

**VETRANS ADMINISTRATION MEDICAL CENTER
E85 FUELING STATION
CONTRACT NO.: VA 701-13-J-0143
PROJECT NO.: 605-332

LOMA LINDA, CALIFORNIA**

CONTRACT SPECIFICATIONS (100%)

AMEC ENVIRONMENT & INFRASTRUCTURE, INC.

April 29, 2014

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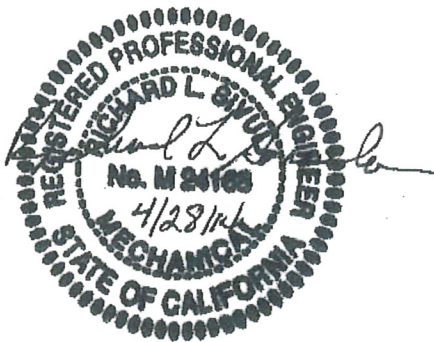
CONTRACT SPECIFICATIONS (100%)



CIVIL



STRUCTURAL



MECHANICAL



ELECTRICAL

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April 29, 2014

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SECTION 00 01 15
LIST OF DRAWING SHEETS

The drawings listed below accompanying this specification form a part of the contract.

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GI001	Cover Sheet
VF101	Existing Conditions
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CS101	Site Plan
CS102	Grading and Drainage Plan
CS103	Fuel Truck Turn Path Analysis
CS501	Civil Details
SS001	Structural General Notes
SS501	Structural Tank Pad and Concrete Spill Pad
MS001	Fueling Legend, Notes, Abbreviations and Flow Diagram
MS101	Fueling Site Plan
MS201	E85 Fuel Storage Tank Plan View
MS501	Fueling Details
ES001	Electrical Legend, Abbreviations and General Notes
ES101	Electrical Site Plan 1 of 2
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EP102	Fueling Station - Grounding
ES501	Electrical Details 1 of 3
ES502	Electrical Details 2 of 3
ES503	Electrical Details 3 of 3
EI601	Electrical Single Line Diagrams - Schedules

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SECTION 01 32 16.15
PROJECT SCHEDULES
(SMALL PROJECTS - DESIGN/BID/BUILD)

PART 1- GENERAL

1.1 DESCRIPTION

- A. The Contractor shall develop a Critical Path Method (CPM) plan and schedule demonstrating fulfillment of the contract requirements (Project Schedule), and shall keep the Project Schedule up-to-date in accordance with the requirements of this section and shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). Conventional Critical Path Method (CPM) technique shall be utilized to satisfy both time and cost applications.

1.2 CONTRACTOR'S REPRESENTATIVE

- A. The Contractor shall designate an authorized representative responsible for the Project Schedule including preparation, review and progress reporting with and to the Contracting Officer's Representative (COTR).
- B. The Contractor's representative shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the requirements of this specification section.
- C. The Contractor's representative shall have the option of developing the Project Schedule within their organization or to engage the services of an outside consultant. If an outside scheduling consultant is utilized, subsection 1.3 of this Section will apply.

1.3 CONTRACTOR'S CONSULTANT

- A. The Contractor shall submit a qualification proposal to the COTR, within 10 days of bid acceptance. The qualification proposal shall include:
1. The name and address of the proposed consultant.
 2. Information to show that the proposed consultant has the qualifications to meet the requirements specified in the preceding paragraph.
 3. A representative sample of prior construction projects for which the proposed consultant has performed complete project scheduling services. These representative samples shall be of similar size and scope.
- B. The Contracting Officer has the right to approve or disapprove the proposed consultant, and will notify the Contractor of the VA decision within seven calendar days from receipt of the qualification proposal. In case of disapproval, the Contractor shall resubmit another consultant within 10 calendar days for renewed consideration. The Contractor shall

have their scheduling consultant approved prior to submitting any schedule for approval.

1.4 COMPUTER PRODUCED SCHEDULES

- A. The contractor shall provide monthly, to the Department of Veterans Affairs (VA), all computer-produced time/cost schedules and reports generated from monthly project updates. This monthly computer service will include: three copies of up to five different reports (inclusive of all pages) available within the user defined reports of the scheduling software approved by the Contracting Officer; a hard copy listing of all Project Schedule changes, and associated data, made at the update and an electronic file of this data; and the resulting monthly updated schedule in PDM format. These must be submitted with and substantively support the contractor's monthly payment request and the signed look ahead report. The COTR will identify the five different report formats that the Contractor shall provide.
- B. The Contractor shall be responsible for the correctness and timeliness of the computer-produced reports. The Contractor shall also be responsible for the accurate and timely submittal of the updated Project Schedule and all CPM data necessary to produce the computer reports and payment request that is specified.
- C. The VA will report errors in computer-produced reports to the Contractor's representative within ten calendar days from receipt of reports. The Contractor shall reprocess the computer-produced reports and associated diskette(s), when requested by the COTR, to correct errors which affect the payment and schedule for the project.

1.5 THE COMPLETE PROJECT SCHEDULE SUBMITTAL

- A. Within 45 calendar days after receipt of Notice to Proceed, the Contractor shall submit for the Contracting Officer's review; three copies of the interim schedule on sheets of paper 30 x 42 inches and an electronic file in the previously approved CPM schedule program. The submittal shall also include three copies of a computer-produced activity/event ID schedule showing project duration; phase completion dates; and other data, including event cost. Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, activity/event description, duration, budget amount, early start date, early finish date, late start date, late finish date and total float. Work activity/event relationships shall be restricted to finish-to-start or start-to-start without lead or lag constraints. Activity/event date constraints, not required by the contract, will not be accepted unless submitted to and approved by the Contracting Officer. The Contractor shall make a separate written

detailed request to the Contracting Officer identifying these date constraints and secure the Contracting Officer's written approval before incorporating them into the network diagram. The Contracting Officer's separate approval of the Project Schedule shall not excuse the Contractor of this requirement. Logic events (non-work) will be permitted where necessary to reflect proper logic among work events, but must have zero duration. The complete working schedule shall reflect the Contractor's approach to scheduling the complete project. **The final Project Schedule in its original form shall contain no contract changes or delays which may have been incurred during the final network diagram development period and shall reflect the entire contract duration as defined in the bid documents.** These changes/delays shall be entered at the first update after the final Project Schedule has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.

- D. Within 30 calendar days after receipt of the complete project interim Project Schedule and the complete final Project Schedule, the Contracting Officer or his representative, will do one or both of the following:
1. Notify the Contractor concerning his actions, opinions, and objections.
 2. A meeting with the Contractor at or near the job site for joint review, correction or adjustment of the proposed plan will be scheduled if required. Within 14 calendar days after the joint review, the Contractor shall revise and shall submit three copies of the revised Project Schedule, three copies of the revised computer-produced activity/event ID schedule and a revised electronic file as specified by the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.
- E. The approved baseline schedule and the computer-produced schedule(s) generated therefrom shall constitute the approved baseline schedule until subsequently revised in accordance with the requirements of this section.

1.6 WORK ACTIVITY/EVENT COST DATA

- A. The Contractor shall cost load all work activities/events except procurement activities. The cumulative amount of all cost loaded work activities/events (including alternates) shall equal the total contract

price. Prorate overhead, profit and general conditions on all work activities/events for the entire project length. The Contractor shall generate from this information cash flow curves indicating graphically the total percentage of work activity/event dollar value scheduled to be in place on early finish, late finish. These cash flow curves will be used by the Contracting Officer to assist him in determining approval or disapproval of the cost loading. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

- B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in Article, FAR 52.232 - 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.236 - 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS).
- C. In accordance with FAR 52.236 - 1 (PERFORMANCE OF WORK BY THE CONTRACTOR) and VAAR 852.236 - 72 (PERFORMANCE OF WORK BY THE CONTRACTOR), the Contractor shall submit, simultaneously with the cost per work activity/event of the construction schedule required by this Section, a responsibility code for all activities/events of the project for which the Contractor's forces will perform the work.
- D. The Contractor shall cost load work activities/events for all BID ITEMS. The sum of each BID ITEM work shall equal the value of the bid item in the Contractors' bid.

1.7 PROJECT SCHEDULE REQUIREMENTS

- A. Show on the project schedule the sequence of work activities/events required for complete performance of all items of work. The Contractor shall:
 - 1. Show activities/events as:
 - a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
 - b. Contracting Officer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
 - c. Interruption of VA Facilities utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
 - d. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
 - e. VA inspection and acceptance activity/event with a minimum duration of five work days at the end of each phase and

immediately preceding any VA move activity/event required by the contract phasing for that phase.

2. Show not only the activities/events for actual construction work for each trade category of the project, but also trade relationships to indicate the movement of trades from one area, floor, or building, to another area, floor, or building.
 3. Break up the work into activities/events of a duration no longer than 20 work days each or one reporting period, except as to non-construction activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the COTR may approve the showing of a longer duration. The duration for VA approval of any required submittal, shop drawing, or other submittals will not be less than 20 work days.
 4. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.
 5. The schedule shall be generally numbered in such a way to reflect either discipline, phase or location of the work.
- B. The Contractor shall submit the following supporting data in addition to the Project Schedule:
1. The appropriate project calendar including working days and holidays.
 2. The planned number of shifts per day.
 3. The number of hours per shift.
- Failure of the Contractor to include this data shall delay the review of the submittal until the Contracting Officer is in receipt of the missing data.
- C. To the extent that the Project Schedule or any revised Project Schedule shows anything not jointly agreed upon, it shall not be deemed to have been approved by the COTR. Failure to include any element of work required for the performance of this contract shall not excuse the Contractor from completing all work required within any applicable completion date of each phase regardless of the COTR's approval of the Project Schedule.
- D. Compact Disk Requirements and CPM Activity/Event Record Specifications: Submit to the VA electronic file(s) containing one file of the data required to produce a schedule, reflecting all the activities/events of the complete Project Schedule being submitted.

1.8 PAYMENT TO THE CONTRACTOR

- A. Monthly, the Contractor shall submit the AIA application and certificate for payment documents G702 & G703 reflecting updated schedule activities and cost data in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, FAR 52.232 - 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.236 - 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS). The Contractor shall be entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated Project Schedule. Monthly payment requests shall include: a listing of all agreed upon Project Schedule changes and associated data; and electronic file(s) of the resulting monthly updated schedule.
- B. Approval of the Contractor's monthly Application for Payment shall be contingent, among other factors, on the submittal of a satisfactory monthly update of the Project Schedule.

1.9 PAYMENT AND PROGRESS REPORTING

- A. Monthly schedule update meetings will be held on dates mutually agreed to by the COTR and the Contractor. Contractor and their CPM consultant (if applicable) shall attend all monthly schedule update meetings. The Contractor shall accurately update the Project Schedule and all other data required and provide this information to the COTR three work days in advance of the schedule update meeting. Job progress will be reviewed to verify:
1. Actual start and/or finish dates for updated/completed activities/events.
 2. Remaining duration for each activity/event started, or scheduled to start, but not completed.
 3. Logic, time and cost data for change orders, and supplemental agreements that are to be incorporated into the Project Schedule.
 4. Changes in activity/event sequence and/or duration which have been made, pursuant to the provisions of following Article, ADJUSTMENT OF CONTRACT COMPLETION.
 5. Completion percentage for all completed and partially completed activities/events.
 6. Logic and duration revisions required by this section of the specifications.
 7. Activity/event duration and percent complete shall be updated independently.
- B. After completion of the joint review, the Contractor shall generate an updated computer-produced calendar-dated schedule and supply the

Contracting Officer's representative with reports in accordance with the Article, COMPUTER PRODUCED SCHEDULES, specified.

- C. After completing the monthly schedule update, the Contractor's representative or scheduling consultant shall rerun all current period contract change(s) against the prior approved monthly Project Schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the Contractor and COTR for the contract change(s). When there is a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the COTR. After each rerun update, the resulting electronic Project Schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.4 and 1.7. This electronic submission is separate from the regular monthly Project Schedule update requirements and shall be submitted to the COTR within fourteen (14) calendar days of completing the regular schedule update. **Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the Contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.**
- D. Following approval of the CPM schedule, the VA, the General Contractor, its approved CPM Consultant, RE office representatives, and all subcontractors needed, as determined by the SRE, shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of Project Schedule and to identify any necessary actions required to maintain Project Schedule during the reporting period. The Government representatives and the Contractor should conclude the meeting with a clear understanding of those work and administrative actions necessary to maintain Project Schedule status during the reporting period. This schedule coordination meeting will occur after each monthly Project Schedule update meeting utilizing the resulting schedule reports from that schedule update. If the project is behind schedule, discussions should include ways to prevent further slippage as well as ways to improve the Project Schedule status, when appropriate.

1.10 RESPONSIBILITY FOR COMPLETION

- A. If it becomes apparent from the current revised monthly progress schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:
 - 1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
 - 2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
 - 3. Reschedule the work in conformance with the specification requirements.
- B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the COTR for the proposed schedule changes. If such actions are approved, the representative schedule revisions shall be incorporated by the Contractor into the Project Schedule before the next update, at no additional cost to the Government.

1.11 CHANGES TO THE SCHEDULE

- A. Within 30 calendar days after VA acceptance and approval of any updated Project Schedule, the Contractor shall submit revised electronic file(s) and a list of any activity/event changes including predecessors and successors for any of the following reasons:
 - 1. Delay in completion of any activity/event or group of activities/events, which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the CPM as the direct cause for delaying the project beyond the acceptable limits.
 - 2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
 - 3. The schedule does not represent the actual prosecution and progress of the project.
 - 4. When there is, or has been, a substantial revision to the activity/event costs regardless of the cause for these revisions.
- B. CPM revisions made under this paragraph which affect the previously approved computer-produced schedules for Government furnished equipment, vacating of areas by the VA Facility, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, shall be furnished in writing to the Contracting Officer for approval.

- C. Contracting Officer's approval for the revised Project Schedule and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the VA representative.
- D. The cost of revisions to the Project Schedule resulting from contract changes will be included in the proposal for changes in work as specified in FAR 52.243 - 4 (Changes) and VAAR 852.236 - 88 (Changes - Supplemental), and will be based on the complexity of the revision or contract change, man hours expended in analyzing the change, and the total cost of the change.
- E. The cost of revisions to the Project Schedule not resulting from contract changes is the responsibility of the Contractor.

1.12 ADJUSTMENT OF CONTRACT COMPLETION

- A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, CPM data and supporting evidence as the COTR may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in this request. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer-produced calendar-dated schedule for the time period in question and all other relevant information.
- B. Actual delays in activities/events which, according to the computer-produced calendar-dated schedule, do not affect the extended and predicted contract completion dates shown by the critical path in the network, will not be the basis for a change to the contract completion date. The Contracting Officer will within a reasonable time after receipt of such justification and supporting evidence, review the facts and advise the Contractor in writing of the Contracting Officer's decision.
- C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under FAR 52.243 - 4 (Changes) and VAAR 852.236 - 88 (Changes - Supplemental). The Contractor shall include, as a part of each change order proposal, a sketch showing all CPM logic revisions, duration (in work days) changes, and cost changes, for work in question

and its relationship to other activities on the approved network diagram.

- D. All delays due to non-work activities/events such as RFI's, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month by month basis.

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SECTION 01 33 23
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- 1.1 Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- 1.2 For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1.3 Submit for approval, all of the items specifically mentioned under the separate sections of the Specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
 - A. Satisfactory written evidence is presented to, and approved by the Contracting Officer or the Contracting Officer's Representative (COTR), that manufacturer cannot make scheduled delivery of approved item or;
 - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
 - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1.4 Forward submittals in sufficient time to permit proper consideration and approval action by Government. Timely submission shall be made to assure adequate lead time for procurement of items required by the contract. Delays attributable to untimely and rejected submittals will not serve as a basis for extending contract time for completion.
- 1.5 Submittals will be reviewed for compliance with contract requirements by the COTR, and action thereon will be taken by the COTR on behalf of the Contracting Officer.
- 1.6 Upon receipt of submittals, the COTR will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.
- 1.7 The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional

submittals beyond those required by the contract are furnished pursuant to request by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.

- 1.8 Schedules called for in the Specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and the COTR. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and COTR assume no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- 1.9 Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
 - A. Submit samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified. A PDF format submittal with electronic signature may be accepted at the COTR's discretion.
 - B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Submittal shall be sent via overnight express package prepaid by the Contractor and shall contain the list of items, name of Medical Center, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, industry standard or Federal Specification Number (if any), and such additional information as may be required by the Specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
 1. A copy of the transmittal letter must be enclosed with items. Any items received without transmittal letter will be considered "unclaimed goods" and held for a limited time only.
 2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Medical Center, name of Contractor, manufacturer, brand, contract number, industry standard or Federal Specification Number as applicable, and location(s) on project.

3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.
- C. In addition to complying with the applicable requirements specified in the preceding paragraphs of subsection, samples which are required to have Laboratory Tests shall be tested in a commercial laboratory approved by the Contracting Officer.
1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
 2. Certificates shall also set forth a list of comparable projects for which laboratory has performed similar functions during past five years.
 3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory(ies).
 4. Contractor shall forward a copy of transmittal letter to the COTR simultaneously with submission to a commercial testing laboratory.
 5. Laboratory test reports shall be sent directly to the COTR for appropriate action.
 6. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
 7. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.
- D. If submittal samples not requiring laboratory testing have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.
- E. Approved samples will be kept on file by the COTR at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of the Specifications, approved samples in good condition may be used in their proper locations in contract work.

At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.

F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.

1. Each drawing shall have marked thereon, proper descriptive title, including Medical Center name and location, project number, manufacturer's number, reference to contract drawing number, detail number, and Specification section number.
2. A space 4-3/4 by 5 inches shall be reserved on each drawing to accommodate approval or disapproval stamp.
3. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
4. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
5. When work is directly related and involves more than one trade, shop drawings shall be submitted to the COTR under one cover.

1.10 Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to:

(COTR)

(Address)

(City, State and Zip Code)

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials testing activities and inspection services required during project construction. Unless otherwise specified, all testing and inspection services shall be performed by approved Testing Laboratories retained by the Contractor.

1.2 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. Referenced publications shall be the current version as of the date of advertisement of the project.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- T27.....Standard Method of Test for Sieve Analysis of
Fine and Coarse Aggregates
- T96.....Standard Method of Test for Resistance to
Degradation of Small-Size Coarse Aggregate by
Abrasion and Impact in the Los Angeles Machine
- T104.....Standard Method of Test for Soundness of
Aggregate by Use of Sodium Sulfate or Magnesium
Sulfate
- T180.....Standard Method of Test for Moisture-Density
Relations of Soils using a 10 lb. Rammer and a
18 in. Drop
- T191.....Standard Method of Test for Density of Soil In-
Place by the Sand-Cone Method
- C. ASTM International (ASTM):
- A325.....Standard Specification for Structural Bolts,
Steel, Heat Treated, 120/105 ksi Minimum Tensile
Strength
- A370.....Standard Test Methods and Definitions for
Mechanical Testing of Steel Products
- A490.....Standard Specification for Heat Treated Steel
Structural Bolts, 150 ksi Minimum Tensile
Strength
- C31/C31M.....Standard Practice for Making and Curing Concrete
Test Specimens in the Field
- C33/C33M.....Standard Specification for Concrete Aggregates

C39/C39M.....Standard Test Method for Compressive Strength of
Cylindrical Concrete Specimens

C138/C138M.....Standard Test Method for Density (Unit Weight),
Yield, and Air Content (Gravimetric) of Concrete

C143/C143M.....Standard Test Method for Slump of Hydraulic
Cement Concrete

C172/C172M.....Standard Practice for Sampling Freshly Mixed
Concrete

C173/C173M.....Standard Test Method for Air Content of freshly
Mixed Concrete by the Volumetric Method

C1064/C1064M.....Standard Test Method for Temperature of Freshly
Mixed Portland Cement Concrete

C1077.....Standard Practice for Agencies Testing Concrete
and Concrete Aggregates for Use in Construction
and Criteria for Testing Agency Evaluation

D422.....Standard Test Method for Particle-Size Analysis
of Soils

D698.....Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Standard Effort

D1556.....Standard Test Method for Density and Unit Weight
of Soil in Place by the Sand-Cone Method

D1557.....Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Modified Effort
(56,000ft lbf/ft³ (2,700 KNm/m³))

D2937.....Standard Test Methods for Density of Soil in
Place by the Drive-Cylinder Method

D3666.....Standard Specification for Minimum Requirements
for Agencies Testing and Inspecting Road and
Paving Materials

D3740.....Standard Practice for Minimum Requirements for
Agencies Engaged in Testing and/or Inspection
of Soil and Rock as used in Engineering Design
and Construction

D6938.....Standard Test Method for In-Place Density and
Water Content of Soil and Soil-Aggregate by
Nuclear Methods (Shallow Depth)

E94.....Standard Guide for Radiographic Examination

E164.....Standard Practice for Contact Ultrasonic Testing
of Weldments

E329.....Standard Specification for Agencies Engaged in
Construction Inspection, Testing, or Special
Inspection

E543.....Standard Specification for Agencies Performing
Non-Destructive Testing

E709.....Standard Guide for Magnetic Particle Examination

D. American Welding Society (AWS):

D1.1.....Structural Welding Code-Steel

1.3 REQUIREMENTS

- A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e. E329, C1077, D3666, D3740, E543) listed in the technical sections of the Specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by the COTR.
- C. Written Reports: Testing laboratory shall submit test reports to the Contractor who shall then submit the documents to the COTR, unless other arrangements are agreed to in writing by the COTR. Submit reports of tests that fail to meet construction contract requirements on colored paper or other type of documentation as determined by the COTR.
- D. Verbal Reports: Testing laboratory shall give verbal notification to the Contractor and COTR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK

- A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:
 - 1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COTR regarding suitability or unsuitability of areas where proof-rolling was observed. Where

unsuitable results are observed, witness excavation of unsuitable material and recommend to the COTR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.

