill in layers not to exceed 6 inches in thickness.
- B. Provide fill materials as specified in Part 2- Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- C. In addition to the requirements of this Section, import and/or exported materials shall comply with the requirements of Section 01 4524, Environmental Import/Export Materials Testing.
- D. Imported fill materials shall be sampled by the Geotechnical Engineer, for compliance with the requirements of Part 2 of this Section.
- E. The Geotechnical Engineer, will submit the samples to an independent DSA approved testing laboratory for testing.
- F. Initial sampling and testing shall be performed before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and entity responsible for the source site. The Geotechnical Engineer, will obtain both the initial and additional samples from the identified site and submit samples for required testing.

- G. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.
- H. The independent approved testing laboratory will perform the required tests and report results of tests noting if the tested material passed or failed such tests and will furnish copies to the Project Inspector, ENGINEER, CONTRACTOR, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents and California Building Code.
- I. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
- J. Upon completion of import operations, provide the OAR a certification statement attesting that imported material has been obtained from the identified source site.

3.06 INSTALLATION OF MATERIALS

- A. Pavement: Fill or backfill materials shall be installed in horizontal layers of 6 inches, unless otherwise required. Each layer shall be evenly placed and moistened or aerated as necessary. Unless otherwise reviewed by the Geotechnical Engineer, each layer of fill material shall cover the length and width of the area to be filled before the next layer of material is installed. Top surface of each layer shall be installed to an approximate level with a crown or crossfall of at least 1 in 50, but not more than 1 in 20. Provide adequate drainage at all times during installation of the Work of this Section.
- B. Structures:
 - 1. After concrete has been placed, forms removed, and concrete Work inspected, backfill excavations with earth to indicated or required grades. Backfill simultaneously on each side of walls or grade beams. Remove rubbish, debris and other waste materials from excavations before placing backfill.
 - 2. Before placing backfill, adequately cure concrete and provide bracing, if required to stabilize structure. Protect waterproofing or damp-proofing against damage during backfilling operations, with required protection board. Remove bracing as backfill operation progresses.
 - 3. Do not furnish or install expansive soils for retaining wall backfill.
 - 4. Rigidly control the amount of water to be installed to provide optimum moisture content for type of fill material furnished. Do not over-saturate or compact by flooding or jetting.
 - 5. Install wall backfill before installing railings and fences on walls.

6. Install weep hole drainage at the backside of walls so the backing completely covers the weep holes, is horizontally centered and extends at least 12 inches above the bottom of the weep opening. Provide an 8-inch square section of 1/4 inch galvanized or aluminum screen, with a minimum wire diameter of 0.03 inch, and install at the backside of each weep hole before installing the backfill material.
 7. Where a reviewed drainage matting system is provided instead of permeable backfill for retaining structures, install in accordance with the manufacturer recommendations.
- C. Utilities:
1. Do not install backfill until the Work of this Section has been inspected and tested. Do not furnish or install materials excavated from the Project site containing materials not permitted for backfill.
 2. Backfill electrical or other excavated utility trenches located outside of barricaded installation areas within 24 hours after inspection by the IOR.
 3. Install backfill in layers not exceeding 4 inches in thickness, except cement-sand slurry.
 4. If materials excavated from the Project site are not permitted for trench backfill in paved areas, backfill trenches with a cement-sand slurry mix. Install backfill to an elevation of the existing undisturbed grades plus one inch.

3.07 COMPACTING

- A. Each layer of fill material shall be compacted by tamping, sheepsfoot rollers, or pneumatic-tired rollers to provide specified relative compaction. At inaccessible locations, provide specified compaction by manually held, operated and directed compaction equipment.
- B. Install and compact sand bedding to provide a uniform bearing under the full length of piping and conduits.
- C. Unless otherwise indicated, compact each layer of fill material to a relative compaction of at least ninety percent.
- D. When fill materials, or a combination of fill materials, are encountered or provided which develop densely packed surfaces as a result of installation or compacting operations, scarify each layer of compacted fill before installing the next succeeding layer.

3.08 INSPECTION AND TESTING

- A. The Geotechnical Engineer will inspect and test excavations, sample material quality for testing as set required in Part 2, and observe installation and compaction of fill materials.

- B. The Geotechnical Engineer will sample imported fill materials from their designated source and submit samples to the independent approved testing laboratory before delivery to the Project site.
- C. Installation of backfill shall be observed by the Geotechnical Engineer.
- D. The Geotechnical Engineer will inspect and test excavation Work before the installation of fill and other materials.
- E. Compaction: Test compaction in accordance with ASTM D1557, Method C.
- F. The Project Inspector will inspect foundation excavations when completed and ready for forms, after forms are in place, and before first placement of concrete.

3.09 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

3.10 CLEANING

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 31 2323
EXCAVATION AND FILL FOR UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Excavating, backfilling, and compacting utility trenches such as water, gas, irrigation, storm drain, sewer lines, concrete-encased conduits, and manholes, vaults, valve boxes, catch basins, underground tanks, thrust blocks, yard boxes, pull boxes and other utility appurtenances.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 32 0117 - Pavement Repair.
3. Section 32 1313 - Site Concrete Work.
4. Section 33 3000 - Site Sanitary Sewer Utilities.
5. Section 33 4000 - Storm Drainage Utilities.
6. Division 22 - Plumbing.
7. Division 26 - Electrical.