2. Provide full time observation of fill placement and compaction and field density testing in construction areas to verify that earthwork compaction obtained is in accordance with contract documents.
3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with the industry standards referenced in individual specification sections.
2. Make field density tests in accordance with the primary testing method following ASTM D6938 wherever possible. Field density tests utilizing ASTM D1556 or ASTM D2937 shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the COTR before the tests are conducted.
 - a. Concrete Slab Subgrade for Tanks and Truck Offloading: At least one test of compacted subgrade for every 1000 square feet of each concrete slab, but in no case fewer than three tests at each slab.
 - b. Pavement Subgrade: At least one test of compacted subgrade for each 1000 square feet, but in no case fewer than two tests.
 - d. Curb, Gutter, and Sidewalk: At least one test of compacted subgrade for each 100 feet, but in no case fewer than two tests.
 - e. Trenches: At least one test of compacted subgrade at maximum 100-foot intervals, but in no case fewer than two tests.

C. Fill and Backfill Material Gradation: Minimum of one test for each visible change in material for stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in compliance with the industry standards referenced in individual specification sections.

D. Testing Materials: Test suitability of on-site and off-site borrow as directed by the COTR.

3.2 ASPHALT CONCRETE PAVING

A. Aggregate Base Course:

1. Determine maximum density and optimum moisture content for aggregate base material in accordance with AASHTO T180, Method D or ASTM D1557, Method D.
2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with AASHTO T191 or ASTM D1556.
3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the referenced Standard Specifications of the State of California Department of Transportation (CALTRANS).

B. Hot Mix Asphalt (HMA):

1. Aggregate: Sample and test aggregates in stockpiles and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104), unless otherwise required in the referenced CALTRANS Standard Specifications.
2. Temperature: Check temperature of each load of HMA at mixing plant and at site of paving operation.
3. Density: Perform field density testing of HMA for each day's paving operation in accordance with the applicable requirements of the referenced CALTRANS Standard Specifications.

3.3 SITE WORK CONCRETE

- A. Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

3.4 CONCRETE

A. Batch Plant Materials Testing:

1. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate construction site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the

- site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 50 cubic yards or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. Label each cylinder with an identification number. The COTR may require additional cylinders to be molded and cured under job conditions.
 4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
 5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 25 cubic yards thereafter each day. For concrete not required to be air-entrained, test every 100 cubic yards at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
 6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
 7. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
 8. Verify that specified mixing has been accomplished.
 9. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
 - a. When ambient air temperature falls below 40 degrees F, record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
 - b. When ambient air temperature rises above 85 degrees F, record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
 10. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.

11. Observe conveying, placement, and consolidation of concrete for conformance to the Specifications.
 12. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
 13. Observe curing procedures for conformance with the Specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
 14. Observe preparations for placement of concrete:
 - a. Inspect handling, conveying, and placing equipment; inspect vibrating and compaction equipment.
 - b. Inspect preparation of construction, expansion, and isolation joints.
 15. Observe preparations for protection from hot weather, cold weather, sun, and rain; and observe preparations for curing.
 16. Observe concrete mixing:
 - a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.
- C. Laboratory Tests of Field Samples:
1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by the COTR. Compile laboratory test reports as follows: compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
 2. Furnish certified compression test reports (duplicate) to the COTR. In test report, indicate the following information:
 - a. Cylinder identification number and date cast.
 - b. Specific location at which test samples were taken.
 - c. Type of concrete, slump, and percent air.
 - d. Compressive strength of concrete in psi.
 - e. Weather conditions during placing.
 - f. Temperature of concrete in each test cylinder when test cylinder was molded.
 - g. Maximum and minimum ambient temperature during placing.
 - h. Ambient temperature when concrete sample in test cylinder was taken.
 - i. Date delivered to laboratory and date tested.

3.5 REINFORCEMENT

- A. Review mill test reports furnished by Contractor.

3.6 STRUCTURAL STEEL

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.
- B. Prefabrication Inspection:
 - 1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
 - 2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
 - 3. Approve welder qualifications by certification or retesting.
 - 4. Approve procedure for control of distortion and shrinkage stresses.
 - 5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.
- C. Fabrication and Erection:
 - 1. Weld Inspection:
 - a. Inspect welding equipment for capacity, maintenance and working condition.
 - b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
 - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
 - d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
 - e. Measure 25 percent of fillet welds.
 - f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
 - 1) 20 percent of all shear plate fillet welds at random, final pass only.
 - 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
 - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
 - 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
 - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
 - g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and

- moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
- h. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.
 - i. Verify that correction of rejected welds are made in accordance with AWS D1.1.
 - j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:
- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
 - e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
 - f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to Resident Engineer.

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SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies the control of environmental pollution and damage that the Contractor shall consider for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, radiant energy, and radioactive materials, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.
- B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
 - 1. Adversely effect human health or welfare,
 - 2. Unfavorably alter ecological balances of importance to human life,
 - 3. Effect other species of importance to humankind, or;
 - 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.
- C. Definitions of Pollutants:
 - 1. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
 - 2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
 - 3. Sediment: Soil and other debris that has been eroded and transported by runoff water.
 - 4. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
 - 5. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.
 - 6. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.

7. Sanitary Wastes:

- a. Sewage: Domestic sanitary sewage and human and animal waste.
- b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2 QUALITY CONTROL

- A. Establish and maintain quality control for the environmental protection of all items set forth herein.
- B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

1.3 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. U.S. National Archives and Records Administration (NARA):
33 CFR 328.....Definitions

1.4 SUBMITTALS

- A. In accordance with Section, 01 33 23, furnish the following:
 - 1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the COTR to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the Contracting Officer for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
 - a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
 - b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.
 - c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
 - d. Description of the Contractor's environmental protection personnel training program.
 - e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
 - f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses,

ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.

- g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
 - h. Permits, licenses, and the location of the solid waste disposal area.
 - i. Drawings showing locations of any proposed temporary excavations or embankments, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials.
 - j. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - k. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
- B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.5 PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the Specifications and Drawings.
- B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the COTR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.
- 1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.

2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the Drawings to be preserved by marking, fencing, or using any other approved techniques.
 - a. Box and protect from damage existing trees and shrubs to remain on the construction site.
 - b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
 - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms or other devices (as applicable) to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.
 - a. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and permanent erosion and sedimentation control features shown on the Drawings or as otherwise approved by the COTR. Maintain temporary erosion and sediment control measures until permanent drainage and erosion control facilities are completed and operative.
6. Manage borrow areas on Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.
7. Manage and control spoil areas on Government property to limit spoil to areas shown and prevent erosion of soil or sediment from entering nearby water courses or lakes.
8. Protect adjacent areas from despoilment by temporary excavations and embankments.
9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and

- dispose of waste in compliance with Federal, State, and local requirements.
10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 11. Handle discarded materials other than those included in the solid waste category as directed by the COTR.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas.
 2. Monitor water areas affected by construction.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife.
- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of California and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
 2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
 3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.

4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.

F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COTR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.

1. Perform construction activities involving repetitive, high-level impact noise only between 8:00 a.m. and 6:00 p.m unless otherwise permitted by local ordinance or the COTR. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:

a. Maintain maximum permissible construction equipment noise levels at 50 feet (dBA):

<u>EARTHMOVING</u>		<u>MATERIALS HANDLING</u>	
FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS	75		
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

b. Use shields or other physical barriers to restrict noise transmission.

c. Provide soundproof housings or enclosures for noise-producing machinery.

d. Use efficient silencers on equipment air intakes.

- e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
 - f. Line hoppers and storage bins with sound deadening material.
 - g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure at the property line or 50 feet from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at three to six feet in front of any building face. Submit the recorded information to the COTR noting any problems and the alternatives for mitigating actions.
- G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.
- H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the COTR. Cleaning shall include off-site disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.
- B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.
- C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:
 - 1. Waste Management Plan development and implementation.
 - 2. Techniques to minimize waste generation.
 - 3. Sorting and separating of waste materials.
 - 4. Salvage of existing materials and items for reuse or resale.
 - 5. Recycling of materials that cannot be reused or sold.
- D. At a minimum the following waste categories shall be diverted from landfills:
 - 1. Soil.
 - 2. Inerts (e.g. concrete, masonry and asphalt).
 - 3. Clean dimensional wood and palette wood.
 - 4. Green waste (biodegradable landscaping materials).
 - 5. Engineered wood products (plywood, particle board and I-joists, etc).
 - 6. Metal products (eg, steel, wire, beverage containers, copper, etc).
 - 7. Cardboard, paper and packaging.
 - 8. Bitumen roofing materials.
 - 9. Plastics (eg, ABS, PVC).

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- B. Section 02 41 00, DEMOLITION.

1.3 QUALITY ASSURANCE

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:

1. Excess or unusable construction materials.
 2. Packaging used for construction products.
 3. Poor planning and/or layout.
 4. Construction error.
 5. Over ordering.
 6. Weather damage.
 7. Contamination.
 8. Mishandling.
 9. Breakage.
- B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.
- C. Contractor shall develop and implement procedures to recycle construction and demolition waste to a minimum of 50 percent.
- D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.
- E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website <http://www.wbdg.org/tools/cwm.php> provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.
- F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.
- G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.
- H. Report to COTR any problems in complying with laws, regulations and ordinances with corrective action taken.

1.4 TERMINOLOGY

- A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.
- B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.
- C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.
- D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.
- E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).
- F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.
- G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.
- H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.
- I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.
- J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.
- K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.
- L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.

1. On-site Recycling - Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
 2. Off-site Recycling - Materials hauled to a location and used in an altered form in the manufacture of new products.
- M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.
- N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.
- O. Return: To give back reusable items or unused products to vendors for credit.
- P. Salvage: To remove waste materials from the site for resale or re-use by a third party.
- Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.
- R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.
- S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, furnish the following:
- B. Prepare and submit to the COTR a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
1. Procedures to be used for debris management.
 2. Techniques to be used to minimize waste generation.
 3. Analysis of the estimated job site waste to be generated:
 - a. List of each material and quantity to be salvaged, reused, recycled.
 - b. List of each material and quantity proposed to be taken to a landfill.

4. Detailed description of the Means/Methods to be used for material handling.
 - a. On site: Material separation, storage, protection where applicable.
 - b. Off site: Transportation means and destination. Include list of materials.
 - 1) Description of materials to be site-separated and self-hauled to designated facilities.
 - 2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
 - c. The names and locations of mixed debris reuse and recycling facilities or sites.
 - d. The names and locations of trash disposal landfill facilities or sites.
 - e. Documentation that the facilities or sites are approved to receive the materials.
- C. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
- D. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COLLECTION

- A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.
- B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.
- C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

3.2 DISPOSAL

- A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.

- B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

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SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies demolition and removal of designated concrete slabs, asphalt pavement, utilities, and other existing improvements and facilities shown on the Drawings.

1.2 RELATED WORK

- A. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- E. Construction Waste Management: Section 017419 CONSTRUCTION WASTE MANAGEMENT.

1.3 PROTECTION

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Clean the work area daily.
- E. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
 - 1. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for

immediate use. Instruct all possible users in use of fire extinguishers.

2. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 15 feet of fire hydrants.

F. Before beginning any demolition work, the Contractor shall survey the site and examine the Drawings and Specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center; any damaged items shall be repaired or replaced as approved by the COR. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COR's approval.

G. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DEMOLITION

A. Concrete Curbing, Slabs and Asphalt Paving:

1. Where portions of curbing, slabs and pavement are to be removed, score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed, including where excavation or trenching occurs.
2. For trenches, extend pavement sections to be removed a minimum of 12 inches on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated.
3. Break up and remove asphalt and concrete within demolition areas to the designated limits.
4. At limits of asphalt and concrete remaining in place, maintain cuts in good order until adjacent construction is completed.

B. Debris, including brick, concrete, asphalt, stone, metals and similar materials shall become property of Contractor and shall be disposed of daily, off the Medical Center Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored

in areas designated by the COR. Contractor shall dispose of debris in compliance with applicable federal, state or local permits, rules and/or regulations.

- C. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COR. When Utility lines are encountered that are not indicated on the Drawings, the COR shall be notified prior to further work in that area.

3.2 CLEAN-UP

- A. On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COR. Clean-up shall include off-site disposal (off the Medical Center) of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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SECTION 03 30 53
(SHORT-FORM) CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies cast-in-place structural concrete and material and mixes for other concrete.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

1.3 TOLERANCES

- A. ACI 117.
- B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E1155.

1.4 REGULATORY REQUIREMENTS

- A. ACI SP-66 ACI Detailing Manual.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Concrete Mix Design.
- C. Shop Drawings:
 - 1. Reinforcing steel: Complete shop drawings.
 - 2. Tank Anchorage to Concrete: Provide structural calculations and drawings prepared by a professional engineer licensed in the State of California presenting required anchor layout, anchor size, embedment, material specifications and other details indicating conformance to the design loading criteria noted on the Drawings.
- D. Manufacturer's Product Data Sheets and Certificates: Air-entraining admixture, chemical admixtures, curing compounds.
- E. Quality Control Testing: Submit results of field and laboratory testing performed during concrete construction as specified in Section 01 45 29.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only. Referenced publications shall be the current version as of the date of advertisement of the project.
- B. American Concrete Institute (ACI):
 - 117.....Specification for Tolerances for Concrete Construction, Materials and Commentary

- 211.1.....Standard Practice for Proportions for Normal,
Heavyweight, and Mass Concrete
- 301.....Specifications for Structural Concrete
- 305.1.....Specification for Hot Weather Concreting
- 306.1.....Standard Specification for Cold Weather
Concreting
- SP-66ACI Detailing Manual
- 318.....Building Code Requirements for Structural
Concrete and Commentary
- 347.....Guide to Formwork for Concrete
- C. ASTM International (ASTM):
 - A185/A185M.....Standard Specification for Steel Welded Wire
Reinforcement, Plain, for Concrete Reinforcement
 - A615/A615M.....Standard Specification for Deformed and Plain
Carbon Steel Bars for Concrete Reinforcement
 - A996/A996M.....Standard Specification for Rail Steel and Axle
Steel Deformed Bars for Concrete Reinforcement
 - C31/C31M.....Standard Practice for Making and Curing Concrete
Test Specimens in the Field
 - C33/C33M.....Standard Specification for Concrete Aggregates
 - C39/C39M.....Standard Test Method for Compressive Strength of
Cylindrical Concrete Specimens
 - C94/C94M.....Standard Specification for Ready Mixed Concrete
 - C143/C143M.....Standard Test Method for Slump of Hydraulic
Cement Concrete
 - C150.....Standard Specification for Portland Cement
 - C171.....Standard Specification for Sheet Material for
Curing Concrete
 - C172.....Standard Practice for Sampling Freshly Mixed
Concrete
 - C173.....Standard Test Method for Air Content of Freshly
Mixed Concrete by the Volumetric Method
 - C192/C192M.....Standard Practice for Making and Curing Concrete
Test Specimens in the Laboratory
 - C231.....Standard Test Method for Air Content of Freshly
Mixed Concrete by the Pressure Method
 - C260.....Standard Specification for Air-Entraining
Admixtures for Concrete
 - C494/C494M.....Standard Specification for Chemical Admixtures
for Concrete

C618.....Standard Specification for Coal Fly Ash and Raw
or Calcined Natural Pozzolan for Use in Concrete
D1751Standard Specification for Preformed Expansion
Joint Fillers for Concrete Paving and Structural
Construction (Non-extruding and Resilient
Bituminous Types)
E1155.....Standard Test Method for Determining F_F Floor
Flatness and F_L Floor Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS

- A. Wood, plywood, metal, or other materials, approved by Resident Engineer, of grade or type suitable to obtain type of finish specified.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 12 inches thick. Coarse aggregate for applied topping slabs shall be Size 7.
- D. Fine Aggregate: ASTM C33.
- E. Lightweight Aggregate for Structural Concrete: Not permitted.
- F. Mixing Water: Fresh, clean, and potable.
- G. Air-Entraining Admixture: ASTM C260.
- H. Chemical Admixtures: ASTM C494.
- I. Vapor Barrier: Not required.
- J. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See structural drawings for grade.
- K. Welded Wire Fabric: ASTM A185.
- L. Expansion Joint Filler: ASTM D1751.
- M. Sheet Materials for Curing Concrete: ASTM C171.
- N. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- O. Liquid Hardener and Dustproofer: Fluosilicate solution or magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer.
- P. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- Q. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout shall show no settlement or vertical drying shrinkage at 3 days or thereafter based on

initial measurement made at time of placement, and produce a compressive strength of at least 2500 psi at 3 days and 5000 psi at 28 days.

2.3 CONCRETE MIXES

- A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days shall be not less than 4000 psi.
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 4 inches tested in accordance with ASTM C143.
- E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete: Strength	Non-Air-Entrained		Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio
35 (5000) ^{1,3}	375 (630)	0.45	385 (650)	0.40
30 (4000) ^{1,3}	325 (550)	0.55	340 (570)	0.50
25 (3000) ^{1,3}	280 (470)	0.65	290 (490)	0.55
25 (3000) ^{1,2}	300 (500)	*	310 (520)	*

- 1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 1200 psi in excess of f'c. For concrete strengths above 5000 psi, the proposed mix design shall achieve a compressive strength 1400 psi in excess of f'c.
- 2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
- 3. Determined by Laboratory in accordance with ACI 211.1 for normal concrete.

- F. Air-entrainment is required for all exterior concrete. Air content shall conform with the following table:

**TABLE I - TOTAL AIR CONTENT
FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)**

Nominal Maximum Size of Coarse Aggregate	Total Air Content Percentage by Volume
10 mm (3/8 in)	6 to 10
13 mm (1/2 in)	5 to 9
19 mm (3/4 in)	4 to 8
25 mm (1 in)	3 1/2 to 6 1/2
40 mm (1 1/2 in)	3 to 6

2.4 BATCHING & MIXING

- A. Store, batch, and mix materials as specified in ASTM C94.
1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.
 2. Ready-Mixed: Ready-mixed concrete comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed concrete producer shall furnish, in duplicate, certification as required by ASTM C94.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Installation shall conform to ACI 347. Framework shall be sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.
- B. Treating and Wetting: Treat or wet contact forms as follows:
1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
 2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather cool metal forms by thoroughly wetting with water just before placing concrete.
 3. Use sealer on reused plywood forms as specified for new material.
- C. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.

D. Construction Tolerances:

1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 REINFORCEMENT

- A. Details of concrete reinforcement, unless otherwise shown, in accordance with ACI 318 and ACI SP-66. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

3.3 PLACING CONCRETE

- A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of Resident Engineer before placing concrete. Provide screeds at required elevations for concrete slabs.
- B. Before placing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.
- C. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water or cement more than 1 1/2 hours. Do not allow concrete to drop freely more than 5 feet in unexposed work nor more than 3 feet in exposed work. Place and consolidate concrete in horizontal layers not exceeding 12 inches in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.
- D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 12 inches and to permit

concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from Resident Engineer.

3.4 PROTECTION AND CURING

- A. Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method shall be subject to approval by Resident Engineer.

3.5 FORM REMOVAL

- A. Forms remain in place until concrete has a sufficient strength to carry its own weight and loads supported. Removal of forms at any time is the Contractor's sole responsibility.

3.6 SURFACE PREPARATION

- A. Immediately after forms have been removed and work has been examined and approved by Resident Engineer, remove loose materials, and patch all stone pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part portland cement and 2 to 3 parts sand.