1.02 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.03 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications for Public Works construction, current edition except as modified herein.

- B. Sampling, testing, and certification of imported and/or exported soils shall be performed in accordance with Section 01 4524 - Environmental Import/Export Materials Testing.

1.04 TESTING

- A. OWNER will retain a Geotechnical Engineer as an OWNER Consultant who will provide observations, tests, inspections, and approvals identified in the Contract Documents as being the responsibility of OWNER.
- B. Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.02 of this Section.

1.05 PROJECT CONDITIONS

- A. Information on Drawings or in soils report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Bedding material from trench bottom to one foot above the pipe:
 - 1. Sand, gravel, crushed aggregate or native free-draining granular material providing a sand equivalent of at least 30 or a coefficient of permeability greater than 1.4 inches per hour.
 - 2. Sand complying with the Specifications for cement concrete aggregates.
- B. Backfill Materials:
 - 1. Excavated trench material to be installed for backfilling shall be clean, free of large clods, and stones larger than 2 ½-inch in any dimension.
 - 2. Cement-sand slurry shall be provided with one sack of cement per cubic yard of the mixture.
 - 3. Imported Fill Material: Imported fill material shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing a 200-mesh sieve. Material shall provide a coefficient of expansion of not more than two percent from air dry to optimum moisture content and not more than six percent from air dry to saturation. Imported materials shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

PART 3 - EXECUTION

3.01 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be forwarded to the OWNER. For on-site utilities, retain a state-licensed third party underground utility locating service.
- B. Barricade trenches, ditches, pits, sumps, and similar Work outside the barricaded working area with chain link fence as specified in Section 01 5000, Construction Facilities and Temporary Controls, and in accordance with Cal-OSHA standards and requirements.
- C. Saw-cut concrete or bituminous paving for trench installation.
- D. Trenches over 5 feet in depth shall conform to the Cal-OSHA.
- E. Where indicated and required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.
- F. Backfill over excavations to the required elevations with earth, gravel, sand, or concrete and compact as required. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. Slope adjacent grades away from excavations to minimize entry of water.
- G. Do not install piping lengthwise under concrete walls without review by the ENGINEER.
- H. Do not excavate trenches parallel to footings closer than 18 inches from the face of the footing or below a plane having a downward slope of two horizontal to one vertical, from a line 9 inches above bottom of footings.
 - 1. Unless otherwise indicated on Drawings, depth of excavations outside the buildings shall allow for a minimum coverage above top of pipe, tank, or conduit measured from the lowest adjoining finished grade, as follows:

Steel Pipe	24 inches below finished grade
Copper Water Tube	18 inches below finished grade
Cast-Iron Pressure Pipe	36 inches below finished grade
Plastic Pipe (other than waste)	30 inches below finished grade
Tanks or other structures	36 inches below finished grade
Soil, Sewer & Storm Drain	minimum 18 inches below finished grade, and as required for proper pitch and traffic load. (Install polypropylene

Irrigation Pipe: sewer pipe with at least 24 inches coverage)
nonpressure pipe 12 inches, pressure pipe 24 inches

2. Trench width shall provide ample space for fitting and joining. Excavate for piping bells and fittings, bell and spigot pipe and other fittings.
 - I. Unless indicated otherwise, excavate trenches to the required depths for utilities, such as pipes, conduit and tanks, with minimum allowances of 6 inches at the bottom and 6 inches at the sides for bedding of unprotected piping or as required for concrete encasement of conduits as indicated on Drawings. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before installing sand bedding or concrete encasement.
 - J. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed soil and fill as required. Slope adjacent grades away from excavations to minimize entry of water.
 - K. Provide a minimum clear dimension of 2 inches from sides of wall excavation to outer surfaces of buried pipes or conduits installed in the same trench or outside surfaces of containers and tanks.
 - L. Do not install backfill until required inspections and testing is completed.
 - M. Backfill electrical or other excavated utility trenches located outside of barricaded installation areas within 24 hours after inspection by the Project Inspector.
 - N. Install backfill materials in layers not exceeding 6 inches in thickness and compact to 90 percent of the maximum density.
 - O. If materials excavated from the Project site are not permitted for trench backfill in paved areas, backfill trenches with a cement-sand slurry mix. Install backfill to an elevation of the existing undisturbed grade plus one inch.
 - P. Install and compact sand bedding to provide a uniform full length bearing under piping and conduits.
 - Q. Where portions of existing structures, walks, paving, or other improvements are removed or cut for piping or conduit installation, replace the material with equal quality, finished to match adjoining existing improvements. Repair pavement as specified in Section 32 0117, Pavement Repair.

3.02 IMPORT/EXPORT OF MATERIALS

- A. Provide fill materials as specified in Part 2, Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- B. In addition to the requirements of this Section, import and exported materials shall comply with the requirements of Section 01 4524, Environmental Import/Export Material Testing.
- C. Imported fill materials will be sampled by the Geotechnical Engineer for compliance with the requirements of Part 2 of this Section.
- D. The Geotechnical Engineer will perform the tests by utilizing an independent approved testing laboratory.
- E. Initial sampling will be performed by the Geotechnical Engineer before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The Geotechnical Engineer will obtain both the initial sample and additional samples from the identified site and shall submit all samples to the approved independent testing laboratory.
- F. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.
- G. The independent approved testing laboratory will perform the required tests and report results of all tests noting if the tested material passed or failed such tests and will furnish copies to the Project Inspector, ENGINEER, OAR, DSA, CONTRACTOR, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, CBC and the DSA. Upon completion of the Work of this Section, the independent testing laboratory and Geotechnical Engineer will submit a verified report to the DSA as required by CBC.
- H. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
- I. Upon completion of import operations, provide the OAR a certification statement attesting that imported material has been obtained from the identified source site.

3.03 INSPECTION AND TESTING

- A. The Geotechnical Engineer will inspect and test excavations, sample material quality as required in Part 2, observe installation and compaction of fill materials.
- B. Compaction test shall be performed in accordance with ASTM D1557, method "C."

3.04 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

3.05 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 32 0117
ASPHALT PAVEMENT REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bituminous Surfacing Repair: Areas removed for utility trenches, heaved by tree roots, cracked areas, protruding areas where pavement meets hard surfaces, depressed areas, holes, and areas around new structures, and raveled bituminous pavement.
2. Areas heaved by tree roots, cracked areas, holes and trenches, and areas around new structures.

B. Related Sections:

1. Division 01 - General Requirements.
2. Section 01 3593 - Off-site Improvement Procedures.
3. Section 31 2200 - Grading.
4. Section 31 2313 - Excavation and Fill.
5. Section 31 2323 - Excavation and Fill for Utilities.
6. Section 32 1216 - Asphalt Paving.
7. Section 32 1313 - Site Concrete Work.

1.2 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating areas to be repaired.
- B. Product Data: Submit manufacturer's technical data for materials and products.

1.3 QUALITY ASSURANCE

- A. Comply with Standard Specifications for Public Works Construction, current edition.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Asphalt paving materials: Section 32 1216 - Asphalt Paving.
- B. Headers: Section 32 1216 - Asphalt Paving.

2.2 BITUMINOUS MATERIALS

- A. Provide materials and products of the class, grade or type indicated, conforming to relevant provisions of Section 203 - Bituminous Materials of the latest Standard Specifications for Public Works Construction.

PART 3 - EXECUTION

3.1 PAVEMENT REMOVAL

- A. Remove bituminous and concrete pavement in accordance with applicable provisions of Section 300 - Earthwork of the Standard Specifications for Public Works Construction.
- B. Pavement Heaved By Roots: Remove pavement to limits of distortion and expose roots. Trim roots to provide at least 12-inch clearance to pavement.
- C. Remove protruding bituminous surfaces flush with the surrounding grade using a suitable tool or equipment so that adjacent finishes are not blackened.
- D. Remove raveled and depressed bituminous pavement to limits indicated or required.
- E. Saw cut existing improvements, trim holes and trenches in bituminous and concrete pavement to permit mechanical hand tampers to compact the fill.
- F. Remove broken concrete by saw cutting. If the required cut line is within 30 inches of a score or joint line or edge, cut and remove to the score, joint line, or edge.

3.2 EXCAVATING, BACKFILLING AND COMPACTING

- A. Conform to requirements in Section 31 2313 - Excavation and Fill; Section 31 2316 - Excavation and Fill for Paving; Section 31 2319 - Excavation and Fill for Structures; or Section 31 2323 - Excavation and Fill for Utilities, as required.
- B. Where subgrade or base is deemed to be unstable or otherwise unsuitable, excavate such materials to firm earth, and replace with a required material. Install and compact fill materials in accordance with the requirements of related Specification sections.

3.3 HEADERS

- A. Install headers along edge of bituminous surfacing abutting turf, earth, or planting area, unless indicated otherwise.

- B. Install headers so the bottom surface has continuous bearing on solid grade. Where excavation for headers is undercut, thoroughly tamp soil under the header. Compact backfill on both sides of header to the density of the adjacent undisturbed grade.
- C. Fasten headers in place with redwood or Douglas fir stakes of length necessary to extend into solid earth a minimum of 12 inches. Stakes shall be of sound material, neatly pointed, driven vertically, and securely nailed to headers. Space stakes, not to exceed 4 feet on centers with top of stakes set one inch below top of header. Provide a minimum of two 12d galvanized common nails through each stake.
- D. Remove existing headers where new surfacing is installed adjacent to existing surfacing.
- E. Install temporary headers at transverse joints of paving where continuous paving operations are not maintained.
- F. Provide additional stakes and devices as required to fasten headers.

3.4 BASE COURSE

- A. Unless otherwise indicated, base course shall be crushed aggregate base, fine grade, 3 inches thick or equal to thickness of the existing base, whichever is greater.
- B. Fill grade and compact as specified in Section 31 2200 - Grading.