3.7 FINISHES

A. Slab Finishes:

1. Scratch Finish: Slab surfaces to receive a bonded applied cementitious application shall all be thoroughly raked or wire broomed after partial setting (within 2 hours after placing) to roughen surface to insure a permanent bond between base slab and applied cementitious materials.
2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.
3. Float Finish: Ramps, stair treads, and platforms, both interior and exterior, equipment pads, and slabs to receive non-cementitious materials, except as specified, shall be screened and floated to a smooth dense finish. After first floating, while surface is still soft, surfaces shall be checked for alignment using a straightedge or template. Correct high spots by cutting down with a trowel or similar tool and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat the slab to a uniform sandy texture.
4. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.

5. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:

Slab on grade & Shored suspended slabs	Unshored suspended slabs
Specified overall value F_F 25/ F_L 20	Specified overall value F_F 25
Minimum local value F_F 17/ F_L 15	Minimum local value F_F 17

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SECTION 13 05 41
SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide seismic restraint in accordance with the requirements of this section in order to maintain the integrity of nonstructural components of the building (or structure) so that they remain safe and functional in case of seismic event.
- B. The design to resist seismic load shall be based on Seismic Design Categories per section 4.0 of the VA Seismic Design Requirements (H-18-8) dated August 2013, <http://www.cfm.va.gov/til/etc/seismic.pdf>.
- C. Definitions: Non-structural building components are components or systems that are not part of the building's structural system whether inside or outside, above or below grade. Non-structural components of buildings include:
 - 1. Architectural Elements: Facades that are not part of the structural system and its shear resistant elements; cornices and other architectural projections and parapets that do not function structurally; glazing; nonbearing partitions; suspended ceilings; stairs isolated from the basic structure; cabinets; bookshelves; medical equipment; and storage racks.
 - 2. Electrical Elements: Power and lighting systems; substations; switchgear and switchboards; auxiliary engine-generator sets; transfer switches; motor control centers; motor generators; selector and controller panels; fire protection and alarm systems; special life support systems; and telephone and communication systems.
 - 3. Mechanical Elements: Heating, ventilating, and air-conditioning systems; fuel systems; medical gas systems; plumbing systems; sprinkler systems; pneumatic systems; boiler equipment and components.
 - 4. Transportation Elements: Mechanical, electrical and structural elements for transport systems, i.e., elevators and dumbwaiters, including hoisting equipment and counterweights.

1.2 QUALITY CONTROL

- A. Shop-Drawing Preparation:
 - 1. Have seismic-force-restraint shop drawings and calculations prepared by a professional structural engineer experienced in the area of seismic force restraints. The professional structural engineer shall be registered in the state where the project is located.

2. Submit design tables and information used for the design-force levels, stamped and signed by a professional structural engineer registered in the State where project is located.

B. Coordination:

1. Do not install seismic restraints until seismic restraint submittals are approved by the Resident Engineer.
2. Coordinate and install trapezes or other multi-pipe hanger systems prior to pipe installation.

C. Seismic Certification:

In structures assigned to IBC Seismic Design Category C, D, E, or F, permanent equipments and components are to have Special Seismic Certification in accordance with requirements of section 13.2.2 of ASCE 7 except for equipment that are considered rugged as listed in section 2.2 OSHPD code application notice CAN No. 2-1708A.5, and shall comply with section 13.2.6 of ASCE 7.

1.3 SUBMITTALS

A. Submit a coordinated set of equipment anchorage drawings prior to installation including:

1. Description, layout, and location of items to be anchored or braced with anchorage or brace points noted and dimensioned.
2. Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, bolts, welds etc. clearly identified and specified.
3. Numerical value of design seismic brace loads.
4. For expansion bolts, include design load and capacity if different from those specified.

B. Submit prior to installation, a coordinated set of bracing drawings for seismic protection of piping, with data identifying the various support-to-structure connections and seismic bracing structural connections, include:

1. Single-line piping diagrams on a floor-by-floor basis. Show all suspended piping for a given floor on the same plain.
2. Type of pipe (Copper, steel, cast iron, insulated, non-insulated, etc.).
3. Pipe contents.
4. Structural framing.
5. Location of all gravity load pipe supports and spacing requirements.
6. Numerical value of gravity load reactions.
7. Location of all seismic bracing.
8. Numerical value of applied seismic brace loads.

- #### 1.4 APPLICABLE PUBLICATIONS

- Seismic Restraint Requirements for Non-Structural Components
13 05 41 - 3

- A325M-09.....Standard Specification for High-Strength Bolts
for Structural Steel Joints [Metric]
- A490-10.....Standard Specification for Heat-Treated Steel
Structural Bolts, 150 ksi Minimum Tensile
Strength
- A490M-10.....Standard Specification for High-Strength Steel
Bolts, Classes 10.9 and 10.9.3, for Structural
Steel Joints [Metric]
- A500/A500M-10.....Standard Specification for Cold-Formed Welded
and Seamless Carbon Steel Structural Tubing in
Rounds and Shapes
- A501-07.....Specification for Hot-Formed Welded and Seamless
Carbon Steel Structural Tubing
- A615/A615M-09.....Standard Specification for Deformed and Plain
Billet-Steel Bars for Concrete Reinforcement
- A992/A992M-06.....Standard Specification for Steel for Structural
Shapes for Use in Building Framing
- A996/A996M-09.....Standard Specification for Rail-Steel and Axle-
Steel Deformed Bars for Concrete
Reinforcement
- E488-96(R2003).....Standard Test Method for Strength of Anchors in
Concrete and Masonry Element
- E. American Society of Civil Engineers (ASCE 7) Latest Edition.
- F. California Building Code, 2013 Edition
- G. International Building Code (IBC) Latest Edition
- H. VA Seismic Design Requirements, H-18-8, August 2013
- I. National Uniform Seismic Installation Guidelines (NUSIG)
- J. Sheet Metal and Air Conditioning Contractors National Association
(SMACNA): Seismic Restraint Manual - Guidelines for Mechanical Systems,
1998 Edition and Addendum

1.5 REGULATORY REQUIREMENT

- A. California Building Code, 2013 Edition.
- B. IBC Latest Edition.
- C. Exceptions: The seismic restraint of the following items may be omitted:
1. Equipment weighing less than 400 pounds, which is supported directly on the floor or roof.
 2. Equipment weighing less than 20 pounds, which is suspended from the roof or floor or hung from a wall.
 3. Gas and medical piping less than 2 ½ inches inside diameter.
 4. Piping in boiler plants and equipment rooms less than 1 ¼ inches inside diameter.

5. All other piping less than 2-1/2 inches inside diameter, except for automatic fire suppression systems.
6. All piping suspended by individual hangers, 12 inches or less in length from the top of pipe to the bottom of the support for the hanger.
7. All electrical conduits, less than 2 ½ inches inside diameter.
8. All rectangular air handling ducts less than six square feet in cross sectional area.
9. All round air handling ducts less than 28 inches in diameter.
10. All ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of support for the hanger.

PART 2 - PRODUCTS

2.1 STEEL

- A. Structural Steel: ASTM A36 or A992.
- B. Structural Tubing: ASTM A500, Grade B.
- C. Structural Tubing: ASTM A501.
- D. Steel Pipe: ASTM A53, Grade B.
- E. Bolts & Nuts: ASTM A307, A325 or A490.

2.2 CAST-IN-PLACE CONCRETE:

- A. Concrete: 28 day strength, f'c = 30 MPa (4,000 psi).
- B. Reinforcing Steel: ASTM A615/615M or ASTM A996/A996M deformed.

PART 3 - EXECUTION

3.1 CONSTRUCTION, GENERAL:

- A. Provide equipment supports and anchoring devices to withstand the seismic design forces, so that when seismic design forces are applied, the equipment cannot displace, overturn, or become inoperable.
- B. Provide anchorages in conformance with recommendations of the equipment manufacturer and as shown on approved shop drawings and calculations.
- C. Construct seismic restraints and anchorage to allow for thermal expansion.
- D. Testing Before Final Inspection:
 1. Test 10-percent of anchors in masonry and concrete per ASTM E488, and ACI 355.2 to determine that they meet the required load capacity. If any anchor fails to meet the required load, test the next 20 consecutive anchors, which are required to have zero failure, before resuming the 10-percent testing frequency.
 2. Before scheduling Final Inspection, submit a report on this testing indicating the number and location of testing, and what anchor-loads were obtained.

3.2 EQUIPMENT RESTRAINT AND BRACING:

- A. See drawings for equipment to be restrained or braced.

3.3 MECHANICAL DUCTWORK AND PIPING; BOILER PLANT STACKS AND BREACHING; ELECTRICAL BUSWAYS, CONDUITS, AND CABLE TRAYS; AND TELECOMMUNICATION WIRES AND CABLE TRAYS

- A. Support and brace mechanical ductwork and piping; electrical busways, conduits and cable trays; and telecommunication wires and cable trays including boiler plant stacks and breeching to resist directional forces (lateral, longitudinal and vertical).
- B. Brace duct and breeching branches with a minimum of 1 brace per branch.
- D. Provide supports and anchoring so that, upon application of seismic forces, piping remains fully connected as operable systems which will not displace sufficiently to damage adjacent or connecting equipment, or building members.
- E. Seismic Restraint of Piping:
 - 1. Design criteria:
 - a. Piping resiliently supported: Restrain to support 120 percent of the weight of the systems and components and contents.
 - b. Piping not resiliently supported: Restrain to support 60 percent of the weight of the system components and contents.
- F. Piping Connections: Provide flexible connections where pipes connect to equipment. Make the connections capable of accommodating relative differential movements between the pipe and equipment under conditions of earthquake shaking.

3.4 STORAGE RACKS, CABINETS, AND BOOKCASES

- A. Install storage racks to withstand earthquake forces and anchored to the floor or laterally braced from the top to the structural elements.
- B. Anchor medical supply cabinets to the floor or walls and equip them with properly engaged, lockable latches.
- C. Anchor filing cabinets that are more than 2 drawers high to the floor or walls, and equip all drawers with properly engaged, lockable latches.
- D. Anchor bookcases that are more than 30 inches high to the floor or walls, and equip any doors with properly engaged, lockable latches.

- - - E N D - - -

SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, panelboards, and other items and arrangements for the specified items are shown on the drawings.
- C. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
 - 1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that

- maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
 3. Certified: Materials and equipment which:
 - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Are periodically inspected by a NRTL.
 - c. Bear a label, tag, or other record of certification.
 4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
- B. Product Qualification:
 1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
 2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

- A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.
- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.
- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
 - 1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the COTR a minimum of 15 working days prior to the manufacturer's performing the factory tests.
 - 2. Four copies of certified test reports shall be furnished to the COTR two weeks prior to final inspection and not more than 90 days after completion of the tests.
 - 3. When materials and equipment fail factory tests, and re-testing and re-inspection is required, the Contractor shall be liable for all additional expenses for the Government to witness re-testing.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

- A. Where the Government or the Contractor requests variations from the contract requirements, the connecting work and related components shall

include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 MATERIALS AND EQUIPMENT PROTECTION

- A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
 - 1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
 - 2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
 - 3. Damaged equipment shall be repaired or replaced, as determined by the COTR.
 - 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 - 5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

- A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J - General Environmental Controls, OSHA Part 1910 subpart K - Medical and First Aid, and OSHA Part 1910 subpart S - Electrical, in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
 - 1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.

2. Before initiating any work, a job specific work plan must be developed by the Contractor with a peer review conducted and documented by the COTR and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the COTR.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.
- C. Inaccessible Equipment:
 1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, cabinets, motor controllers, fused and non-fused safety switches, individual breakers, panelboards,

motor control assemblies, control devices and other significant equipment.

- B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 1/2 inch high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.
- C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm²), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

1.12 SUBMITTALS

- A. Submit to the COTR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".

2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion, etc.) associated with equipment or piping so that the proposed installation can be properly reviewed. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and attached to the equipment.
3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
4. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.

F. Maintenance and Operation Manuals:

1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:

- a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
 - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
- G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
- H. After approval and prior to installation, furnish the COTR with one sample of each of the following:
- 1. A minimum 12 inches length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
 - 2. Each type of conduit coupling, bushing, and termination fitting.
 - 3. Conduit hangers, clamps, and supports.
 - 4. Duct sealing compound.
 - 5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 POLYCHLORINATED BIPHENYL (PCB) EQUIPMENT

- A. This project requires the removal, transport, and disposal of electrical equipment containing Polychlorinated Biphenyls (PCB) in accordance with the Federal Toxic Substances Control Act (TSCA).
- B. The equipment to be removed is shown on the drawings.
- C. The selective demolition shall be in accordance with Section 02 41 00, DEMOLITION.

1.15 ACCEPTANCE CHECKS AND TESTS

- A. The Contractor shall furnish the instruments, materials, and labor for tests.
- B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
- C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Government.

1.16 WARRANTY

- A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

1.17 INSTRUCTION

- A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.
- B. Furnish the services of competent instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be trained in operating theory as well as practical operation and maintenance procedures.
- C. A training schedule shall be developed and submitted by the Contractor and approved by the COTR at least 30 days prior to the planned training.

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Contract Specifications (100%)
April 29, 2014

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

---END---

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:
Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- C. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Installation of conductors and cables in ducts.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

- A. Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

1.5 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - 1) Electrical ratings and insulation type for each conductor and cable.
 - 2) Splicing materials and pulling lubricant.
 - 2. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.

- b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.
- B. American Society of Testing Material (ASTM):
- D2301-10.....Standard Specification for Vinyl Chloride
Plastic Pressure-Sensitive Electrical
Insulating Tape
 - D2304-10.....Test Method for Thermal Endurance of Rigid
Electrical Insulating Materials
 - D3005-10.....Low-Temperature Resistant Vinyl Chloride
Plastic Pressure-Sensitive Electrical
Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):
- WC 70-09.....Power Cables Rated 2000 Volts or Less for the
Distribution of Electrical Energy
- D. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
- 44-10.....Thermoset-Insulated Wires and Cables
 - 83-08.....Thermoplastic-Insulated Wires and Cables
 - 467-07.....Grounding and Bonding Equipment
 - 486A-486B-03.....Wire Connectors
 - 486C-04.....Splicing Wire Connectors
 - 486D-05.....Sealed Wire Connector Systems
 - 486E-09.....Equipment Wiring Terminals for Use with
Aluminum and/or Copper Conductors
 - 493-07.....Thermoplastic-Insulated Underground Feeder and
Branch Circuit Cables
 - 514B-04.....Conduit, Tubing, and Cable Fittings

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.
- B. All conductors shall be copper stranded.

C. Single Conductor and Cable:

1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
2. Insulation: THHN-THWN, THWN-2, and XHHW-2. XHHW-2 shall be used for isolated power systems.

D. Color Code:

1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
2. No. 8 AWG and larger: Color-coded using one of the following methods:
 - a. Solid color insulation or solid color coating.
 - b. Stripes, bands, or hash marks of color specified.
 - c. Color using 0.75 inches wide tape.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

6. Lighting circuit "switch legs", shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the COTR.
7. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
 1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped conductors.

3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.
 4. All bolts, nuts, and washers used with splices shall be zinc-plated, cadmium-plated or steel.
- D. Above Ground Splices for 250 kcmil and Larger:
1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.
- E. Underground Splices for No. 10 AWG and Smaller:
1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- F. Underground Splices for No. 8 AWG and Larger:
1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.

- G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.3 CONNECTORS AND TERMINATIONS

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated, cadmium-plated or steel.

2.4 CONTROL WIRING

- A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

2.5 WIRE LUBRICATING COMPOUND

- A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.
- B. Shall not be used on conductors for isolated power systems.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.
- B. Install all conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.

- G. For connections to motors, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors. Conduits entering hazardous classified boundaries shall be sealed at both ends of conduits. See construction drawings to identify the locations of the hazardous boundaries.
- I. Conductor and Cable Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
 - 2. Use nonmetallic pull ropes. Pull ropes are required on all spare conduits for future use.
 - 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
 - 4. All conductors in a single conduit shall be pulled simultaneously.
 - 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. No more than three branch circuits shall be installed in any one conduit.
- K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.2 SPLICE AND TERMINATION INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

3.3 CONDUCTOR IDENTIFICATION

- A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 3 inches from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

3.4 FEEDER CONDUCTOR IDENTIFICATION

- A. In each underground handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 1-1/2 inches in diameter and 40 mils thick. Attach tags with plastic ties.

3.5 EXISTING CONDUCTORS

- A. Unless specifically indicated on the plans, existing conductors shall not be reused.

3.6 CONTROL WIRING INSTALLATION

- A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.
- B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

3.7 CONTROL WIRING IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.

3.8 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests: Inspect physical condition.
 - 2. Electrical tests:
 - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
 - b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
 - c. Perform phase rotation test on all three-phase circuits.

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC.
- C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:
Low-voltage conductors.
- C. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
 - 2. Test Reports:
 - a. Two weeks prior to the final inspection, submit ground resistance field test reports to the COTR.
 - 3. Certifications:
 - a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
- B1-07.....Standard Specification for Hard-Drawn Copper Wire
 - B3-07.....Standard Specification for Soft or Annealed Copper Wire
 - B8-11.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- 81-83.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- D. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code (NEC)
 - 70E-12.....National Electrical Safety Code
 - 99-12.....Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
- 44-10Thermoset-Insulated Wires and Cables
 - 83-08Thermoplastic-Insulated Wires and Cables
 - 467-07Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be insulated stranded copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
- B. Bonding conductors shall be bare stranded copper. Bonding conductors shall be stranded for final connection to motors, transformers and vibrating equipment.
- C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

- D. Insulation: THHN-THWN, THWN-2, and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2 GROUND RODS

- A. Copper clad steel, 0.75 inch diameter by 10 feet long.
- B. Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

2.3 CONCRETE ENCASED ELECTRODE

- A. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

2.4 GROUND CONNECTIONS

- A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.
- B. Above Grade: Ground connections include and not limited to connections to cabinets, enclosures and tanks.
1. Listed for use with copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated, cadmium-plated or steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
2. Connection to Building Steel: Exothermic-welded type connectors.

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 0.25 inch thick x 0.75 inch wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

2.6 GROUND TERMINAL BLOCKS

- A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated, cadmium-plated or steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install grounding equipment in accordance with the NEC, as shown on the drawings, and as specified herein.
- B. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, lighting poles, foundation rebar, existing fence, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.
- C. Tie new grounding system into existing ground grid system at two locations as a minimum.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.3 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

- A. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):
 - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
 - 2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.
- B. Panelboards and Disconnects: and other electrical equipment:
 - 1. Connect the equipment grounding conductors to the ground bus.
 - 2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.

3.5 RACEWAY

- A. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
 - 3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.

4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
- D. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.
- E. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- F. Fixed electrical equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

3.6 OUTDOOR METALLIC FENCES AROUND ELECTRICAL EQUIPMENT

- A. Fences shall be grounded with a ground rod at each fixed gate post and at each corner post. If fences are existing, tie fences to new grounding system.
- B. Drive ground rods until the top is 12 inches below grade. Attach a No. 4 AWG copper conductor by exothermic weld to the ground rods, and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 12 inches of fence mesh and fasten by two approved bronze compression fittings, one to bond the wire to post and the other to bond the wire to fence. Each gate section shall be bonded to its gatepost by a 0.375 inch x 1 inch flexible, braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.7 CORROSION INHIBITORS

- A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.8 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.9 EXTERIOR LIGHT POLES

- A. Provide 20 feet of No. 4 AWG bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation as required to reach pole ground stud.

3.10 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.11 GROUND ROD INSTALLATION

- A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 24 inches below final grade.
- B. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.
- C. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

3.12 ACCEPTANCE CHECKS AND TESTS

- A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical system is energized, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.
- B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required

resistance, but the specified number of electrodes must still be provided.

- C. Below-grade connections shall be visually inspected by the COTR prior to backfilling. The Contractor shall notify the COTR 24 hours before the connections are ready for inspection.

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SECTION 26 05 41
UNDERGROUND ELECTRICAL CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of underground raceways, and pullboxes to form a complete underground electrical raceway system.
- B. The terms "duct" and "conduit" are used interchangeably in this section.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:
Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- C. Section 31 20 11, EARTH WORK: Trenching, backfill, and compaction.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Coordinate layout and installation of ducts, manholes, and pullboxes with final arrangement of other utilities, site grading, and surface features.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit information on pullboxes, ducts, and hardware.
 - c. Proposed deviations from the drawings shall be clearly marked on the submittals. If it is necessary to locate pullboxes, at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit to the COTR for approval prior to construction.
 - 2. Certifications: Two weeks prior to the final inspection, submit the following.

- a. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the materials have been properly installed, connected, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Concrete Institute (ACI):
 - Building Code Requirements for Structural Concrete
 - 318-11/318M-11.....Building Code Requirements for Structural Concrete & Commentary
 - SP-66-04.....ACI Detailing Manual
- C. American National Standards Institute (ANSI):
 - 77-10.....Underground Enclosure Integrity
- D. American Society for Testing and Materials (ASTM):
 - C858-10e1.....Underground Precast Concrete Utility Structures
 - C990-09.....Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.
- E. National Electrical Manufacturers Association (NEMA):
 - TC 2-03.....Electrical Polyvinyl Chloride (PVC) Conduit
 - TC 3-04.....Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit And Tubing
 - TC 6 & 8-03.....Polyvinyl Chloride (PVC) Plastic Utilities Duct For Underground Installations
 - TC 9-04.....Fittings For Polyvinyl Chloride (PVC) Plastic Utilities Duct For Underground Installation
- F. National Fire Protection Association (NFPA):
 - 70-11.....National Electrical Code (NEC)
 - 70E-12.....National Electrical Safety Code
- G. Underwriters Laboratories, Inc. (UL):
 - 6-07.....Electrical Rigid Metal Conduit-Steel
 - 467-07.....Grounding and Bonding Equipment
 - 651-11.....Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings

651A-11.....Schedule 40 and 80 High Density Polyethylene
(HDPE) Conduit

651B-07.....Continuous Length HDPE Conduit

PART 2 - PRODUCTS

2.1 PULLBOXES

- A. General: Size as indicated on the drawings. Provide pullboxes with weatherproof, non-skid covers with recessed hook eyes, secured with corrosion- and tamper-resistant hardware. Cover material shall be identical to pullbox material. Covers shall have molded lettering, ELECTRIC or SIGNAL as applicable. Pullboxes shall comply with the requirements of ANSI 77 Tier 5, Tier 8, Tier 15 and Tier 22 loading. Provide pulling irons, 0.875 inch diameter galvanized steel bar with exposed triangular-shaped opening.
- B. Polymer Concrete Pullboxes: Shall be molded of sand, aggregate, and polymer resin, and reinforced with steel, fiberglass, or both. Pullbox shall have open bottom.
- C. Fiberglass Pullboxes: Shall be sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
- D. Concrete Pullboxes: Shall be monolithically-poured reinforced concrete.

2.3 DUCTS

- A. Number and sizes shall be as shown on the drawings.
- B. Ducts (direct-burial):
 - 1. Plastic duct:
 - a. NEMA TC2 and TC3 UL 651, 651A, and 651B, Schedule 80 PVC conduit.
 - b. Duct shall be suitable for use with 90° C rated conductors.
 - 2. Rigid metal conduit: UL6 and NEMA RN1 galvanized rigid metal, half-lap wrapped with 10 mil PVC tape.
 - 3. Rigid metal conduit, PVC coated.

2.4 GROUNDING

- A. Ground Rods and Ground Wire: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

2.5 WARNING TAPE

- A. 4-mil polyethylene 3 inches wide detectable tape, red with black letters, imprinted with "CAUTION - BURIED ELECTRIC CABLE BELOW" or similar.

2.6 PULL ROPE FOR SPARE DUCTS

- A. Plastic with 200 lb minimum tensile strength.

PART 3 - EXECUTION

3.1 PULLBOX INSTALLATION

- A. Assembly and installation shall be per the requirements of the manufacturer.
 - 1. Install pullboxes level and plumb.
 - 2. Units shall be installed on a 12 inches thick level bed of 90% compacted granular fill, well-graded from the 1 inches sieve to the No. 4 sieve. Granular fill shall be compacted with a minimum of four passes with a plate compactor.
- B. Access: Ensure the top of frames and covers are flush with finished grade.

3.2 TRENCHING

- A. Refer to Section 31 20 11 EARTH WORK for trenching, backfilling, and compaction.
- B. Before performing trenching work at existing facilities, a Ground Penetrating Radar Survey shall be carefully performed by a certified technician to reveal all existing underground ducts, conduits, cables, and other utility systems.
- C. Work with extreme care near existing ducts, conduits, and other utilities to avoid damaging them.
- D. Cut the trenches neatly and uniformly.
- E. Individual conduits to be installed under existing paved areas and roads that cannot be disturbed shall be jacked into place using rigid metal conduit, or bored using plastic utilities duct or PVC conduit, as approved by the COTR.

3.3 DUCT INSTALLATION

- A. General Requirements:
 - 1. Ducts shall be in accordance with the NEC, as shown on the drawings, and as specified.
 - 2. Join and terminate ducts with fittings recommended by the manufacturer.
 - 3. Slope ducts to drain towards pullboxes, and away from building and equipment entrances. Pitch not less than 4 inch in 100 feet.
 - 4. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 5 feet outside the

- building foundation. Tops of conduits below building slab shall be minimum 24 inches below bottom of slab.
5. Stub-ups and sweeps to equipment mounted on outdoor concrete slabs shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 5 feet away from the edge of slab.
 6. Install insulated grounding bushings on the conduit terminations.
 7. Radius for sweeps shall be sufficient to accomplish pulls without damage. Minimum radius shall be six times conduit diameter.
 8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 3 inches above the bottom of the trench during the concrete pour. Spacer spacing shall not exceed 5 feet. Secure spacers to ducts and earth to prevent floating during concrete pour. Provide nonferrous tie wires to prevent displacement of the ducts during concrete pour. Tie wires shall not act as substitute for spacers.
 9. Duct lines shall be installed no less than 12 inches from other utility systems, such as water, sewer, chilled water.
 10. Clearances between individual ducts:
 - a. For similar services, not less than 3 inches.
 - b. For power and signal services, not less than 6 inches.
 11. Couple the ducts with proper couplings. Stagger couplings in rows and layers to ensure maximum strength and rigidity of the duct bank.
 12. Keep ducts clean of earth, sand, or gravel, and seal with tapered plugs upon completion of each portion of the work.
 13. Spare Ducts: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.
 14. Duct Identification: Place continuous strip of warning tape approximately 12 inches above ducts before backfilling trenches. Warning tape shall be preprinted with proper identification.
 15. Duct Sealing: Seal ducts, including spare ducts, at building entrances and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of foreign objects and material, moisture, and gases.
 16. Use plastic ties to secure cables to insulators on cable arms. Use minimum two ties per cable per insulator.

B. Direct-Burial Ducts:

1. Install direct-burial ducts only where shown on the drawings.
Provide direct-burial ducts only for low-voltage power and lighting branch circuits.
2. Tops of ducts shall be:
 - a. Not less than 24 inches and not less than shown on the drawings, below finished grade.
 - b. Not less than 30 inches and not less than shown on the drawings, below roads and other paved surfaces.
 - c. Additional burial depth shall be required in order to accomplish NEC-required minimum bend radius of ducts.
3. Do not kink the ducts. Compaction shall not deform the ducts.

C. Connections to Existing Ducts: Where connections to existing ducts are indicated, excavate around the ducts as necessary. Cut off the ducts and remove loose concrete from inside before installing new ducts. Provide a reinforced-concrete collar, poured monolithically with the new ducts, to take the shear at the joint of the duct banks.

D. Partially-Completed Ducts: During construction, wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable plugs. Fit concrete envelope of a partially completed ducts with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 12 inches apart. Restrain reinforcing assembly from moving during pouring of concrete.

3.4 ACCEPTANCE CHECKS AND TESTS

A. Duct Testing and Cleaning:

1. Upon completion of the duct installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the duct, and to test for out-of-round conditions.
2. The mandrel shall be not less than 12 inches long, and shall have a diameter not less than 0.5 inch less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush

- shall be the same as, or slightly larger than, the diameter of the duct.
3. If testing reveals obstructions or out-of-round conditions, the Contractor shall replace affected section(s) of duct and retest to the satisfaction of the COTR at no cost to the Government.
 4. Mandrel pulls shall be witnessed by the COTR.

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SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of panelboards.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:
Low-voltage conductors.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:
Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 26 09 23, LIGHTING CONTROLS: Lighting controls integral to panelboards.
- F. Section 26 43 13, SURGE PROTECTIVE DEVICES: Surge protective devices integral to panelboards.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.
 - 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering circuit breakers and replacement parts.

- 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the panelboards.
- 2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the panelboards conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the panelboards have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):
IBC-12.....International Building Code
- C. National Electrical Manufacturers Association (NEMA):
PB 1-11.....Panelboards
250-08.....Enclosures for Electrical Equipment (1,000V Maximum)
- D. National Fire Protection Association (NFPA):
70-11.....National Electrical Code (NEC)
70E-12.....Standard for Electrical Safety in the Workplace
- E. Underwriters Laboratories, Inc. (UL):
50-95.....Enclosures for Electrical Equipment
67-09.....Panelboards
489-09.....Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.

- B. Panelboards shall have main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, bottom feed, surface mounting, branch circuit breakers, and accessories as shown on the drawings.
- C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.
- D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.
- E. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
- F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.
- G. Neutral bus shall be 100% rated, mounted on insulated supports.
- H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.
- I. Bus bars shall be braced for the available short-circuit current as shown on the drawings.
- J. Series-rated panelboards are not permitted.

2.2 ENCLOSURES AND TRIMS

A. Enclosures:

- 1. Provide galvanized steel enclosures, with NEMA rating 4X as shown on the drawings or as required for the environmental conditions in which installed.
- 2. Enclosures shall not have ventilating openings.
- 3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
- 4. Provide manufacturer's standard option for prepunched knockouts on top and bottom endwalls.
- 5. Include removable inner dead front cover, independent of the panelboard cover.

B. Trims:

- 1. Hinged "door-in-door" type.
- 2. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
- 3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners,

requiring a key or tool for entry. Hand-operated latches are not acceptable.

4. Inner and outer doors shall open left to right.

5. Trims shall be flush or surface type as shown on the drawings.

2.3 MOLDED CASE CIRCUIT BREAKERS

A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.

B. Circuit breakers shall be bolt-on type.

C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current.

D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame.

E. Circuit breaker features shall be as follows:

1. A rugged, integral housing of molded insulating material.

2. Silver alloy contacts.

3. Arc quenchers and phase barriers for each pole.

4. Quick-make, quick-break, operating mechanisms.

5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.

6. Electrically and mechanically trip free.

7. An operating handle which indicates closed, tripped, and open positions.

8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.

9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where shown on the drawings.

10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory accordingly.

2.4 SURGE PROTECTIVE DEVICES

A. Where shown on the drawings, furnish panelboards with integral surge protective devices. Refer to Section 26 43 13, SURGE PROTECTIVE DEVICES.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- C. Install a printed schedule of circuits in each panelboard after approval by the COTR. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards
- D. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).
- E. Provide blank cover for each unused circuit breaker mounting space.
- F. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims with finishes to match surrounding surfaces after the panelboards have been installed. Do not paint nameplates.
- G. Rust and scale shall be removed from the inside of existing enclosures where new interior components are to be installed. Paint inside of enclosures with rust-preventive paint before the new interior components are installed. Provide new trim. Trim shall fit tight to the enclosure.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify appropriate anchorage and required area clearances.
 - d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
 - e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
 - f. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

---END---

SECTION 26 29 21
ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of fused switches (indicated as switches in this section) for use in electrical systems rated 600 V and below.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:
Low-voltage conductors.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:
Requirements for personnel safety and to provide a low impedance path for possible ground faults.
- D. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - 1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.
 - c. Certification from the manufacturer that representative enclosed switches have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:
 - a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses and replacement parts.
 - 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches.
 - 2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the enclosed switches conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the enclosed switches have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):
IBC-12.....International Building Code
- C. National Electrical Manufacturers Association (NEMA):
FU 1-07.....Low Voltage Cartridge Fuses
KS 1-06.....Enclosed and Miscellaneous Distribution
Equipment Switches (600 Volts Maximum)
- D. National Fire Protection Association (NFPA):
70-11.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
98-07.....Enclosed and Dead Front Switches
248-00.....Low Voltage Fuses

PART 2 - PRODUCTS

2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS

- A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.
- B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.
- C. Shall be horsepower (HP) rated.
- D. Shall have the following features:
 - 1. Switch mechanism shall be the quick-make, quick-break type.
 - 2. Copper blades, visible in the open position.
 - 3. An arc chute for each pole.
 - 4. External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
 - 5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
 - 6. Fuse holders for the sizes and types of fuses specified.
 - 7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
 - 8. Ground lugs for each ground conductor.
 - 9. Enclosures:
 - a. Shall be the NEMA types shown on the drawings.
 - b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
 - c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.

2.2 MOTOR RATED TOGGLE SWITCHES

- A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.
- B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

2.3 CARTRIDGE FUSES

- A. Shall be in accordance with NEMA FU 1.
- B. Service Entrance: Class RK1, time delay.
- C. Feeders: Class RK1, time delay.
- D. Control Circuits: Time delay.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. In seismic areas, enclosed switches shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- C. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - d. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 SPARE PARTS

- A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the COTR.

---END---

SECTION 26 43 13
SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of Type 2 Surge Protective Devices, as defined in NFPA 70, and indicated as transient voltage surge suppression or TVSS in this section.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- B. Section 26 24 16, PANELBOARDS: For factory-installed or external TVSS.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings and device nameplate data.
 - 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
 - 3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the TVSS conforms to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the TVSS has been properly installed.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplement and errata) form a part of this specification to the extent

referenced. Publications are referenced in the text by the basic designation only.

B. Institute of Engineering and Electronic Engineers (IEEE):

IEEE C62.41.2-02.....Recommended Practice on Characterization of
Surges in Low-Voltage (1000 V and Less) AC
Power Circuits

IEEE C62.45-03.....Recommended Practice on Surge Testing for
Equipment Connected to Low-Voltage (1000 V and
Less) AC Power Circuits

C. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

UL 1283-05.....Electromagnetic Interference Filters

UL 1449-06.....Surge Protective Devices

PART 2 - PRODUCTS

2.1 PANELBOARD TVSS

A. General Requirements:

1. Comply with UL 1449 and IEEE C62.41.2.
2. Modular design with field-replaceable modules, or non-modular design.
3. Fuses, rated at 200 kA interrupting capacity.
4. Bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant suppression circuits.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device.
10. Four-digit transient-event counter.

B. Surge Current per Phase: Minimum 120kA per phase.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Factory-installed TVSS: Panelboard manufacturer shall install TVSS at the factory.

B. Field-installed TVSS: Contractor shall install TVSS with conductors or buses between TVSS and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide a circuit breaker as a dedicated disconnecting means for TVSS as shown on drawings.

C. Do not perform insulation resistance tests on panelboards, or feeders with the TVSS connected. Disconnect TVSS before conducting insulation resistance tests, and reconnect TVSS immediately after insulation resistance tests are complete.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

- a. Compare equipment nameplate data with specifications and approved shop drawings.
- b. Inspect physical, electrical, and mechanical condition.
- c. Verify that disconnecting means and feeder size and maximum length to TVSS corresponds to approved shop drawings.
- d. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.
- e. Vacuum-clean enclosure interior. Clean enclosure exterior.
- f. Verify the correct operation of all sensing devices, alarms, and indicating devices.

3.3 FOLLOW-UP VERIFICATION

A. After completion of acceptance checks and tests, the Contractor shall show by demonstration in service that TVSS are in good operating condition and properly performing the intended function.

3.4 INSTRUCTION

A. Provide the services of a factory-trained technician for one 2-hour training period for instructing personnel in the maintenance and operation of the TVSS, on the date requested by the COTR.

---END---

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SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of exterior luminaires, poles, and supports.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low voltage power and lighting wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.
- E. Section 26 09 23, LIGHTING CONTROLS: Controls for exterior lighting.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Clearly present sufficient information to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting, details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, poles, luminaires, lamps, and accessories. Include electronic photometric files in IES format, or provide link (URL) to manufacturer's website that contains photometric data for each specific fixture used, excluding wallpack fixtures.
- C. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the COTR. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement lamps, ballasts, and parts.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:

1. Certification by the manufacturer that the materials are in accordance with the drawings and specifications.
2. Certification by the contractor that the complete installation has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Aluminum Association Inc. (AA):

AAH35.1-06.....Alloy and Temper Designation Systems for
Aluminum

C. American Concrete Institute (ACI):

318-05Building Code Requirements for Structural
Concrete

D. American National Standards Institute (ANSI):

C81.61-09Electrical Lamp Bases - Specifications for
Bases (Caps) for Electric Lamps

E. American Society for Testing and Materials (ASTM):

A123/A123M-09Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products

A153/A153M-09.....Zinc Coating (Hot-Dip) on Iron and Steel
Hardware

B108-03a-08Aluminum-Alloy Permanent Mold Castings

C1089-06Spun Cast Prestressed Concrete Poles

F. Illuminating Engineering Society of North America (IESNA)

HB-9-00.....Lighting Handbook

RP-8-05.....Roadway Lighting

RP-20-98.....Lighting for Parking Facilities

RP-33-99.....Lighting for Exterior Environments

LM-5-96.....Photometric Measurements of Area and Sports
Lighting Installations

LM-50-99.....Photometric Measurements of Roadway Lighting
Installations

- LM-52-99.....Photometric Measurements of Roadway Sign
Installations
- LM-64-01.....Photometric Measurements of Parking Areas
- LM-72-97.....Directional Positioning of Photometric Data
- LM-79-08.....Approved Method for the Electrical and
Photometric Measurements of Solid-State Lighting
Products
- LM-80-08.....Approved Method for Measuring Lumen Maintenance
of LED Light Sources
- G. National Electrical Manufacturers Association (NEMA):
 - C136.3-05For Roadway and Area Lighting Equipment -
Luminaire Attachments
 - ICS 2-00 (R2005)Controllers, Contactors and Overload Relays
Rated 600 Volts
 - ICS 6-93 (R2006)Enclosures
- H. National Fire Protection Association (NFPA):
 - 70-08National Electrical Code (NEC)
- I. Underwriters Laboratories, Inc. (UL):
 - 496-08Lampholders
 - 773-95.....Plug-In, Locking Type Photocontrols for Use
with Area Lighting
 - 773A-06Nonindustrial Photoelectric Switches for
Lighting Control
 - 1598-08Luminaires
 - 8750-08.....Light Emitting Diode (LED) Light Sources for
Use in Lighting Products

1.6 DELIVERY, STORAGE, AND HANDLING

Provide manufacturer's standard provisions for protecting pole finishes during transport, storage, and installation. Do not store poles on ground. Store poles so they are at least 12 in above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

2.2 POLES

- A. General:

1. Poles shall be as shown on the drawings, and as specified. Finish shall be as specified on the drawings.
2. The pole and arm assembly shall be designed for wind loading of 100 mph, with an additional 30% gust factor, supporting luminaire(s) and accessories such as shields, banner arms, and banners that have the effective projected areas indicated. The effective projected area of the pole shall be applied at the height of the pole base, as shown on the drawings. Height of new pole(s) shall match height of existing pole.
3. Poles shall be anchor-bolt type designed for use with underground supply conductors. Poles shall have handhole having a minimum clear opening of 2.5 x 5 in. Handhole covers shall be secured by stainless steel captive screws.
4. Provide a steel-grounding stud opposite handhole openings, designed to prevent electrolysis when used with copper wire.
5. Provide a base cover that matches the pole in material and color to conceal the mounting hardware pole-base welds and anchor bolts.
6. Hardware and Accessories: All necessary hardware and specified accessories shall be the product of the pole manufacturer.
7. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.

B. Types:

1. Aluminum: Provide square aluminum poles manufactured of corrosion-resistant AA AAH35.1 aluminum alloys conforming to AASHTO LTS-4. Poles shall be seamless extruded or spun seamless type.

2.3 FOUNDATIONS FOR POLES

- A. Foundations shall be cast-in-place concrete, having 3000 psi minimum 28-day compressive strength.
- B. Foundations shall support the effective projected area of the specified pole, arm(s), luminaire(s), and accessories, such as shields, banner arms, and banners, under wind conditions previously specified in this section.
- C. Place concrete in spirally-wrapped treated paper forms for round foundations, and construct forms for square foundations.
- D. Rub-finish and round all above-grade concrete edges to approximately 0.25 in radius.