3.5 RESURFACING

- A. Holes and Trenches: Remove loose dirt and backfill with cement-sand slurry allowing for surfacing one inch thicker than existing. Resurface flush with existing adjoining pavement installing the same type of materials and section provided in existing improvements.
- B. Other Areas: Other surface improvements damaged or removed shall be cut to a neat even line and excavated one inch below the bottom of the existing pavement. Resurface by following the original grades and installing the same type of materials provided in existing improvements.
- C. Where bituminous surfacing abuts concrete, masonry, walks or paving, tamp joint smooth, if necessary, as described above to obtain a uniformly even joint, true to line and grade. Tamp and smooth materials before asphalt cools.

3.6 REPAIRING AND RESEALING EXISTING SURFACES

- A. Preparation of Surfaces: Prior to filling cracks, clean existing bituminous surface of loose and foreign materials and coat with a film of asphalt emulsion.
- B. Repair of Existing Surfacing:

1. Fill cracks $\frac{1}{2}$ inch wide and less with RS-1 emulsion and silica sand or other required material. Cracks larger than $\frac{1}{2}$ inch wide shall be filled with Type C2 Asphalt Concrete as specified. Cracks shall be filled to the level of adjacent surfacing.
 2. Where low areas, holes, or depressions occur in existing surfacing, repair with emulsified asphalt. Install material, strike off the emulsified asphalt with a straightedge flush with adjoining surfacing. Finish with a steel trowel, and after dehydration, compact by rolling or tamping.
- C. Testing: Flood test entire area in presence of the Project Inspector. The entire area tested shall be free of standing water or puddles.
- D. Surface Seal: After the surface has been repaired and tested, install seal coat over entire area indicated. Surface seal shall be as specified in Section 32 1236 - Seal For Bituminous Surfacing.

3.7 CLEANING

- A. Remove all stains on the Project site and adjacent properties caused by or attributed to the Work of this section.
- B. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.08 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Material requirements for aggregate base courses, to be furnished and placed to lines, grades, and dimensions in accordance with drawings, specifications, and directions of PFMD Project Manager.
- A. Related Sections:
 - 1. Section 32 12 16, Asphalt Paving.
 - 2. Section 32 13 13, Concrete Paving

1.02 REFERENCE STANDARDS

- A. ASTM: ASTM International.
- B. Caltrans: State of California Department of Transportation, Standard Specifications.
- C. Standard Specifications for Public Works Construction (SSPWC), 2022.

1.03 SUBMITTALS

- A. Submit under Section 01 33 00, Submittal Procedures.
- B. Compliance: Supplier's certification that material delivered to the site is in compliance with the specifications.
- C. Samples: As required by PFMD Project Manager, samples of not less than 150 lbs. Samples may be obtained independently by PFMD Project Manager's representative for testing to determine whether material delivered to the site is in compliance with specifications.
- D. Equipment: List of all equipment used for placing and compacting sub-ballast.

1.04 QUALITY CONTROL

- A. Provide and install materials in compliance with applicable sections of reference standards.
- B. Establish and maintain required lines and elevations.

1.05 GEOTECHNICAL REPORTS – NOT APPLICABLE

- A. Soil borings have been made and subsurface conditions at the sites have been investigated. Refer to the following report:
 - 1. Not applicable.
- B. Copies of the reports are available for reference at the offices of the PFMD.
- C. The geotechnical reports are not intended to convey or imply any warranty or guarantee as to variation of subsurface between borings, or variations of ground water level. Although the requirements of these specifications are based upon recommendations of the referenced reports, the reports are made available to the Contractor for reference only and are not a part of the Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIAL REQUIREMENTS

- A. Aggregate base shall conform to the requirements for Class 2 Aggregate Base in Section 26-1.02A of the Caltrans Standard Specifications. Aggregate may contain material processed from reclaimed asphalt concrete, Portland cement concrete, lean concrete base, cement treated base or a combination of any of these materials. The amount of the reclaimed material shall not exceed 50% of the total volume of the aggregate used.
- B. The aggregate shall conform to the grading and quality requirements in the tables Section 26-1.02A. Aggregate shall be graded for 1-1/2 maximum size aggregate.

PART 3 - EXECUTION

3.01 AGGREGATE BASE

- A. Aggregate base shall not be spread until PFMD Project Manager has approved the earthwork and compacted sub-base.
- B. Spread and compact aggregate base in conformance with the requirements of Caltrans Standard Specifications Section 26. Compaction shall be to a minimum of 95 percent relative density per ASTM D 1557. The maximum lift is 6 inches.
- C. The surface of the aggregate base shall be stable to permit follow-on stages of construction without rutting.
- D. Aggregate base shall be finished to within 0.05 feet of the lines and grades indicated on the drawings and shall be maintained in a condition acceptable to PFMD Project Manager until paving material has been placed and approved.

3.02 SUBGRADE PREPARATION

- A. Immediately before spreading the aggregate base, the subgrade must comply with the specified compaction and elevation tolerance for the material involved and be free from loose or extraneous material.
- B. Areas of the subgrade lower than the grade may be filled with aggregate base.
- C. Subgrade shall be compacted per SSPWC Section 301, Treated Soil, Subgrade Preparation, and Placement of Base Materials.

PART 4 - MEASUREMENT AND PAYMENT

No separate measurement or payment shall be made under this Section.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Preparation, placement, and compaction of asphaltic concrete, including seal coat, tack coat, base course, and wearing course.
 2. Cold milling (grinding) of existing asphalt concrete pavement.
 3. Adjusting utility manholes, vault covers, valve boxes etc. to finished grade.

1.02 REFERENCE STANDARDS

- A. SSPWC: Standard Specifications for Public Works Construction, Section 203-6, Asphalt Concrete.
- B. Caltrans: State of California Department of Transportation, Standard Specifications
- C. ASTM: ASTM International (formerly American Society for Testing and Materials).

1.03 SUBMITTALS

- A. Submit under Section 01 33 00, Submittal Procedures.
- B. Test reports from an independent laboratory for materials and mix designs or proof that mix designs and all materials are currently approved for use as asphaltic concrete pavement by Caltrans.
- C. A 75-lb. sample of representative aggregate retained on the No. 4 sieve and a 3-pound sample of the representative aggregate passing the No. 4 sieve for testing of aggregate quality.
- D. Tests reports for field density tests performed after placement and compaction of each course of asphaltic concrete.
- E. List of equipment to be used for the placing, spreading, and compaction of asphaltic concrete paving. Only equipment approved by SBC Project Manager shall be used.

1.04 QUALITY ASSURANCE

- A. Maintain in good operating condition equipment used for handling materials, mixing, placing, and compacting. SBC Project Manager may reject equipment found to produce work that does not meet requirements indicated in the contract documents. Equipment shall meet requirements specified in Caltrans Standard Specifications, Section 39-5.
- B. Legally dispose of all on-site and off-site waste material produced as a result of Contractor's operations. The cost of disposal for waste will be considered incidental to the cost of construction and no additional payment will be made for performing this work. Remove waste materials from SBC's property within 2 weeks of the work and, if necessary to protect existing soils from contamination, install an impermeable barrier to protect existing subgrade and runoff.
- C. Density of asphaltic concrete will be measured using nuclear density methods in accordance with ASTM D 2950 at the time of placement.
- D. Density tests shall be performed by the SBC's independent laboratory.
- E. Provide SBC Project Manager access for sampling stockpiles, hot bin analyses, and other tests.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials shall meet requirements of referenced standards.
- B. Aggregate: Type A per Caltrans Standard Specifications, Section 39, Asphalt Concrete.
- C. Asphalt: Steam refined paving asphalt per SSPWC Section 203, grade as follows:
 - 1. Parking areas: PG 70-10.
- D. Asphaltic Concrete Mixture: Conforming to Type C2 per SSPWC Section 203-6.4 and Table 203-6.4.3 (A).
- E. Tack Coat: PG 70-10 paving asphalt applied at an approximate rate of 0.05 gallons per square yard.
- F. Seal Coat – the sealer shall be applied to the pavement at a minimum rate of 50 gallons per 1000 square feet per SSPWC Section 302-8 Sealcoat for Miscellaneous Areas.

PART 3 - EXECUTION

3.01 GENERAL

- A. Subgrade, aggregate base, curbs, gutters, and drains shall be approved by SBC Project Manager before asphalt-paving operations are started.
- B. Mixing plants shall conform to the requirements of Caltrans Section 39-3.04, Mixing, and 39-3.06 Asphalt Concrete Plants.
- C. Verify utility locations before driving stakes or pins.
- D. Trucks used for transporting asphaltic concrete mixtures shall have smooth, clean, tight metal beds. Beds shall be sprayed with a minimum amount of paraffin oil or other approved release agent. Before loading with asphaltic concrete, drain off excess oil.
- E. Construction procedures and requirements shall conform to SSPWC Section 302-5, Asphalt Concrete Pavement.
- F. Material shall be rolled until it reaches minimum 95 percent relative compaction based on field density tests using a properly calibrated nuclear asphalt-testing device.
- G. All asphalt pavement shall be of the thickness shown on the drawings. Total thickness shall be attained per SSPWC Section 302-5.5, Distribution and Spreading.
- H. Application of sealcoat shall be per SSPWC Section 302-8.2.
- I. Cold milling of existing asphalt concrete shall be per SSPWC Section 302-1 Cold milling of existing pavement.
- J. Manhole frame and cover, and other utility valve boxes, pull boxes etc. shall be adjusted to finished grade per SSPWC Section 301-1.6 after the paving operations are complete.

PART 4 - MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for the work of this section.

END OF SECTION

SECTION 32 1313
SITE CONCRETE WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: On-site concrete work:
1. Portland cement concrete pavement, driveways, curbs, gutters and mowing strips.
 2. Ramps and stairs on grade.
 3. Footings for fence post, bollards, flagpoles, light standards, and athletic equipment.
 4. Pipe encasements, thrust blocks, and equipment pads.
 5. Retaining walls, planter walls and concrete benches.
 6. Skateboard deterrents.
- B. Related Requirements:
1. Division 01 - General Requirements.
 2. Section 03 11 00 – Concrete Forming and Accessories.
 3. Section 03 21 13 – Reinforcement Steel Bars.
 4. Section 03 30 00 – Cast-in-Place Concrete.
 5. Division 26 - Electrical.
 6. Section 31 23 13 - Excavation and Fill.
 7. Section 31 23 23 – Excavation and Fill Utilities.
 8. Section 32 12 16 - Asphalt Paving.
 9. Section 32 17 23 – Pavement Markings.
 10. Section 33 3000 - Site Sanitary Sewer Utilities.