- E. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on the drawings. Anchor bolts shall be in a welded cage or properly positioned by the tie wire to stirrups.
- F. Prior to concrete pour, install electrode per Section 26 05 26,
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

2.4 LUMINAIRES

- A. Per UL 1598 and NEMA C136.17. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat, and safe cleaning and relamping.
- B. Light distribution pattern types shall be as shown on the drawings.
- C. Incorporate ballasts in the luminaire housing, except where otherwise shown on the drawings.
- D. Lenses shall be frame-mounted, heat-resistant, borosilicate glass, with prismatic refractors, unless otherwise shown on the drawings. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Pre-wire internal components to terminal strips at the factory.
- F. Bracket-mounted luminaires shall have leveling provisions and clamp-type adjustable slip-fitters with locking screws.
- G. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- H. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, match finish process and color of pole or support materials.
- I. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

2.5 LAMPS

- A. Install the proper lamps in every luminaire installed.
- B. Lamps shall be general-service, outdoor lighting types.
- C. LED sources shall meet the following requirements:
 - 1. Operating temperature rating shall be between -40° F and 120° F.
 - 2. Correlated Color Temperature (CCT): 4000K.
 - 3. Color Rendering Index (CRI): ≥ 65.
 - 4. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature

Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock
Variable Vibration Frequency, and Solder Heat Resistance (SHR).

D. Mercury vapor lamps shall not be used.

2.6 LED DRIVERS

A. LED drivers shall meet the following requirements:

1. Drivers shall have a minimum efficiency of 85%.
2. Starting Temperature: -40° F.
3. Input Voltage: 120 to 480 (±10%) V.
4. Power Supplies: Class I or II output.
5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 µs, 10kA/8 x 20 µs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
6. Power Factor (PF): ≥ 0.90.
7. Total Harmonic Distortion (THD): ≤ 20%.
8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

2.7 EXISTING LIGHTING SYSTEMS

- A. For modifications or additions to existing lighting systems, the new components shall be compatible with the existing systems.
- B. New poles and luminaires shall have approximately the same configurations and dimensions as the existing poles and luminaires, except where otherwise shown on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Pole Foundations:
 1. Excavate only as necessary to provide sufficient working clearance for installation of forms and proper use of tamper to the full depth of the excavation. Prevent surface water from flowing into the excavation. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath, and the end of conduit.
 2. Set anchor bolts according to anchor-bolt templates furnished by the pole manufacturer.

3. Install poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.
4. After the poles have been installed, shimmed, and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 0.375 in inside diameter through the grout, tight to the top of the concrete base to prevent moisture weeping from the interior of the pole.

C. Install lamps in each luminaire.

D. Adjust luminaires that require field adjustment or aiming.

3.2 GROUNDING

- A. Ground noncurrent-carrying parts of equipment, including metal poles, luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially-treated or lined connectors suitable and listed for this purpose.

3.3 ACCEPTANCE CHECKS AND TESTS

Verify operation after installing luminaires and energizing circuits.

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SECTION 27 52 31
SECURITY EMERGENCY CALL STATION

PART 1 - GENERAL

1.1 SECTION SUMMARY

- A. This section specifies the furnishing, installation, connection, and testing of the emergency call station.
- B. Work shall be complete, tested, labeled, certified and ready for operation.

1.2 RELATED SECTIONS

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 REFERENCES

- A. The installation shall comply fully with all governing authorities, laws and ordinances, regulations, codes and standards, including, but not limited to:
 - 1. United States:
 - a. Department of Labor, Occupational Safety and Health Administration (OSHA): All standards for personnel physical and life safety.
 - b. Department of Veterans Affairs, Office of Cyber and Information Security (OCIS):
 - 1) Handbook 6500, Information Security Program.
 - c. Federal Communications Commission (FCC): Part 15, Restrictions of use for Part 15 listed Radio Equipment in Safety of Life / Emergency Functions / Equipment/Locations.

2. NFPA:

70	National Electrical Code (2011 Edition) - Articles 517, 645 and 800.
75	Standard for Protection of Electronic Computer Data- Processing Equipment.
77	Recommended Practice on Static Electricity.
99	Healthcare Facilities.
101	Life Safety Code.

3. Underwriters Laboratories (UL):

65	Standard for Wired Cabinets.
468	Standard for Grounding and Bonding Equipment.
1449	Standard for Transient Voltage Surge Suppressors.

4. Local Codes.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Store products in original containers.

PART 2 - PRODUCTS AND FUNCTIONAL REQUIREMENTS

2.1 EMERGENCY CALL STATIONS

- A. The emergency call station shall be a dual button emergency phone. The unit shall be powered, free standing and ADA compliant, multi-function, high strength, security unit. The unit shall include a high quality, hands free communications device, a powerful (1 million candlepower) strobe light and a vivid blue area light, which serves to identify the unit from great distances. The station shall include a key pad. Coordinate with VA COR to designate the appropriate phone number(s) to be connected to this emergency station. It shall also include the capability to call 911.
- B. The unit shall have an integrated blue light and strobe encased in Lexan. The blue light shall be always lit, calling attention to the location of the emergency communication unit. When the emergency phone is activated, the strobe shall flash at 1 million candlepower and 60 fpm. The strobe shall flash until either actively terminated by the personnel receiving the call or automatically upon termination of the call itself.
- C. The enclosure, NEMA 4/4X shall be made of a vandal resistant, 12-gauge No.4 vertical brushed stainless steel. It shall be designed to withstand prolonged exposure to harsh environments. The unit shall have a blue light/strobe located at the top of the unit, housed in a vandal resistant, blue polycarbonate refractor housing. This blue light and strobe shall be further enclosed in a clear polycarbonate security enclosure. The free standing shall measure approximately 12 1/8 inches w x 32 1/4 inches h x 7 9/16 inches d and weigh approximately 75 lbs.

The ADA-compliant, hands-free emergency phone shall be flush mounted into the free standing enclosure. Emergency phone station faceplate shall be 12-gauge No.4 brushed stainless steel or as otherwise approved.

- D. The blue light and strobe shall be controlled via the emergency phone, and connect to an auxiliary output of the emergency phone. The emergency phone shall connect via its RJ-11 connector to a standard CAT 5E phone line. The emergency phone requires 120V power circuit. The blue light, strobe, and faceplate light require 24VAC 60 Hz power. Provide 120VAC - 24VAC, 60 Hz transformer.
- D. The system shall immediately and automatically dial the security desk when activated. The designated phone number shall be determined by the VA IT Manager. Programming shall be occurred via the call station provider's web page.
- E. Graphics:
 - 1. The graphics shall be cut from an engineering grade reflective vinyl for high visibility and legibility, with a seven-year durability.
 - 2. The standard graphics text shall be "Emergency". Standard colors shall be reflective white, reflective blue and reflective black.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Execute work in accordance with National, State and local codes, regulations and ordinances.
 - 2. Install work neatly, plumb and square and in a manner consistent with standard industry practice.
 - 3. Install equipment according to manufacturer's recommendations.
 - 4. Secure equipment firmly in place, etc.
 - a. All supports, mounts, fasteners, attachments and attachment points shall support their loads.
- B. Wiring Practice:
 - 1. Execute all communication wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.

3.2 SYSTEM PROGRAMMING

Provide all programming required for a complete and operational system. Coordinate programming parameters with Owner and Engineer.

3.3 CLEANING AND PATCHING

- A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.
- B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.
- C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the Work or to make its parts fit together properly.

3.4 GROUNDING

- A. Install grounding electrodes as specified in Division 26, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- B. Do not use "3rd or 4th" wire internal electrical system conductors for ground.
- C. Do not "mix grounds" of different systems

PART 4 -TESTING/GUARANTY/TRAINING

4.1 PROOF OF PERFORMANCE TESTING

- A. Acceptance Test:
 - 1. The system shall be tested in the presence of a Government Representative and a manufacturer's certified representative. The test shall verify that the total system meets all the requirements of this specification.

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SECTION 28 23 00
VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide and install a Video Camera to be connected to the existing Video Surveillance System.
- B. This Section includes video surveillance system consisting of cameras, data transmission wiring.

1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- C. Section 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Requirements for power cables.
- D. Section 26 05 41 - UNDERGROUND ELECTRICAL CONSTRUCTION. Requirements for underground installation of wiring.
- E. Section 26 56 00 - EXTERIOR LIGHTING. Requirements for perimeter lighting.

1.3 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the Video Camera System as shown.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated existing security systems.

1.4 SUBMITTALS

- A. Submit camera and wiring products in conjunction with Section 01 33 23.
- B. Provide manufacturer security system product cut-sheets.
- C. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide maintenance and operating manuals per the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):

330-09.....Electrical Performance Standards for CCTV
Cameras

C. Institute of Electrical and Electronics Engineers (IEEE):

C62.41-02.....IEEE Recommended Practice on Surge Voltages in
Low-Voltage AC Power Circuits

802.3af-08.....Power over Ethernet Standard

D. Federal Communications Commission (FCC):

(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

E. National Electrical Contractors Association (NECA):

303-2005.....Installing Closed Circuit Television (CCTV)
Systems

F. National Fire Protection Association (NFPA):

70-11.....Article 780-National Electrical Code

G. Underwriters Laboratories, Inc. (UL):

983-06.....Standard for Surveillance Camera Units

PART 2 - PRODUCTS

2.1 DIGITAL BASED VIDEO MANAGEMENT SYSTEM

A. Existing 7 VSOM IP Based System

1. Video cameras shall be Cisco 6400 IP or approved equal that is compatible for use with the existing central server and software 7 VSOM 6.3.2.

2.2 VIDEO CAMERAS

A. The cameras shall be outdoor high-resolution, high definition color video cameras with wide dynamic range capturing capability.

B. The camera shall meet or exceed the following specifications:

1. The image capturing device shall be a 1/3-inch image sensor designed for capturing wide dynamic images.
 - a. The image capturing device shall have a separate analog-to-digital converter for every pixel.
 - b. The image capturing device shall sample each pixel multiple times per second.
 - c. The dynamic range shall be 95 dB typical and 120 dB maximum.
3. The camera shall optimize each pixel independently.
4. The camera shall have onscreen display menus for programming of the camera's settings.
5. The signal system shall be NTSC.

C. The camera shall have composite video output.

D. The camera shall come with a manual varifocal lens.

E. The video output shall be composite: 1.0 volts peak-to-peak at 75-ohm load.

F. Fixed Color Camera

1. The camera shall be a high-resolution color video camera with wide dynamic range capturing capability.
2. Comply with UL 639.
3. Pickup Device: 1/3 CCD interline transfer.
4. Signal-to-Noise Ratio: Not less than 50 dB, with the camera AGC off.
5. With AGC, manually selectable on or off.
6. Manually selectable modes for backlight compensation or normal lighting.
7. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
8. White Balance: Auto-tracing white balance, with manually selectable fixed balance option.

2.3 WIRES AND CABLES

- A. Shall meet or exceed the manufactures recommendation for power and signal.
- B. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either RGS conduit.
- C. All conduit, pull boxes, and junction boxes shall be clearly marked with colored permanent tape or paint that will allow it to be distinguished from all other conduit and infrastructure.
- D. Conduit fills shall not exceed 50 percent unless otherwise documented.
- E. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
- F. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security system shall be defined as any cable or sets of cables carrying 30 VDC/VAC or higher.
 1. Signal Cables:
 - a. Signal wiring for PoE cameras depends on the distance the camera is being installed from either a hub or the server.
 - b. If the camera is up to 300 ft from a hub or the server, then use a shielded UTP category 5 (CAT-V) cable a with standard RJ-45

connector at each end. The cable with comply with the Power over Ethernet, IEEE802.3af, Standard.

- c. If the camera is over 300 ft from a hub or server then utilize a multimode fiber optic cable with a minimum size of 62 microns.
- d. Provide a separate cable for power.
- e. CAT-5 Technical Characteristics:

Number of Pairs	4
Total Number of Conductors	8
AWG	24
Stranding	Solid
Conductor Material	BC - Bare Copper
Insulation Material	PO - Polyolefin
Overall Nominal Diameter	.230 in.
IEC Specification	11801 Category 5
TIA/EIA Specification	568-B.2 Category 5e
Max. Capacitance Unbalance	(pF/100 m) 150 pF/100 m
Nom. Velocity of Propagation	70 %
Max. Delay	(ns/100 m) 538 @ 100MHz
Max. Delay Skew	(ns/100m) 45 ns/100 m
Max. Conductor DC Resistance	9.38 Ohms/100
Max. DCR Unbalance@ 20°C	3 %
Max. Operating Voltage	UL 300 V RMS

2. Power Cables

- a. Will be sized accordingly and shall comply with the NEC. High voltage power cables will be a minimum of three conductors, 14 AWG, stranded, and coated with a non-conductive polyvinylchloride (PVC) jacket. Low voltage cables will be a minimum of 18 AWG, stranded and non-conductive polyvinylchloride (PVC) jacket.
- b. Will be utilized for all components of the VASS System that require either a 110 VAC 60 Hz or 220 VAC 50 Hz input. Each feed will be connected to a dedicated circuit breaker at a power panel that is primarily for the security system.
- c. All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used as a means of surge protection.

- d. Shall be rated for either 110 or 220 VAC, 50 or 60 Hz, and shall comply with VA Master Spec 26 05 19 Low Voltage Electrical Power Conductors and Cables.
- e. Low Voltage Power Cables
 - 1) Shall be a minimum of 18 AWG, Stranded and have a polyvinylchloride outer jacket.
 - 2) Cable size shall determined using a basic voltage over distance calculation and shall comply with the NEC's requirements for low voltage cables.

PART 3 - EXECUTION

3.1. GENERAL

- A. Installation: The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable data transmission system.
- B. Identification and Labeling: The Contractor shall supply permanent identification labels for each cable at each

3.2 INSTALLATION

- A. Existing Equipment
 - 1. The Contractor shall connect to and utilize existing video equipment, video and control signal transmission lines, and devices as outlined in the design package.
 - 2. The Contractor shall perform a field survey, including testing and inspection of all existing video equipment and signal lines intended to be incorporated into the existing System, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
 - 3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or

- control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.
4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or incorrect installation of equipment.
- C. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
- D. Cameras:
1. Install the cameras with the focal length lens as indicated for each zone.
 2. Connect power and signal lines to the camera.
 3. Aim camera to give field of view as needed to cover the alarm zone.
 4. Aim fixed mounted cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun.
 5. Focus the lens to give a sharp picture (to include checking for day and night focus and image quality) over the entire field of view
 6. Synchronize all cameras so the picture does not roll on the monitor when cameras are selected.
 7. PTZ cameras shall have all preset positions and privacy areas defined and programmed.
- E. Monitors - Existing - Connect new camera to existing monitors.
- F. Video Server - Existing - Connect new cameras to existing Video Server. Verify new cameras are compatible with the existing server prior to procurement.
- G. Video Signal Equipment:
1. Install the video signal equipment as shown in the design and construction documents, and as specified by the OEM.
 2. Connect video or signal inputs and outputs as shown and specified.
 3. Terminate video inputs as required.
 4. Connect alarm signal inputs and outputs as required.
 5. Connect control signal inputs and outputs as required
 6. Connect electrically powered equipment to AC power.
- H. Camera Housings, Mounts, and Poles:
1. Install the camera housings and mounts on lighting poles as specified by the manufacturer and as shown, provide mounting

- hardware sized appropriately to secure each camera, housing and mount with maximum wind and ice loading encountered at the site.
2. Provide a foundation for each camera pole as specified and shown.
 3. Provide a ground rod for each camera pole and connect the camera pole to the ground rod as specified in Division 26 of the VA Master Specification and the VA Electrical Manual 730.
 4. Provide electrical and signal transmission cabling to the mount location via a hardened carrier system from the Physical Access Control System and Database Management to the device.
 5. Connect signal lines and AC power to the housing interfaces.
 6. Connect pole wiring harness to camera.

3.3 SYSTEM START-UP

- A. The Contractor shall not apply power to the System until the following items have been completed:
 1. System equipment items and have been set up in accordance with manufacturer's instructions.
 2. A visual inspection of the System has been conducted.
 3. System wiring has been tested and verified as correctly connected as indicated.
 4. All system grounding and transient protection systems have been verified as installed and connected as indicated.
- B. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.
- C. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.

3.6 DEMONSTRATION AND TRAINING

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, "GENERAL REQUIREMENTS".
- B. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

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SECTION 31 20 11
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This section specifies the requirements for furnishing all equipment, materials, labor and techniques for earthwork including excavation, fill, and backfill.

1.2 DEFINITIONS

- A. Unsuitable Materials:
 - 1. Fills: Topsoil, frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 3 inches; organic materials, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable.
 - 2. Existing Subgrade (except footings): Same materials as above paragraph, that are not capable of supporting concrete and asphalt pavement, and similar construction, with the possible exception of improvement by compaction, proofrolling, or similar methods of improvement.
 - 3. Existing Subgrade (footings only): Same as Paragraph 1, but no fill or backfill. If materials differ from design requirements, excavate to acceptable strata subject to approval of the COR.
- B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for structures and trenchwork throughout the job site.
- C. Degree of Compaction: Degree of compaction is expressed as a percentage of maximum density obtained by the test procedure presented in T180 or ASTM D1557.
- D. The term fill means fill or backfill as appropriate.

1.3 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

1.4 CLASSIFICATION OF EXCAVATION

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on the surface; utilities, and other items

including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Contractor shall submit procedure and location for disposal of unused satisfactory material and proposed source of borrow material (if applicable).
- D. Qualifications of the commercial testing laboratory or Contractor's Testing facility shall be submitted.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Referenced publications shall be the current version as of the date of advertisement of the project.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - T99.....Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop
 - T180.....Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10 lb) Rammer and a 457 mm (18 inch) Drop
- C. ASTM International (ASTM):
 - D698.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
 - D1557.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
 - D2487.....Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D. State of California Department of Transportation (Caltrans) Standard Specifications, 2010 edition.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide borrow material when sufficient satisfactory soil materials are not available from excavations.
- B. Engineered Fill: Naturally or artificially graded granular soil mixture complying with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP,

SM, SC, and ML, or any combination of these groups, or as approved by the COTR or material with at least 90 percent passing a 1 1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

- C. Pipe Bedding and Initial Trench Backfill: Granular material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, or any combination of these groups, with maximum particle size of 1/2 inch. Material obtained from trench excavations may be used, provided it conforms to the above specifications and is substantially free of roots, trash and other material which may be compressible or which cannot be compacted properly.
- D. Final Trench Backfill: Soil obtained from excavation for installation of piping, drop inlets and manholes, provided that it is substantially free of material which may be compressible or which cannot be compacted properly.
- E. Buried Warning and Identification Tape: Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specific below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, Unaffected by moisture or soil. Warning tape color codes:
 - Red: Electric
 - Yellow: Gas, Oil, Dangerous Materials
 - Orange: Telephone and Other Communications
 - Green: Sewer Systems
- F. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Existing Concrete Slabs and Asphalt Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend

pavement section to be removed a minimum of 12 inches on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from the Medical Center property.

- B. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope to its angle of repose banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities, in compliance with OSHA requirements.
1. Extend shoring and bracing to the bottom of the excavation. Shore excavations that are carried below the elevations of adjacent existing foundations.
 2. If the bearing of any foundation is disturbed by excavating, improper shoring or removal of shoring, placing of backfill, and similar operations, provide a concrete fill support under disturbed foundations, as directed by the COR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by Resident Engineer.
- B. Excavation Drainage: Operate pumping equipment or provide other materials, means and equipment as required to keep excavations free of water and exposed excavated surfaces dry, firm, and undisturbed until approval of permanent work has been received from the COR. When subgrade for foundations and other concrete work has been disturbed by water, remove the disturbed material to firm undisturbed material after the water is brought under control. Replace disturbed subgrade in trenches by mechanically tamped sand or gravel. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least two feet below the working level. Operate dewatering system continuously until construction work below existing water levels is complete.

C. Earthwork for Pavements and Structural Subgrade:

1. Excavation shall be accomplished as required by the Drawings and Specifications.
2. Excavate to required subgrade elevation for asphalt pavement and concrete construction to solid undisturbed subgrade.
3. Remove loose or soft material to solid bottom as approved by the COR.
4. Fill excess cut under footings or foundations with 3000 psi concrete, poured separately from the footings (if applicable).
3. Do not tamp earth for backfilling in footing bottoms, except as specified.

D. Trench Earthwork:

1. Utility trenches (except storm sewer):
 - a. Excavate to a width as necessary for sheeting (or other required slope stabilization) and proper performance of the work.
 - b. Grade bottom of trenches with bell holes, scooped out to provide a uniform bearing.
 - c. Support piping on suitable undisturbed earth unless a mechanical support is shown. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.
 - d. The length of open trench in advance of pipe laying shall not be greater than is authorized by the COR.
 - e. Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade. Under pavements and slabs, bury tape 6 inches below top of subgrade
 - f. Bedding shall be of the type and thickness shown. Initial trench backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the top of the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.
2. Storm sewer trenches:
 - a. Trench width below a point 6 inches above top of the pipe shall be 24 inches for up to and including 12 inches diameter and four-thirds diameter of pipe plus 8 inches for pipe larger than 12 inches. Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
 - b. The bottom quadrant of the pipe shall be bedded on suitable undisturbed soil or granular fill. Depth of bedding shall be a minimum of 4 inches, unless otherwise indicated on the Drawings.

Place and tamp fill material by hand. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

- c. Initial Trench Backfill: Place backfill to 12 inches above top of pipe. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Place and compact fill material by hand using methods that will not disturb or damage pipe.
 - d. Place and compact as specified the remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
 - e. Use granular fill for bedding where rock or rocky materials are excavated.
- E. Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.
- F. Site Earthwork: Excavation shall be accomplished as required by the Drawings and Specifications. Remove subgrade materials that are determined by the COR as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the Contractor shall obtain samples of the material, under the direction of the COR, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. When unsuitable material is encountered and removed, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on yardage in cut section only.
- G. Finished elevation of subgrade shall be as follows:
- 1. Asphalt Pavement and Concrete Construction Areas - Bottom of the asphalt pavement aggregate base course or bottom of concrete, as applicable.
 - 2. Planting and Lawn Areas - 4 inches below the finished grade, unless otherwise specified or indicated on the Drawings.

3.3 FILLING AND BACKFILLING

- A. General: Do not fill or backfill until all debris, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from the excavation. Use excavated materials or borrow for fill and backfill, as applicable. Do not use unsuitable excavated materials.

- B. Placing: Place material in horizontal layers not exceeding 8 inches in loose depth and then compacted. Do not place material on surfaces that are muddy, frozen, or contain frost.
- C. Compaction: Use approved equipment (hand or mechanical) well suited to the type of material being compacted. Do not operate mechanized vibratory compaction equipment within 10 feet of new or existing building walls or retaining walls without the prior approval of the COR. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
- D. Borrow Material: Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

3.4 GRADING AND COMPACTION

- A. General: Uniformly grade the areas within the limits of new construction, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Compact top 8 inches of subgrade under asphalt and concrete pavement to at least 95 percent of the materials' maximum dry density determined in accordance with AASHTO T180 or ASTM D1557. The subgrade under the concrete structural tank pad will not require compaction if conditions are acceptable to the COR.
- C. Finish subgrade in a condition acceptable to the COR at least one day in advance of asphalt paving and concrete placement operations. Maintain finished subgrade in a smooth and compacted condition until the succeeding operation has been accomplished. Scarify, compact, and grade the subgrade prior to further construction when approved compacted

subgrade is disturbed by contractor's subsequent operations or adverse weather.

- D. Grading for Asphalt Pavement and Concrete Construction Areas (including curbs and gutters): Provide final grades for both subgrade and base course to +/- 0.25 inches of indicated grades.

3.5 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.
- B. Place excess excavated materials suitable for fill and/or backfill on site where directed.
- C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.

3.6 CLEAN-UP

- A. Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove debris, rubbish, and excess material from the Medical Center property.

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SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies construction of aggregate base course and hot mix asphalt (HMA) pavement courses on prepared subgrade, and the protection of the base and pavement courses. HMA pavement shall be constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, cross-section, and elevation shown on the Drawings and shall be rolled, finished, and approved before the placement of the next course.

1.2 RELATED WORK

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Section 31 11 00, EARTHWORK.

1.3 QUALITY ASSURANCE

- A. The Contracting Officer's Representative (COR) shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.
- B. The Contractor's Registered Professional Land Surveyor (refer to Section 01 00 00) shall establish and control the pavement grades, elevations, and cross-sections as shown on the Drawings.

1.4 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Data and Test Reports:
 - 1. Aggregate Base Course: Sources, gradation, resistance, durability, and other tests required by Caltrans.
 - 2. HMA Pavement Course(s): Aggregate source, gradation, and other tests required by Caltrans.
 - 3. Job-mix formulas.
- C. Certifications:
 - 1. Asphalt prime and tack coat material certificate(s) of conformance to Caltrans requirements.
 - 2. Asphalt binder certificate of conformance to Caltrans requirements.
 - 3. Job-mix certification - Submit plant mix certification that mix equals or exceeds Caltrans requirements.
- D. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Referenced publications shall be the current version as of the date of advertisement of the project.
- B. State of California Department of Transportation (Caltrans) Standard Specifications, 2010 edition.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Aggregate base and asphalt concrete materials shall conform to the requirements of the Caltrans Standard Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Department" is referenced in the Caltrans Standard Specifications, it shall mean the VA Contracting Officer or COR.

2.2 AGGREGATES

- A. Furnish aggregates for aggregate base course and for HMA pavement courses in conformance with the applicable requirements of Sections 26 and 39 of the Caltrans Standard Specifications.

2.3 HMA PAVEMENT

- A. Materials and mix design shall comply with the applicable requirements of Section 39 of the Caltrans Standard Specifications for the type of pavement to be constructed. Furnish Hot Mixed Asphalt Base (HMAB) and HMA surface course as approved by COR. Total depth of HMA pavement courses shall be 3.5 inches minimum or match existing, whichever is greater.

PART 3 - EXECUTION

3.1 GENERAL

- A. HMA paving equipment, weather limitations, job-mix formulas, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the Caltrans Standard Specifications for the type of material specified.

3.2 MIXING HMA PAVEMENT MATERIALS

- A. Conform to the applicable requirements of Section 39 of the Caltrans Standard Specifications.

3.3 SUBGRADE

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.

- D. Should the subgrade become rutted or displaced prior to the placing of the aggregate base, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 50 ton gross weight dump truck as directed by the COR. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

- A. Aggregate Base Construction:
 - 1. Conform to the applicable requirements of Section 26 of the Caltrans Standard Specifications and as specified in the following paragraphs.
 - 2. Spread and compact to the thickness shown on the Drawings.
 - 3. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 4. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for HMA pavement.
- B. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0 to plus 1/2 inch.
- C. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 3/16 inch in ten feet.
- D. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.5 PLACEMENT OF HMA PAVEMENT COURSE(S)

- A. Conform to the applicable requirements of Section 39 of the Caltrans Standard Specifications and as specified in the following paragraphs.
- B. Remove all loose materials from the compacted base.
- C. Apply tack coat where required and allow to dry in accordance with Section 39 of the Caltrans Standard Specifications.
- C. Receipt of HMA pavement materials:
 - 1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 280 degrees F.
 - 2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 50 degrees F, and not during fog, rain, or other unsuitable conditions.
- E. Spreading:
 - 1. Spread material in a manner that requires the least handling.
 - 2. Where finished thickness of each course will be 3 inches or less, spread in one layer.
- F. Rolling:
 - 1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the Drawings.

2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
 - a. No depressions which will retain standing water.
 - b. No deviation greater than 1/8 inch in six feet.

3.6 PROTECTION

- A. Protect the HMA pavement areas from traffic in accordance with Section 39 of the Caltrans Standard Specifications.

3.7 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

- - - E N D - - -

SECTION 33 52 10
SERVICE PIPING, FUEL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section defines the requirements for pipe, piping components, and valves as related to service station fuel distribution systems. Provide the entire fuel distribution system as a complete and fully operational system. Size, select, construct, and install equipment and system components to operate together as a complete system. Substitutions of functions specified herein will not be acceptable. Coordinate the work of the system manufacturer's service personnel during construction, testing, calibration, and acceptance of the system. Equipment and piping specified herein shall be designed to handle a working pressure of 275 psig at 100 deg F. Equipment specified herein shall be compatible with the fuel to be handled.

1.2 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. AMERICAN PETROLEUM INSTITUTE (API)
- API RP 1110(2013) Pressure Testing of Steel Pipelines for
the Transportation of Gas, Petroleum Gas,
Hazardous Liquids, Highly Volatile Liquids or
Carbon Dioxide
- API RP 2003(2008; 7th Ed) Protection Against Ignitions
Arising out of Static, Lightning, and Stray
Currents
- API RP 540(1999; R 2004) Electrical Installations in
Petroleum Processing Plants
- API Spec 5L(2012) Specification for Line Pipe
- API Spec 6D(2008; Errata 1 2008; Errata 2 2008; Errata 3
2009; Addendum 1 2009; Errata 4 2010; Errata 5
2010; Errata 6 2011; Addendum 2 2011; Addendum
3 2012)Specification for Pipeline Valves

- API Spec 6FA(1999; R 2006; Errata 2006; Errata 2008; R
2011) Specification for Fire Test for Valves
- API Std 594(2010) Check Valves: Flanged, Lug, Wafer and
Butt-Welding
- API Std 610(2010; Errata 2011) Centrifugal Pumps for
Petroleum, Petrochemical, and Natural Gas
Industries
- C. AMERICAN WATER WORKS ASSOCIATION (AWWA)
- AWWA C209(2013) Cold-Applied Tape Coatings for the
Exterior of Special Sections, Connections and
Fitting for Steel Water Pipelines
- AWWA C215(2010) Extruded Polyolefin Coatings for the
Exterior of Steel Water Pipelines
- AWWA C216(2007) Heat-Shrinkable Cross-Linked Polyolefin
Coatings for the Exterior of Special Sections,
Connections, and Fittings for Steel Water
Pipelines
- AWWA C217(2009) Petrolatum and Petroleum Wax Tape
Coatings for the Exterior of Connections and
Fittings for Steel Water Pipelines
- D. AMERICAN WELDING SOCIETY (AWS)
- AWS A5.8/A5.8M(2011; Amendment 2012) Specification for Filler
Metals for Brazing and Braze Welding
- AWS BRH(2007; 5th Ed) Brazing Handbook
- E. ASME INTERNATIONAL (ASME)
- ASME B1.1(2003; R 2008) Unified Inch Screw Threads (UN
and UNR Thread Form)
- ASME B16.11(2011) Forged Fittings, Socket-Welding and
Threaded
- ASME B16.18(2012) Cast Copper Alloy Solder Joint Pressure
Fittings
- ASME B16.21(2011) Nonmetallic Flat Gaskets for Pipe
Flanges
- ASME B16.22(2012) Standard for Wrought Copper and Copper
Alloy Solder Joint Pressure Fittings
- ASME B16.26(2011) Standard for Cast Copper Alloy Fittings
for Flared Copper Tubes

- ASME B16.3(2011) Malleable Iron Threaded Fittings,
Classes 150 and 300
- ASME B16.34(2013) Valves - Flanged, Threaded and Welding
End
- ASME B16.39(2009) Standard for Malleable Iron Threaded
Pipe Unions; Classes 150, 250, and 300
- ASME B16.5(2013) Pipe Flanges and Flanged Fittings: NPS
1/2 Through NPS 24 Metric/Inch Standard
- ASME B16.9(2012) Standard for Factory-Made Wrought Steel
Buttwelding Fittings
- ASME B18.2.1(2012) Square and Hex Bolts and Screws (Inch
Series)
- ASME B18.2.2(2010) Nuts for General Applications: Machine
Screw Nuts, Hex, Square, Hex Flange, and
Coupling Nuts (Inch Series)
- ASME B31.3(2012) Process Piping
- ASME B40.100(2005; R 2010) Pressure Gauges and Gauge
Attachments
- ASME B40.200(2008) Thermometers, Direct Reading and Remote
Reading
- ASME BPVC SEC VIII D1 (2010) BPVC Section VIII-Rules for Construction
of Pressure Vessels Division 1
- F. ASTM INTERNATIONAL (ASTM)
- ASTM A105/A105M(2012) Standard Specification for Carbon Steel
Forgings for Piping Applications
- ASTM A182/A182M(2013) Standard Specification for Forged or
Rolled Alloy-Steel Pipe Flanges, Forged
Fittings, and Valves and Parts for High-
Temperature Service
- ASTM A193/A193M(2012a) Standard Specification for Alloy-Steel
and Stainless Steel Bolting Materials for High-
Temperature Service and Other Special Purpose
Applications
- ASTM A194/A194M(2012a) Standard Specification for Carbon and
Alloy Steel Nuts for Bolts for High-Pressure or
High-Temperature Service, or Both

ASTM A216/A216M(2012) Standard Specification for Steel
Castings, Carbon, Suitable for Fusion Welding,
for High-Temperature Service

ASTM A234/A234M(2011a) Standard Specification for Piping
Fittings of Wrought Carbon Steel and Alloy
Steel for Moderate and High Temperature Service

ASTM A269(2010) Standard Specification for Seamless and
Welded Austenitic Stainless Steel Tubing for
General Service

ASTM A276(2013) Standard Specification for Stainless
Steel Bars and Shapes

ASTM A307(2012) Standard Specification for Carbon Steel
Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A312/A312M(2013a) Standard Specification for Seamless,
Welded, and Heavily Cold Worked Austenitic
Stainless Steel Pipes

ASTM A351/A351M(2013) Standard Specification for Castings,
Austenitic, for Pressure-Containing Parts

ASTM A356/A356M(2011) Standard Specification for Steel
Castings, Carbon, Low Alloy, and Stainless
Steel, Heavy-Walled for Steam Turbines

ASTM A358/A358M(2012) Standard Specification for Electric-
Fusion-Welded Austenitic Chromium-Nickel
Stainless Steel Pipe for High-Temperature
Service and General Applications

ASTM A36/A36M(2012) Standard Specification for Carbon
Structural Steel

ASTM A403/A403M(2013) Standard Specification for Wrought
Austenitic Stainless Steel Piping Fittings

ASTM A53/A53M(2012) Standard Specification for Pipe, Steel,
Black and Hot-Dipped, Zinc-Coated, Welded and
Seamless

ASTM A563(2007a) Standard Specification for Carbon and
Alloy Steel Nuts

ASTM A733(2003; E 2009; R 2009) Standard Specification
for Welded and Seamless Carbon Steel and
Austenitic Stainless Steel Pipe Nipples

- ASTM A743/A743M(2013a) Standard Specification for Castings,
Iron-Chromium, Iron-Chromium-Nickel, Corrosion
Resistant, for General Application
- ASTM B117(2011) Standard Practice for Operating Salt
Spray (Fog) Apparatus
- ASTM B247(2009) Standard Specification for Aluminum and
Aluminum-Alloy Die Forgings, Hand Forgings, and
Rolled Ring Forgings
- ASTM B32(2008) Standard Specification for Solder Metal
- ASTM B62(2009) Standard Specification for Composition
Bronze or Ounce Metal Castings
- ASTM B687(1999; R 2011) Standard Specification for
Brass, Copper, and Chromium-Plated Pipe Nipples
- ASTM B75/B75M(2011) Standard Specification for Seamless
Copper Tube
- ASTM B813(2010) Standard Specification for Liquid and
Paste Fluxes for Soldering of Copper and Copper
Alloy Tube
- ASTM B88(2009) Standard Specification for Seamless
Copper Water Tube
- ASTM D229(2009b) Rigid Sheet and Plate Materials Used
for Electrical Insulation
- ASTM D3308(2012) PTFE Resin Skived Tape
- ASTM D5677(2005; R 2010) Fiberglass (Glass-Fiber-
Reinforced Thermosetting-Resin) Pipe and Pipe
Fittings, Adhesive Bonded Joint Type, for
Aviation Jet Turbine Fuel Lines
- ASTM F1172(1988; R 2010) Standard Specification for Fuel
Oil Meters of the Volumetric Positive
Displacement Type
- ASTM F436(2011) Hardened Steel Washers
- ASTM F844(2007a) Washers, Steel, Plain (Flat),
Unhardened for General Use
- G. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
- IEEE 1100(2005) Emerald Book IEEE Recommended Practice
for Powering and Grounding Electronic Equipment

- IEEE 142(2007) Recommended Practice for Grounding of
Industrial and Commercial Power Systems - IEEE
Green Book
- H. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)
MSS SP-58(2009) Pipe Hangers and Supports - Materials,
Design and Manufacture, Selection, Application,
and Installation
MSS SP-69(2003; Notice 2012) Pipe Hangers and Supports -
Selection and Application (ANSI Approved
American National Standard)
- I. NACE INTERNATIONAL (NACE)
NACE SP0185(2007) Extruded Polyolefin Resin Coating
Systems with Soft Adhesives for Underground or
Submerged Pipe
NACE SP0188(1999; R 2006) Discontinuity (Holiday) Testing
of New Protective Coatings on Conductive
Substrates
- J. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA MG 1(2011; Errata 2012) Motors and Generators
NEMA MG 11(1977; R 2012) Energy Management Guide for
Selection and Use of Single Phase Motors
- K. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 30(2012; Errata 2011; Errata 2011) Flammable and
Combustible Liquids Code
NFPA 70(2014) National Electrical Code
NFPA 77(2007) Recommended Practice on Static
Electricity
NFPA 780(2014) Standard for the Installation of
Lightning Protection Systems
- L. SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)
SAE AMS3275(2009; Rev C) Sheet, Acrylonitrile Butadiene
(NBR) Rubber and Non-Asbestos Fiber Fuel and
Oil Resistant
SAE J514(2012) Hydraulic Tube Fittings
- M. THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)
SSPC PA 1(2000; E 2004) Shop, Field, and Maintenance
Painting of Steel

- N. U.S. GENERAL SERVICES ADMINISTRATION (GSA)
CID A-A-50561(Basic) Pumps, Rotary, Power-Driven, Viscous
Liquids
- O. UNDERWRITERS LABORATORIES (UL)
UL FLAMMABLE & COMBUSTIBLE(2012) Flammable and Combustible
Liquids and Gases Equipment
Directory

1.3 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Shop Drawings:
 - 1. Grounding and Bonding
 - 2. Pipe Hangers and Supports
- C. Product Data:
 - 1. Carbon Steel Pipe
 - 2. Pressure Gauge
 - 3. Wafer Type Check Valve
 - 4. Ball Valve
 - 5. Pressure Relief Valve
 - 6. Tank Overfill Prevention Valve
 - 7. Anti-siphon valve
 - 8. Submersible Pump
 - 9. Coating
- D. Test Reports:
 - 1. Exterior Coating Holiday Test
 - 2. Preliminary Pneumatic Test
 - 3. Final Pneumatic Test
 - 4. Hydrostatic Test
 - 5. Coating Environmental Conditions
 - 6. Results of dry film thickness measurements
- E. Certificates:
 - 1. Contractor Qualifications
 - 2. Licensed Personnel
 - 3. Demonstrations
- F. Operation and Maintenance Data:
 - 1. Wafer Type Check Valve
 - 2. Ball Valve

3. Pressure Relief Valve
4. Tank Overfill Prevention Valve
5. Anti-siphon valve
6. Submersible Pump

1.4 QUALITY ASSURANCE

- A. Contractor Qualifications: Each installation Contractor shall have successfully completed at least 3 projects of the same scope and the same size, or larger, within the last 6 years; demonstrate specific installation experience in regard to the specific system installation to be performed; have taken, if applicable, manufacturer's training courses on the installation of piping; and meet the licensing requirements in the state. Submit a letter listing prior projects, the date of construction, a point of contact for each prior project, the scope of work of each prior project, and a detailed list of work performed providing in the letter evidence of prior manufacturer's training and state licensing.

B. Regulatory Requirements

1. Licensed Personnel: Pipe installers shall be licensed/certified by the state when the state requires licensed installers.
2. Provide documentation required for Air Resources Board Vapor Recovery Advisory Number 393 for this facility to be a research and development test site. Letter shall list all equipment (manufacturer, make and model) to be used at this facility. Equipment selected must meet the California Air Resource Board requirements and be accepted.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.6 PROJECT/SITE CONDITIONS

- A. Fuel required for the testing, flushing and cleaning efforts, as specified in this Section, will be provided and delivered by the Contracting Officer. Do not flush, clean, or test any system with fuel or liquid not intended for final system operation. Fuel used in the system will remain the property of the Government. Fuel shortages not attributable to normal handling losses shall be reimbursed to the Government.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Internal parts and components of equipment, piping, piping components, and valves that could be exposed to fuel during system operation shall not be constructed of zinc coated (galvanized) metal, brass, bronze, or other copper bearing alloys. Do not install cast iron bodied valves in piping systems that could be exposed to fuel during system operation.

1. Standard Products: Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products; that are of a similar material, design and workmanship; and that have been in satisfactory commercial or industrial use for a minimum 2 years prior to bid opening. The 2 year period shall include applications of the equipment and materials under similar circumstances and of similar size. Materials and equipment shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.
2. Nameplates: Attach nameplates to all specified equipment, thermometers, gauges, and valves defined herein. List on each nameplate the manufacturer's name, address, component type or style, model or serial number, catalog number, capacity or size, and the system that is controlled. Construct plates of anodized aluminum or stainless steel. Install nameplates in prominent locations with nonferrous screws, nonferrous bolts, or permanent adhesive. Minimum size of nameplates shall be 1 by 2.5 inches. Lettering shall be the normal block style with a minimum 0.25 inch height. Accurately align all lettering on nameplates.