1.2 REFERENCES

- A. Structural work, such as retaining walls, planter walls, cast-in-place benches, equipment, fence and flagpole footings, and equipment pads, conform to the following Sections:
 - 1. Section 03 1000 Concrete Forming.
 - 2. Section 03 2000 Concrete Reinforcing.
 - 3. Section 03 3000 Cast-in-Place Concrete.
- B. Flatwork, such as walkways, driveways, ramps and steps on grade, swales, curbs, mow strips and utility related concrete, conform to:
 - 1. Standard Specifications for Public Works Construction, the "Greenbook", except reclaimed aggregates and processed miscellaneous base are not allowed.
- C. Imported or exported earthwork shall conform to Section 01 4524 Environmental Import / Export Materials Testing.
- D. National Ready Mixed Concrete Association (NRMCA):
 - 1. Checklist for the Concrete Pre-Construction Conference.

1.3 QUALITY ASSURANCE

- A. Source Limitations for Exposed Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties. Secure material required for the duration of the project as needed to ensure consistent quality in appearance.
- B. Pre-Installation Conference:
 - 1. CONTRACTOR shall coordinate and conduct pre-installation conferences in conformance to Section 01 3119 Project Meetings.
 - 2. CONTRACTOR shall use the NRMCA "Checklist for the Concrete Pre-Construction Conference" as the meeting agenda.
- C. Mockup:
 - 1. Build 8 feet by 8 feet mockups of full-thickness sections of concrete paving using processes and techniques intended for use on permanent work, including curing procedures.
 - 2. Build mockups to demonstrate typical joints, surface finishes and standard of workmanship.

3. Obtain ENGINEER's approval of mockup before proceeding with work of this Section.
 4. Mockup shall remain through completion of the work for use as a quality standard for finished work.
 5. Remove mockup when directed by the OAR.
- D. Field applied primers, paintings, sealers, sealants, caulking, leveling and patching compounds, crack/joint repair compounds adhesives and similar products shall be approved by the OWNER's Office of Environmental Health and Safety (OEHS).

1.4 SUBMITTALS

- A. Structural Work: Conform to the applicable requirements of Sections 03 1000 Concrete Forming, 03 2000 Concrete Reinforcing and 03 3000 Cast-in-Place Concrete.
- B. Flatwork: Submit mix design in conformance to the Greenbook.
- C. Shop Drawings: Submit drawings indicating the locations of concrete joints, including construction joints, expansion joints, isolation joints, and contraction joints.
- D. Submit concrete Sample of each specified color.
- E. Submit full range of manufacturer's standard and custom range colors and products for ENGINEER's review and selection.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store cement and aggregate materials so to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.
- B. Packaged materials shall bear the manufacturers and brand name label and shall be stored in their original unbroken package in a weather tight place until ready for use in the work.
- C. Avoid exposure of reinforcing steel bars, wire, and wire fabric to dirt, moisture or conditions harmful to reinforcing.
- D. Reinforcing steel bars, wire, and wire fabric shall be stored on the Project site to permit easy access for examination and identification of each shipment. Material of each shipment shall be separated by size and shape.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Work: Conform to the applicable requirements of the following Sections, except as otherwise specified:
 - 1. Section 03 1000 Concrete Forming.
 - 2. Section 03 2000 Concrete Reinforcing.
 - 3. Section 03 3000 Cast-in-Place Concrete.
 - 4. Section 07 9200 Joint Sealants.
- B. Flatwork: Conform to the applicable requirements of the Greenbook, Section 201.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that gradients and elevations of base are correct. Maintain subgrade clean and in a smooth, compacted condition until the concrete is placed.
- B. Maintain subgrade in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. Earth surface shall be kept moist by frequent sprinkling up to the time of placing concrete.

3.02 CONSTRUCTION OF FORMS

- A. Flatwork Forming: Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 4 stakes per form placed at intervals not to exceed two feet. Use additional stakes and braces at corners, deep sections, and radius bends, as required. Use clamps, spreaders, and braces where required to ensure rigidity in the forms.
- B. Wall Formwork: Forms shall be constructed to conform to final concrete shape, lines and dimensions of members required by Drawings and Specifications. Forms shall be sufficiently tight to prevent leakage of concrete and properly braced or tied together to maintain position and shape.

3.03 STEEL REINFORCEMENT INSTALLATION

- A. Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement

for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are not permitted.

- B. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- C. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces, and lace splices with wire.
- D. Clean reinforcement of loose rust and mill scale, earth, or bond-reducing materials.

3.04 PREPARATION FOR CONCRETE PLACEMENT

- A. Surfaces to receive concrete shall be free of debris, standing water, and any other deleterious substances before start of concrete placing.
- B. Do not place concrete until forms, reinforcement, pipe, conduits, outlet boxes, anchors, sleeves, bolts, and other embedded materials are securely fastened in place. Maintain a minimum of two inches clearance between said items and any part of the concrete reinforcement.
- C. Adjust pull boxes, meter boxes, valve covers and manholes to proposed finish grade prior to placement of concrete. Anchor bolts shall be accurately set and maintained in position by templates while being embedded in concrete.
- D. Clean thoroughly the surfaces of metalwork to be in contact with concrete, remove dirt, grease, loose scale and rust, grout, mortar, and other foreign substances before the concrete is placed.
- E. Moisten subbase to provide a uniform dampened condition at time concrete is placed.

3.05 CONCRETE PLACEMENT

- A. Place, compact, screed, float and trowel concrete as indicated in Section 03 3000 Cast-in-Place Concrete.
- B. Finish: After straight edging, when most of the water sheen has disappeared and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. Produce a scored surface by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.
 1. Provide medium broom finish on surfaces up to six percent slope by striating surface 1/32 to 3/64 inch deep with a soft bristle broom across concrete surface to provide a uniform fine line texture.

2. Provide heavy broom finish on surfaces over six percent by striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom.

3.06 JOINTS

- A. Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated. Align curb, gutter, and sidewalk joints.
- B. Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour.
 1. Continue steel reinforcement across construction joints unless otherwise indicated on the Drawings.
 2. Provide tie bars at sides of paving strips as indicated on the Drawings.
 3. Butt Joints: Use bonding agent or epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated on the Drawings.
- D. Expansion Joints:
 1. Provide pre-molded joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together. Extend expansion joint fillers full-width and depth of joint, and 1/4" below finished surface where joint filler is indicated. If no joint sealer is indicated, place top of pre-molded joint filler flush with top of concrete or curb.
 2. During concrete placement, protect the top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints to a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Remove grooving-tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- F. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Remove edging-tool marks on concrete surfaces.
- G. Where concrete is to be cast against old concrete, (greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by sandblasting, exposing the aggregate. The hardened surface shall be cleaned of latent foreign material and washed clean, prior to the application of an epoxy bonding agent.

3.07 STAIRS AND RAMPS

- A. Install support post sleeves into the perimeter concrete curbing during the installation process of the curbing. Sleeves shall be three-inch diameter, schedule 40 PVC with a cap solvent welded to the bottom of the sleeve. Drill a half-inch weep hole on the bottom of the cap. Sleeve and cap shall be Nibco products or approved equal. Sleeves shall be embedded into concrete a minimum of nine inches and spaced at a maximum of four feet, or as indicated on the Drawings. Fill sleeve with non-shrink grout Quickcrete #1585-01 when setting posts. Provide control joints into the concrete on both sides for each post.
- B. Finish step nosings with a safety step edger/groover with a 1/2-inch radius and four grooves spaced equally 3/4 inch on center and a bit depth between 1/4 to 3/8 inch. Paint with contrasting color.

3.08 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

- A. Formed Curb and Gutter: Place concrete to the required section in a single lift. Consolidate concrete using approved mechanical vibrators. Finish curve shaped gutters with a standard curb mule or concrete slip formed curb paving equipment.
- B. Concrete Finishing: Float and finish exposed surfaces with a smooth wood float until true to grade and section and uniform in texture. Brush floated

surfaces with a fine-hair brush using longitudinal strokes. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the front curb surface, while still wet, in the same manner as the gutter and curb top. Finish the top surface of gutter to grade with a wood float.

- C. Surface and Thickness Tolerances: Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.09 CLEAN UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project Site.

3.10 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 32 17 23

PAVEMENT STRIPING AND MARKINGS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Section Includes:

1. Labor, materials, and equipment necessary and incidental to applying pavement striping and marking on parking lots and painting of curbs.

1.02 REFERENCE STANDARDS

- A. Caltrans: State of California Department of Transportation, Standard Specifications.
- B. Caltrans: State of California Department of Transportation, California MUTCD.
- C. CCR, Title 24: California Code of Regulations: California Building Code.

1.03 SUBMITTALS

- A. Product Data: Technical data for each type of pavement marking materials. Provide manufacturer's recommendations for application, including limitations, safety, and environmental requirements, application rates, dry film thickness (DFT), and equipment required for application.
- B. Test Reports and Certifications: Manufacturer's certification that products used comply with SCAQMD regulations for VOC content.

1.04 QUALITY ASSURANCE

- A. Pavement striping and marking shall be performed by workers with proven skills required to perform the work in accordance with the correct location, alignment, and dimensions of the striping and markings as shown in the drawings or as modified by PFMD Project Manager.
- B. At no additional cost to PFMD, repair or replace pavement markings which fail to present a uniform appearance and those which are marred and damaged

- by traffic or by other causes.
- C. Until acceptance by PFMD Project Manager, Contractor shall be responsible for maintenance of pavement striping and markings until the roadway and/or parking area is open to vehicular traffic.
 - D. Pavement striping and markings, whether temporary or permanent, shall be completed before the roadway or parking area is opened for vehicular traffic.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint materials to site in manufacturer's original, unopened, and labeled containers. Keep containers in clean condition, free of foreign materials, and paint residue. Protect from freezing. Remove paints exposed to freezing conditions and replace at no expense to PFMD when required by PFMD Project Manager.