2.2 ELECTRICAL COMPONENTS

- A. General: Provide motors, motor starters, controllers, integral disconnects, contactors, controls, and control wiring with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified. Provide switches and devices necessary for controlling and protecting electrical equipment. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Controllers and contactors shall have a maximum of 120-volt control circuits and shall have auxiliary contacts for use with

the controls provided. For packaged equipment, the manufacturer shall provide controllers including the required monitors and timed restart.

- B. Motors: Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage. Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Provide polyphase, squirrel-cage medium induction motors, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.
- C. Underground Wiring: Enclose underground electrical wiring in PVC coated conduit. Dielectrically isolate conduit at any steel storage tank connection.
- D. Grounding and Bonding: Grounding and bonding shall be in accordance with NFPA 70, NFPA 77, NFPA 780, API RP 540, API RP 2003, IEEE 142, and IEEE 1100. Provide jumpers to overcome the insulating effects of gaskets, paints, or nonmetallic components.

2.3 FLANGED END CONNECTIONS

- A. Flanges: Provide flanged end connections on equipment, fittings, piping, piping components, adapters, couplers, and valves that conform to ASME B16.5, Class 150.
1. Carbon Steel: Carbon steel flanges shall conform to ASTM A105/A105M.
- B. Flange Gaskets, Non-Isolating: Provide flange gaskets that are 1/8 inch thick and that conform to ASME B16.21, raised-face type unless otherwise indicated. Gaskets shall be constructed of Buna-N.
- C. Flange Gaskets, Electrically Isolating: Flange gaskets shall conform to ASTM D229 and shall provide an electrical insulating material of 1000 ohms minimum resistance. Provide gasket material that is chemically compatible with the fuel to be handled. Provide gaskets

that are the full face type. Provide flanges that have a full surface 0.03 inch thick, spiral-wound mylar insulating sleeves between the bolts and the holes in the flanges. Bolts may have reduced shanks of a diameter not less than the diameter at the root of the threads. Provide high-strength 1/8 inch thick phenolic insulating washers next to the flanges with flat circular stainless steel washers over the insulating washers and under bolt heads and nuts. Provide bolts long enough to compensate for the insulating gaskets and stainless steel washers.

- D. Flange Bolts, Nuts, and Washers: Bolts and nuts for pipe flanges, flanged fittings, valves and accessories shall conform to ASME B18.2.1 and ASME B18.2.2, except as otherwise specified. Bolts shall be regular hexagonal type. Bolts shall be threaded in accordance with ASME B1.1, Class 2A fit, Coarse Thread Series, for sizes 1 inch and smaller and Eight-Pitch Thread Series for sizes larger than 1 inch. Nuts shall be the hexagonal, heavy series type. Nuts shall be threaded in accordance with ASME B1.1, Class 2B fit, Coarse Thread Series for sizes 1 inch and smaller and Eight-Pitch Thread Series for sizes larger than 1 inch. Bolts shall be of sufficient length to obtain full bearing on the nuts and shall project no more than two full threads beyond the nuts with the bolts tightened to the required torque.

1. Stainless Steel Materials: Bolts shall conform to ASTM A193/A193M, Class 2, Grade 8. Nuts shall conform ASTM A194/A194M, Grade 8. Washers shall conform to ASTM F436, flat circular.
2. Carbon Steel Materials: Bolts shall conform to ASTM A307, Grade B, hot-dipped galvanized. Nuts shall conform to ASTM A563, Grade A, hex style, hot-dipped galvanized. Washers shall conform to ASTM F844, hot-dipped galvanized.

2.4 PIPE

- A. Pipe shall meet the material, fabrication and operating requirements of ASME B31.3, except as modified herein.
- B. Carbon Steel Pipe: Provide carbon steel pipe that complies with one of the following:
 1. Pipe shall conform to ASTM A53/A53M, Type E or S, Grade B, seamless or electric welded. Pipe smaller than 2-1/2 inches shall be Schedule 80. Pipe 2-1/2 inches and larger shall be Schedule 40.

2. Pipe shall conform to API Spec 5L, Product Specification Level (PSL) 1, Grade B, seamless or electric welded.

- C. End connections for pipe or fittings smaller than 2-1/2 inches shall be forged, socket weld type conforming to ASTM A182/A182M and ASME B16.11, unless indicated otherwise. End connections for pipe or fittings 2-1/2 inches and larger shall be butt weld type conforming to ASTM A234/A234M, Grade WPB and ASME B16.9 of the same wall thickness as the adjoining pipe. Where threaded end connections are indicated, provide connections that conform to ASME B16.3, Class 150 or ASME B16.11.

2.5 PIPING COMPONENTS

- A. Provide piping components that meet the material, fabrication and operating requirements of ASME B31.3, except as modified herein. Pressure design class for piping components shall be Class 150 as defined in ASME B16.5.
1. Welded Nipples: Nipples shall conform to ASTM A733 or ASTM B687 and be constructed of the same material as the connecting pipe.
 2. Steel Couplings: Couplings shall conform to API Spec 5L, seamless, extra heavy, wrought steel with recessed ends.
 3. Threaded Unions: Unions shall conform to ASME B16.39, Class 150. Unions materials shall conform to ASTM A312/A312M, Grade 304 or 316. Dielectric unions shall conform to dimensional, strength, and pressure requirements of ASME B16.39, Class 150. Steel parts shall be galvanized or plated. Union shall have a water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint. When dry, union shall be able to withstand a 600-volt breakdown test.
 4. Joint Compound: Joint compounds shall be resistant to water and be suitable for use with fuel containing 40 percent aromatics.
 5. Flexible Pipe Connector: Connector shall be the flexible, close pitch, metal hose type that is constructed with exterior annular corrugations and provided with a single layer of braided wire sheath covering. Connectors shall be constructed entirely of stainless steel and be rated for the system working pressure and temperature. Provide threaded end connections for connectors smaller than 2-1/2 inches. Provide flanged end connections for connectors 2-1/2 inches and larger.

6. Pressure Gauge: Gauge shall be the single style type that conform to ASME B40.100. Gauge shall have a 4-1/2 inch dial, a stainless steel case and tube, a stainless steel ball valve, pressure snubbers, and a scale range as indicated. Gauge shall be liquid-filled with glycerin or silicone.
7. Pipe Hangers and Supports: Hangers and supports shall be the adjustable type conforming to MSS SP-58 and MSS SP-69, except as modified herein. Provide hot-dipped galvanized finish on rods, nuts, bolts, washers, hangers, and supports. Provide miscellaneous metal that conforms to ASTM A36/A36M, standard mill finished structural steel shapes, hot-dipped galvanized.
 - a. Pipe Protection Shields: Shields shall conform to MSS SP-58 and MSS SP-69, Type 40, except material shall be Type 316 stainless steel. Provide shields at each slide type pipe hanger and support.
 - b. Low Friction Supports: Supports shall have self-lubricating anti-friction bearing elements composed of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates, prebonded to appropriate backing steel members. The coefficient of static friction between bearing elements shall be 0.06 from initial installation for both vertical and horizontal loads and deformation shall not exceed 0.002 inch under allowable static loads. Bonds between material and steel shall be heat cured, high temperature epoxy. Design pipe hangers and support elements for the loads applied. Provide anti-friction material with a minimum of 0.09 inch thick. Provide hot-dipped galvanized steel supports. Provide supports that are factory designed and manufactured.
8. Escutcheon: Escutcheon shall be the chrome plated, stamped steel, hinged, split ring type. Inside diameter shall closely fit pipe outside diameter. Outside diameter shall completely cover the corresponding floor, wall, or ceiling opening. Provide each escutcheon with necessary set screws.

2.6 GENERAL VALVES

- A. Provide valves that meet the material, fabrication and operating requirements of ASME B31.3, except as modified herein. Valves shall have flanged end connections and conform to ASME B16.34, Class 150 except as modified herein. Provide stainless steel stem and trim for

each valve. Valves shall have a weatherproof housing. Seats, body seals, and stem seals shall be Viton or Buna-N.

1. Carbon Steel Piping. Provide valves with bodies, bonnets, and covers constructed of cast steel conforming to ASTM A216/A216M.
- B. Wafer Type Check Valve: Valve shall be the dual-plate, double flanged, wafer type that conforms to API Std 594. Wafer type check valves may be provided in lieu of swing check valves in piping sizes larger than 4 inches. Valve disc shall be constructed of ASTM A351/A351M, Grade CF8M stainless steel. Valve spring, hinge pin, stop pin, and radial-thrust bearing materials shall be constructed of Type 316 stainless steel.
- C. Ball Valve: Valve shall be the non-lubricated, double seated, ball type that conforms to API Spec 6D. Valve shall operate from fully open to fully closed with 90 degree rotation of the ball. Valve shall be capable of 2-way shutoff. Valve ball shall be constructed of stainless steel. For valves 2 inches and larger, provide full bore type. Valves smaller than 2 inches shall have one piece bodies and shall have a minimum bore not less than 55 percent of the internal cross sectional area of a pipe of the same nominal diameter. Provide valves with worm gear operators, except valves 6 inches and smaller may be lever operated with a minimum 10 adjustable positions between fully opened and fully closed.
- D. Pressure Relief Valve: Valve shall be the fully enclosed, spring loaded, angle pattern, ball seated type with lift lever. Valve shall have corrosion-resistant valve seats. Valve stem shall be fully guided between the fully opened and fully closed positions. Valve shall be factory set to open at the indicated pressure (plus or minus ten percent deviation). Valve setpoint shall be field adjustable within a minimum range of plus or minus 20 percent of the indicated setpoint.
- E. Tank Overfill Prevention Valve: Valve shall be the designed to prevent overfilling of aboveground storage tanks by providing a positive shut-off during a pressurized fill delivery. It shall be an integral part of the drop tube.
- F. Anti-Siphon Valve: Valve shall be a normally closed diaphragm valve that opens when energized to allow fuel flow to the dispenser. Valve shall be equipped with integral thermal pressure relief to relieve pressure back to the tank. Valve shall have threaded end connections.

2.7 PUMPS

- A. Pumps shall be driven by an explosion-proof motor for Class I, Division 1, Group D hazardous locations as defined in NFPA 70. Pump assemblies shall be statically and dynamically balanced for all flow rates from no flow to 120 percent of design flow. Pump motors shall be non-overloading throughout their entire pump curve.

1. Submersible Pump: Pump shall be the single-stage, vertical type. Pump and motor combination shall operate totally submerged in the product of the storage tank. Pump shall extend within 6 inches of the storage tank bottom. Pump fuel inlets shall be horizontal. Pump mounting shall completely support both the weight and vibration of the pump. Pump shall include a steel lifting lug capable of supporting the weight of the entire pump and motor assembly. Pump shall include a vertical solid shaft motor, base mounting flange, horizontal pump discharge, low net positive suction head (NPSH) first stage impellers, and dynamic and thrust balancing of impellers. Pump shall be accessible for servicing without disturbing connecting piping. Pump baseplate, casing, and bearing housing shall be of cast iron construction. Pump shall be provided with a stainless steel one piece pump shaft. Internal pump components in direct contact with the fuel to be handled shall be of compatible construction. Pump bearings shall be selected to give a minimum L-10 rating life of 25,000 hours in continuous operation. Provide pump with flanged end piping connections.

2.8 ACCESSORIES

- A. Concrete Anchor Bolts: Concrete anchors shall conform to ASTM A307, Grade C, hot-dipped galvanized.
- B. Bolts and Studs: Carbon steel bolts and studs shall conform to ASTM A307, Grade B, hot-dipped galvanized. Stainless steel bolts and studs shall conform to ASTM A193/A193M, Class 2, Grade 8.
- C. Nuts: Carbon steel nuts shall conform to ASTM A563, Grade A, hex style, hot-dipped galvanized. Stainless steel nuts shall conform to ASTM A194/A194M, Grade 8.
- D. Washers: Provide flat circular washers under each bolt head and each nut. Washer materials shall be the same as the connecting bolt and nut. Carbon steel washers shall conform to ASTM F844, hot-dipped

galvanized. Stainless steel washers shall conform to ASTM A194/A194M, Grade 8.

- E. Polytetrafluoroethylene (PTFE) Tape: Tape shall conform to ASTM D3308.

2.9 FINISHES

- A. New Equipment and Components: Factory Coating: Unless otherwise specified, provide equipment and components fabricated from ferrous metal with the manufacturer's standard factory finish. For equipment and component surfaces subject to temperatures above 120 degrees F, the factory coating shall be appropriately designed for the temperature service.
- B. Ship, store, and handle coating materials as well as apply and cure coatings in accordance with SSPC PA 1 and manufacturers recommendations.
- C. Exterior Coating, Aboveground Piping
1. Provide non-metallic abrasive conforming to MIL-A-22262, Type I or steel grit conforming to the chemical and physical properties of SSPC AB 3 Class 1
 2. Zinc-Rich Primer: Epoxy polyamide, MIL-DTL-24441/19 (Formula 159, Type III).
 3. Intermediate Coat: Epoxy polyamide, MIL-DTL-24441/31 (Formula 152, Type IV, White (Tinted)). Tint to approximately FED-STD-595 color number 27778 parchment using pigment dispersions prepared for epoxy paint tinting. Manufacturer shall tint material and appropriately label.
 4. Topcoat: Polyurethane coating topcoat of MIL-PRF-85285, Type II, color as directed by Contracting Officer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.3 and NFPA 30, except as modified herein. Safety rules as specified in NFPA 30 shall be strictly observed. Never direct bury threaded connections, socket welded connections, unions, flanges, valves, air vents, or drains. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.
- B. Pumps: Properly level, align, and secure pumps in place in accordance with manufacturer's instructions. Support, anchor, and guide so that

no strains are imposed on a pump by weight or thermal movement of piping.

C. Piping

1. General: Thoroughly clean pipe of all scale and foreign matter before the piping is assembled. Cut pipe accurately to measurements established at the jobsite, and worked into place without springing or forcing. Cut pipe square and have burrs removed by reaming. Install pipe to permit free expansion and contraction without causing damage to the tank nozzles, pipe, joints, or hangers. Cutting or other weakening of the tank nozzles to facilitate piping installation will not be permitted without written approval.
 - a. Use reducing fittings for changes in pipe sizes. Install equipment and piping into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance. Provide electric isolation fittings between dissimilar metals. Install piping straight and true to bear evenly on supports. Piping shall be free of traps, shall not be embedded in concrete pavement, and shall drain as indicated. Make changes in direction with fittings. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted.
 - b. When work is not in progress, securely close open ends of pipe and fittings with an expandable pipe plug so that water, earth, or other substances cannot enter the pipe or fittings. For belowground piping, the full length of each pipe shall rest solidly on the underlying pipe bed.
2. Welded Connections: Unless otherwise indicated on the Drawings, pipe joints shall be welded. Construct branch connections with welding tees or forged welding branch outlets. Do not weld stainless steel pipe to carbon steel pipe.
3. Threaded End Connections: Provide threaded end connections only on piping 2 inches in nominal size or smaller and only where indicated on the Drawings. Provide threaded connections with PTFE tape or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is tighten.

- D. Bolted Connections: For each bolted connection of stainless steel components (e.g., pipes, piping components, valves, and equipment) use stainless steel bolts or studs, nuts, and washers. For each bolted connection of carbon steel components, use carbon steel bolts or studs, nuts, and washers. Extend bolts, or studs, no less than two full threads beyond their corresponding nut when tightened to the required torque. Prior to installing nuts, apply a compatible anti-seize compound to the male threads.
- E. Flanges and Unions: Except where threaded end connections and/or unions are indicated, provide flanged joints in each line immediately preceding the connection to a piece of equipment or material requiring maintenance such as pumps, general valves, control valves, strainers, and other similar items and as indicated. Assemble flanged joints square and tight with matched flanges, gaskets, and bolts. For flanges, provide washers under each bolt head and nut. Torque wrenches shall be used to tighten all flange bolts to the torque recommended by the gasket manufacturer. Tightening pattern shall be as recommended by the gasket manufacturer. Use anti-seize compound on threads for stainless steel bolts.
- F. Flange Protectors: Provide flange protectors on each electrically isolating flange connection.
- G. Valves: Install isolation ball valves on each side of each piece of equipment, at the midpoint of looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Install valves with stems vertically up unless otherwise indicated. Provide individual supports and anchors for each valve.
- H. Air Vents: Provide 2 inch air vents at all high points and where indicated to ensure adequate venting of the piping system.
- I. Sight Flow Indicator: Mount indicator rolled one bolt hole to prevent freeze damage from rainwater accumulation on viewing window. Install a sight flow indicator downstream of each relief valve.
- J. Drains: Provide 1-1/2 inch drains at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.
- K. Flexible Pipe Connectors: Attach connectors to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the

connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.

- L. Pumps: Properly level, align, and secure pumps in place in accordance with manufacturer's instructions. Support, anchor, and guide so that no strains are imposed on a pump by weight or thermal movement of piping.

3.2 PIPE HANGERS AND SUPPORTS

- A. Install hangers with a maximum spacing as defined in Table 1 below, except where indicated otherwise. In addition to meeting the requirements of Table 1, provide additional hangers and supports where concentrated piping loads exist (e.g., valves).

Table 1. Maximum Hanger Spacing

Nominal Pipe Size (Inches)	One and Under	1.5	2	3	4	6	8	10	12

Maximum Hanger Spacing (ft)	7	9	10	12	14	17	19	22	23

3.4 COATING

- A. Coat the exterior of aboveground steel piping, flanges, fittings, nuts, bolts, washers, valves, and piping components with a three coat, two part epoxy coating. Do not paint stainless steel and aluminum surfaces. Do not coat equipment or components provided with a complete factory coating. Prior to any field painting, clean surfaces to remove dust, dirt, rust, oil, and grease.
- B. Prior to any field painting, clean surfaces to remove dust, dirt, rust, oil, and grease in accordance with manufacturers recommendations.
- C. Apply coatings in accordance with manufacturer's written instructions.
1. Dry Film Thickness:
Primer: 2 - 5 mils
Intermediate: 3 - 5 mils
Topcoat: 2 - 3 mils
Total System: 9 - 12 mils
- D. Quality Control
1. Visually inspect surface preparation and each coat of coating system.
 2. Measure dry film thickness of each coat applied.

3.4 FIELD QUALITY CONTROLS

- A. Flushing and Cleaning: The intent of the flushing and cleaning operation is to remove bulk solids and water from the system. Flushing procedures shall precede cleaning procedures. All new fuel piping lines shall be flushed with fuel. Flushing and cleaning shall continue until Contracting Officer certifies that the fuel contains 2 milligrams per gallon or less of particulate and 10 parts per million or less of free water.
- B. Tests: Furnish labor, materials, equipment, electricity, repairs, and retesting necessary for any of the tests required herein. Perform piping test in accordance with the applicable requirements of ASME B31.3 except as modified herein. To facilitate the tests, various sections of the piping system may be isolated and tested separately. Where piping sections terminate at flanged valve points, close the line by means of blind flanges in lieu of relying on the valve. Provide tapped flanges to allow a direct connection between the piping and the air compressor and/or pressurizing pump. Use tapped flanges for gauge connections. Taps in the permanent line will not be permitted. Gauges will be subject to testing and approval. Provide provisions to prevent displacement of the piping during testing. Keep personnel clear of the piping during pneumatic testing. Only authorized personnel shall be permitted in the area during pneumatic and hydrostatic testing. Isolate equipment such as pumps, tanks and meters from the piping system during the testing. Do not exceed the pressure rating of any component in the piping system during the testing. Following satisfactory completion of each test, relieve the test pressure and seal the pipe immediately.
1. Exterior Coating Holiday Test: Following installation, test the exterior coating for holidays using high-voltage spark testing in accordance with NACE SP0188. Repair holidays and retest to confirm holiday-free coating.
 2. Preliminary Pneumatic Test: Apply a 25 psig pneumatic test to product piping. Maintain the pressure while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, visually inspect the entire run of piping, including the bottom surfaces, for leaks (bubble

formations). If leaks are discovered, repair the leaks accordingly and retest.