1.06 PROJECT CONDITIONS

- A. Striping and Markings: Apply traffic paints when temperature surfaces and surrounding air temperatures are between 50 deg F and 90 deg F and weather is not windy or humid, unless otherwise permitted in writing by paint manufacturer and authorized by PFMD Project Manager.
 - 1. Do not apply paints to wet or damp surfaces.
 - 2. Do not apply paints to asphalt or asphalt sealers which have not thoroughly cured and dried.
- B. Take precautions to avoid effects of wind drift during the application of liquid materials.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Paint for traffic striping and marking shall comply with Caltrans Standard Specifications Sections 84-1 and 84-3. Type of paint shall either be standard dry or fast dry waterborne and SCAQMD compliant.
- B. Glass Beads: Conform to California State Specification No. 8010-004 (type II).

2.02 COLORS

- A. The color for pavement striping shall be Caltrans Standard Specifications "white" and "yellow" unless otherwise indicated on drawings.
- B. Parking Areas: Colors per Caltrans Standard Specifications Section 84-3.02 unless otherwise indicated on drawings.
 - 1. Red: Safety and restricted marking (fire lanes and curb markings).
 - 2. Yellow: Traffic and safety markings (directional markings and graphics, lane, and curb markings).
 - 3. Blue: Accessible parking stalls and graphics and disability markings.
 - 4. White: Traffic lanes, parking stalls, and elsewhere.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Layout chalk markings at locations and to dimensions indicated on approved shop drawings. Use stencils, templates, forms, and guidelines for word markings, letters, numerals, and symbols.
- B. Verify that pavement surface is dry, free of dirt, grease, oil, acids, laitance, curing compounds, or foreign matter that will reduce the bond between the paint and pavement.
 - 1. Bituminous Surface: Allow bituminous pavement minimum 30 days to cure prior to application of paint. If paint curls or discolors, removed paint, prepare surface, and recoat.
 - 2. Portland Cement Concrete Surface: Allow Portland cement concrete to cure for a minimum of 28 days prior to application of paint. Test for moisture prior to application of paint.
- C. Clean contaminated areas with solution of trisodium phosphate (10 percent Na_3PO_4 by weight) or other approved cleaning solution. Rinse with clean water and dry prior to application of paint.

3.02 APPLICATION

- A. Paint traffic stripes, lines and pavement markings in accordance with the provisions in Sections 84-1, General, and 84-3, Painted Traffic Stripes and Pavement Markings, of the Caltrans Standard Specifications, details shown on drawings, the Caltrans Standard Plans, Manual of Uniform Traffic Control Devices (MUTCD), and the California Building Code.
- B. Paint: Mix paint in accordance with manufacturer's instructions. Apply at recommended application rate and surface temperature. Addition of thinner is not permitted.
- C. Apply paint by using a striping machine, except for special areas and markings that are inaccessible or not adaptable to machine application, in which case hand application will be permitted with approved masking or stencil use.
- D. The striping machine shall be an approved spray-type marking machine capable of producing the specified dimensions of the markings, striping, etc. with clear-cut edges and uniform smooth film thickness.
- E. The minimum wet film thickness of the paint shall be 15 mils or in accordance with the manufacturer's recommendation and approved by PFMD Project Manager.
- F. Striping and Markings: Provide straight edged uniform line width as shown on the drawings, or if not shown, 4 inches. Accessible parking stalls conform to CBC Figures 11B-18A, 18B and 18C as applicable.
 - 1. Stall Divisions: Provide standard and compact size parking stalls as shown on Contract Drawings, white for standard stalls; blue for accessible stalls.
 - 2. Provide two coats for all painting work including but not limited to all car and bus parking stalls striping, pavement markings, letters, numbers, words, captions, and signage painting shall be aligned straight, clean, without paint smears, blurs, and splatters. All striping, markings and related signage shall be in place, complete and dry prior to the opening of the area for traffic. Add reflectorized glass beads to the second coat of paint striping, for all bus stalls, handicap signs, arrows, numbers, and callouts. Reflectorized glass beads shall broadcast into wet paint at the rate of approximately 5 pounds per gallon of paint.
- G. Arrows and Pavement Signs: Paint directional arrows and markings with stencils. At islands and no parking areas, stripe areas with 4-inch-wide stripes.

- H. Fire Lane Markings: Comply with governing fire PFMD's requirements. Use approved stencils for lettering and graphics.
- I. The contractor shall arrange the work so that the paint is completely dry, and the construction area is ready to be open for traffic by the end of each workday.

3.03 TOLERANCES

- A. Width of Stripe: Maximum variance of 1/4 inch.
- B. Alignment of Stripe: Maximum deviation 1/2 inch in 50 feet.

3.02 CLEANUP

- A. Clean up overspray with approved materials and leave a clean and complete project. Remove surplus materials and rubbish and legally dispose of offsite.

PART 4 - MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for the work of this section.

END OF SECTION