3. Final Pneumatic Test: Following the preliminary pneumatic test, apply a 50 psig pneumatic test to all product piping and hold for a period not less than 2 hours. During the test period, there shall be no drop in pressure in the pipe greater than that allowed for thermal expansion and contraction. Disconnect the pressure source during the final test period. If leaks are discovered, repair the leaks accordingly and retest.
4. Hydrostatic Test: Hydrostatically test product piping with the fuel to be handled to the lesser of 1-1/2 times operating pressure or 275 psig in accordance with API RP 1110. Maintain the pressure within the piping for 4 hours with no leakage or reduction in gauge pressure. If leaks are discovered, repair the leaks accordingly and retest.

3.5 SYSTEM PERFORMANCE TESTS

- A. See Specification Section 33 56 10 Factory-Fabricated Fuel Storage Tanks for system performance testing requirements.

3.6 DEMONSTRATIONS

- A. Conduct a training session for designated Government personnel in the operation and maintenance procedures related to the equipment/systems specified herein. Include pertinent safety operational procedures in the session as well as physical demonstrations of the routine maintenance operations. Furnish instructors who are familiar with the installation/equipment/systems, both operational and practical theories, and associated routine maintenance procedures. The training session shall consist of a total of 4 hours of normal working time and shall start after the system is functionally completed, but prior to final system acceptance. Submit a letter, at least 14 working days prior to the proposed training date, scheduling a proposed date for conducting the onsite training.

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SECTION 33 56 10
FACTORY-FABRICATED FUEL STORAGE TANKS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section defines the requirements for factory-fabricated fuel storage tanks.

1.2 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. AMERICAN PETROLEUM INSTITUTE (API)
- API MPMS 2.2A.....(1995; R 2012) Measurement and Calibration of Upright Cylindrical Tanks by the Manual Strapping Method
- API MPMS 2.2E.....(2004; Errata 2009; R 2009) Petroleum and Liquid Petroleum Products - Calibration of Horizontal Cylindrical Tanks - Part 1: Manual Methods
- API RP 2003.....(2008; 7th Ed) Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents
- API RP 540.....(1999; R 2004) Electrical Installations in Petroleum Processing Plants
- C. ASME INTERNATIONAL (ASME)
- ASME B16.5.....(2013) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
- ASME BPVC SEC VIII D1...(2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1
- D. ASTM INTERNATIONAL (ASTM)
- ASTM A193/A193M.....(2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
- ASTM A194/A194M.....(2012a) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both

- ASTM A27/A27M.....(2010) Standard Specification for Steel
Castings, Carbon, for General Application
- ASTM A307.....(2012) Standard Specification for Carbon Steel
Bolts and Studs, 60 000 PSI Tensile Strength
- ASTM A48/A48M.....(2003; R 2012) Standard Specification for Gray
Iron Castings
- ASTM A563.....(2007a) Standard Specification for Carbon and
Alloy Steel Nuts
- ASTM B117.....(2011) Standard Practice for Operating Salt
Spray (Fog) Apparatus
- ASTM B26/B26M.....(2012) Standard Specification for Aluminum-
Alloy Sand Castings
- ASTM D3308.....(2012) PTFE Resin Skived Tape
- ASTM F844.....(2007a) Washers, Steel, Plain (Flat),
Unhardened for General Use
- E. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
- IEEE 1100.....(2005) Emerald Book IEEE Recommended Practice
for Powering and Grounding Electronic Equipment
- IEEE 142.....(2007) Recommended Practice for Grounding of
Industrial and Commercial Power Systems - IEEE
Green Book
- F. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
- NEMA 250.....(2008) Enclosures for Electrical Equipment
(1000 Volts Maximum)
- G. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
- NFPA 30.....(2012; Errata 2011; Errata 2011) Flammable and
Combustible Liquids Code
- NFPA 30A.....(2012; Errata 2011) Code for Motor Fuel
Dispensing Facilities and Repair Garages
- NFPA 407.....(2012; TIA 11-1) Standard for Aircraft Fuel
Servicing
- NFPA 70.....(2014) National Electrical Code
- NFPA 77.....(2007) Recommended Practice on Static
Electricity
- NFPA 780.....(2014) Standard for the Installation of
Lightning Protection Systems
- H. STEEL TANK INSTITUTE (STI)

STI 700-50-5007.....(2010) Installation Instructions for Shop
Fabricated Aboveground Tanks for Flammable,
Combustible Liquids

I. UNDERWRITERS LABORATORIES (UL)

UL 142.....(2006; Reprint Jul 2013) Steel Aboveground
Tanks for Flammable and Combustible Liquids

UL 2085.....(1997; Reprint Sep 2010) Protected Aboveground
Tanks for Flammable and Combustible Liquids

1.3 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND
SAMPLES, furnish the following:

B. Shop Drawings:

1. Grounding and Bonding

C. Product Data:

1. Aboveground Storage Tank

2. Tank Protective Coatings

3. Automatic Level Alarm System

4. Tank Gauges

5. Leak Detection System

6. Dispenser

7. Fuels Management System

8. Remote Fill Box

D. Test Reports:

1. Aboveground Storage Tank Tightness Tests

2. Tank Manufacturer's Tests

3. Tank Fill Tests

4. Leak Detection System Test

E. Certificates:

1. Contractor Qualifications

2. Permitting

3. Registration

4. Licensed Personnel

5. Demonstrations

F. Manufacturer's Instructions:

1. Aboveground Storage Tank

2. Automatic Level Alarm System

3. Tank Gauges

4. Leak Detection System

- 5. Dispenser
- 6. Fuels Management System
- G. Operation and Maintenance Data:
 - 1. Aboveground Storage Tank
 - 2. Automatic Level Alarm System
 - 3. Tank Gauges
 - 4. Leak Detection System
 - 5. Dispenser
 - 6. Fuels Management System

1.4 QUALITY ASSURANCE

- A. Contractor Qualifications: Each installation Contractor shall have successfully completed at least 3 projects of the same scope, and the same size or larger within the last 6 years, and demonstrated specific installation experience in regard to the specific system installation to be performed. Each installation Contractor shall have taken, if applicable, manufacturer's training courses on the installation of storage tanks and shall meet all applicable licensing requirements in the state. Submit a letter listing prior projects, the date of construction, a point of contact for each prior project, the scope of work of each prior project, and a detailed list of work performed. The letter shall also provide evidence of prior manufacturer's training, state licensing, and other related information.
- B. Regulatory Requirements:
 - 1. Permitting: Obtain necessary permits in conjunction with the installation of storage tanks and dispensing systems as required by federal, state, or local authority.
 - 2. Registration: Obtain and complete all required tank registration forms required by federal, state, and local authorities. Submit all tank registration forms within 30 days after Contract award. The Contracting Officer will submit the forms to the proper regulatory agencies.
 - 3. Licensed Personnel: Tank installers shall be licensed/certified by the state when the state requires licensed installers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.6 PROJECT/SITE CONDITIONS

- A. Exposed moving parts, parts that produce high operating temperatures and pressures, parts that may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices so that proper operation of equipment is not impaired.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

1. General: Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship. Provide materials and equipment that have been in satisfactory commercial or industrial use for a minimum 2 years prior to bid opening. The 2 year period shall include applications of the equipment and materials under similar circumstances and of similar size. Provide materials and equipment that have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.
2. Nameplates: Attach nameplates to all specified equipment defined herein. List on each nameplate the manufacturer's name, address, component type or style, model or serial number, catalog number, capacity or size, and the system that is controlled. Construct plates of anodized aluminum or stainless steel. Install nameplates in prominent locations with nonferrous screws, nonferrous bolts, or permanent adhesive. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be the normal block style with a minimum 0.25 inch height. Accurately align all lettering on nameplates.

2.2 MATERIALS

- A. Internal parts and components of equipment, piping, piping components, and valves that could be exposed to fuel during system operation shall not be constructed of zinc coated (galvanized) metal, brass, bronze, or other copper bearing alloys. Do not install cast iron bodied valves in piping systems that could be exposed to fuel during system operation.

2.3 ELECTRICAL WORK

- A. Provide controllers, integral disconnects, contactors, controls, and control wiring with their respective pieces of equipment. Provide electrical equipment, including motors and wiring, as specified.

Provide switches and devices necessary for controlling and protecting electrical equipment. Controllers and contactors shall have a maximum of 120-volt control circuits and shall have auxiliary contacts for use with the controls provided.

1. Grounding and Bonding for Electrical Systems: Grounding and bonding shall be in accordance with NFPA 70, Article 250. Provide jumpers to overcome the insulating effects of gaskets, paints, or nonmetallic components.

2.4 ABOVEGROUND STORAGE TANK

1. Secondly Contained Steel Tank: Provide a factory-assembled unit that includes a primary storage tank and an integral factory-fabricated secondary containment. Tank assembly shall be in accordance with NFPA 30 and NFPA 30A and be designed and manufactured for a horizontal cylindrical installation. Primary storage tank shall be factory-welded, steel that conforms to UL 142. Tank assembly shall be mounted on the tank manufacturer's standard UL listed support skid that elevates the tank assembly above the underlying concrete slab a minimum of 12 inches. Tank assembly shall have lifting lugs that allow tank relocation. Provide tank assembly with the manufacturer's standard external ladder. The ladder shall be constructed of structural steel and shall allow personal access to the top of the tank system.
2. Fully-Enclosed Steel Containment: The secondary containment reservoir shall be the factory-fabricated, steel type that fully-encloses the primary storage tank. The containment reservoir shall conform to UL 142. The interstitial space between the primary tank and the containment reservoir shall be both pressure testable and verifiable. The entire tank assembly shall conform to UL 2085. Tank assembly shall bear the UL 2085 label as a protected tank. The primary storage tank shall be supported within the containment reservoir with steel tank saddles, or other similar supports, fabricated and installed by the tank manufacturer.

2.5 TANK PROTECTIVE COATINGS

- A. Exterior Surfaces, Aboveground Tanks: Protect the exterior surfaces of each aboveground tank with the manufacturer's standard coating system as modified herein.

2.7 TANK COMPONENTS

- A. Tank Manway: Tank manway shall have an internal diameter of 30 inches. Provide each manway with a matching flanged watertight manway cover. Manway covers shall be UL listed, be constructed of pressed or mild steel, and include a UL listed gasket.
- B. Tank Piping Penetrations: Provide a welded-in-place double tapered National Pipe Thread (NPT) coupling for each tank piping connection.
- C. Tank Striker/Impact Plates: Provide an interior striker/impact plate under appurtenances as noted on the Drawings. Each plate shall be a minimum of 1/4 inch in thickness, be larger in diameter than the tank penetration, fit the curvature of the tank bottom, and be completely coated in the same fashion as the interior tank bottom coating. Each plate shall be welded to the tank bottom at the factory (full circumference connection).
- D. Tank Ladder: Provide interior tank ladder constructed of either fiberglass or steel. The two stringers shall be a minimum 3/8 inch thick and a minimum 2 inches wide. The rungs shall be a minimum 3/4 inch rod on 12 inches centers. Members of the ladder shall be securely affixed. Ladder shall be of sufficient length to extend from the bottom of the tank to the top surface of the tank. Ladder shall be rigidly connected to the tank bottom in accordance with the tank manufacturer's standard. Ladder shall be connected to the top of the tank with pipe guides or slip bars to accommodate expansion of the two stringers.
- E. Aboveground Tank Emergency Vent: Vent shall be the normally-closed, UL listed type that vents outward and upward. Vent shall conform to NFPA 30 and UL 142. Provide vent with the cubic feet per minute (cfm) rating permanently labeled on the vent's exterior.

2.8 AUTOMATIC LEVEL ALARM SYSTEM

- A. Provide a system that will monitor 3 programmable liquid level setpoints. The system shall delineate between each individual setpoint. The system shall produce an audible and visible alarm in the event of monitoring an alarm condition. Mechanically-actuated float assemblies shall be field adjustable. The system shall be totally independent of the tank gauging system.
 - 1. Setpoints: Configure the alarm system's 3 setpoints in accordance with the following.

- a. High Level Setpoint. Produce an alarm condition when a tank's liquid level rises above 90 percent capacity.
 - b. High-High Level Setpoint. Produce an alarm condition when a tank's liquid level rises above 95 percent capacity.
 - c. Low Level Setpoint. Produce an alarm condition when a tank's liquid level drops below 15 percent capacity.
2. Control Panel: Install the control panel for the alarm system in a NEMA 4 rated enclosure in accordance with NEMA 250. Panel doors shall swing left or right.
 - a. Audible Alarm: Panel shall have internal speakers that produce a buzzer sound of 70 decibels or greater in the event of a detected alarm condition.
 - b. Visual Alarm: Panel shall have a visual alarm that illuminates in the event of a detected alarm condition. The visual alarm shall include either individual lights for each alarm condition or shall include a single light and a liquid crystal display (LCD) panel that displaces information regarding each alarm condition.
 - c. Acknowledge Switch: Panel shall have a manual acknowledge switch that will deactivate the audible alarm. The acknowledge switch shall not deactivate subsequent audible alarms unless depressed manually again for each occurrence. Under no circumstance shall this acknowledgement switch extinguish the visual alarms until the alarm condition has been corrected. The acknowledge switch shall be an integral component located on the front of the control panel. The switch shall be either a key switch or push button.

2.9 TANK GAUGES

- A. Stick Gauge: For each tank, provide 2 wooden stick gauges. Gauge length shall allow the measurement of the entire level of fuel in the corresponding tank. Gauges shall be compatible with the fuel to be measured (no swelling or damage from fuel contact). Provide gauge with non-sparking caps on each end. Mark gauges in feet and inches. The smallest unit of measure on the gauge shall be 1/16 inch.
- B. Tank Strapping Table: Furnish 2API MPMS 2.2E certified strapping tables (calibration charts) for each tank. Tables shall indicate the liquid contents in gallons for each 1/16 inch of tank depth. For each tank, provide an electronic media file of each strapping table.

- C. Analog Tank Gauge: Gauge shall be the level sensing, mechanically actuated type that provides the tank level readout in a sealed glass cap contained in a gauge box. Gauge shall be accurate to plus or minus 1/4 inch and shall measure the liquid level over the full range of a tank's height. Gauge shall have vapor tight seals to prevent condensation from fogging the viewing glass.
- D. Automatic Tank Gauge (ATG) System: Gauge system shall be the mechanically or electronically actuated type that can continuously monitor a tank's usable liquid level storage capacity. The system shall provide a digital readout of a tank's liquid level in terms of inches and gallons. The system shall be accurate to plus or minus 1/16 inch. The system shall measure water accumulation in inches from 3/4 to 5 inches off the bottom of a storage tank. Construct system components to be chemically compatible with the fuel to be handled. Provide a sending unit that transmits the digital readout from the tank to the leak detection electronic monitoring/alarm panel. Panel shall be a NEMA 4 enclosure as defined by NEMA 250. Panel doors shall swing left or right. The panel shall display the digital readout of each monitored tank on an LCD mounted exterior to the panel. The panel shall also have external controls to allow operators to toggle between information on the LCD without having to open the panel.

2.10 LEAK DETECTION

- A. Provide a system, including sensors and detectors, that is intrinsically safe for use in a Class 1, Division 1, Group D environment as defined by NFPA 70. System shall be compatible with the fuel to be handled. Sensors shall distinguish and report the difference between hydrocarbons and water. Output and transmission from sensors and detectors shall be electronic. Sensors shall have a minimum probability of detection of 95 percent and a maximum probability of false alarm of 5 percent. Sensors and detectors shall be compatible with the electronic monitoring/alarm panel. Sensors shall be reusable after an alarm condition is sensed. Submit shop drawings for the leak detection system that include wiring schematics for all parts of the system showing each operating device and listing their normal ranges of operating values (including pressures, temperatures, voltages, currents, speeds, etc.).
- 1. Aboveground Secondly Contained Storage shall continuously and automatically monitor the interstitial space of a secondarily

- contained tank for breaches in the integrity of the primary tank and the exterior secondarily contained shell. Monitor the interstitial space with electronic capacitance type liquid sensors.
2. System shall continuously and automatically monitor the transition sump with an electronic capacitance type liquid sensor. Sensor shall detect liquids within a minimum of 1 inch above a sump's bottom.
 3. Electronic Monitoring/Alarm panel shall perform continuous integrity checks on the status of each sensor's connections and wiring. Panel shall include a battery backup (rechargeable) that can operate the complete leak detection system during a power failure for a minimum period of 48 hours. Submit shop drawings of the panel layout along with panel mounting and support details. Panel shall be compatible with and connected to the following:
 - a. Tank interstitial sensors and detectors.
 - b. Transition sump sensors and detectors.
 - c. Digital tank gauge system.
- B. Panel housing shall be a NEMA 4 rated enclosure in accordance with NEMA 250. Panel housing shall have a hinged door to swing left or right (doors shall not swing up or down).
- C. Panel shall account for the effects of thermal expansion or contraction of the fuel product, vapor pockets, tank or piping deformation, evaporation or condensation prior to initiating an alarm condition. Panel shall produce an audible and visual alarm in the event any of the following occur.
1. Sensing of a hydrocarbon liquid from a sensor or detector.
 2. Sensing tank high, high-high, or low level alarm conditions.
- D. Panel shall have internal speakers that produce a buzzer sound of 70 decibels or greater in the event of a detected alarm condition.
- E. Panel shall have a visual alarm that illuminates in the event of a detected alarm condition. Visual alarm shall include either individual lights for each alarm condition or shall include a single light and a liquid crystal display (LCD) panel that displaces information regarding each alarm condition.
- F. Panel shall have a manual acknowledge switch that will deactivate the audible alarm. Acknowledge switch shall not deactivate subsequent audible alarms unless depressed manually again for each occurrence. Under no circumstance shall this acknowledgement switch extinguish the visual alarms until the alarm condition has been corrected. Switches

shall be an integral component located on the front panel and be either a key switch or push button.

2.11 FUEL DISPENSING UNIT

- A. Computer controlled dispensing system shall consist of dispensing unit, management control system, wiring, cabling, and accessory equipment. Unit shall be single sided remote type with one hose outlet suitable for E85. Product delivery rate of 12 gallons per minute from the one nozzle. Steel frame shall be capable of resisting normal vertical and lateral loads and secured to the dispensing island with at least two ½-inch anchor bolts. Exterior panels shall be either stainless steel or steel with baked enamel finish, or a combination of the two. Provide manufacturer's standard microprocessor with the following functions:
1. Displays: mechanical display, five digit cash display to \$999.99 and four digit volume display to 999.9 gallons.
 2. Totalizer: eight digit totalization with identification for each product volume in gallons.
 3. Filters: replaceable filter element on each product line with a nominal filtration efficiency of 25 microns at rated flow.
 4. Accessories: equip each assembly with accessories such as built in air eliminator, line check valve and shear valve. Install stabilizer bar to ensure proper shearing action of shear valve if the dispenser unit is knocked from the foundation.
 5. Hose: provide dispensing hose conforming to UL 330, E85 resistant, statically grounded, flexible in sub-zero temperatures. Each product hose shall be 18-ft long. Provide a counterweight hose retractor to keep excess hose off the ground.
 6. Nozzle: dispensing nozzle shall be automatic shut off type, without latch open, aluminum body, and full hand insulator to prevent splash back.
 7. Breakaway Device: provide on each product hose, UL listed emergency breakaway device designed to retain liquid on both sides of breakaway point. Breakaway device shall have pressure balancing chamber to override line pressure prevent nuisance breaks caused by a restriction in hose diameter.
 8. Unit shall be clearly marked for the fuel they are dispensing.
 9. Dispenser shall be CARB certified for Stage II vapor recovery.

10. Dispenser shall be mounted on a manufactured pedestal to make the dispenser accessible for aboveground piping. Pedestal shall be from the same manufacturer as the dispenser.

2.12 FUELS MANAGEMENT SYSTEM

- A. The automated fuels management system shall be an internet based, centrally managed inventory control center hosted by the fuels management company. A card reader/fuel management system capable of authorizing and recording both fuel and fuel transactions using the FuelForce Fuel Management System (Tom Bates, 609-683-4242) or equal shall be installed capable of authorizing and recording both fuel and fuel transactions using the fleet charge card service provider (Wright Express (WEX) or VISA) and General Services Administration (GSA) Smart fuel cards processing system. Fuels management system shall incorporate the following features:
 1. System shall be interconnected to and compatible with required dispensers.
 2. Console box located on dispensing island shall be self-contained. It shall be constructed of a weather proof enclosure, LCD graphic display, magnetic card reader and sealed keypad.
 3. Ability to collect additional data such as: odometer readings, employee identification, etc.
 4. Ability to stipulate when fueling is or is not available (by both days of the week and hours of the day).
 5. Fuels management system shall directly bill WEX for VA reimbursement of E85 consumed by fleet vehicles.
 6. VA personnel shall have viewing rights of the fuels management system, with ability to change E85 pricing.
 7. Fuels management system shall be integrated with the tank level monitoring system to provide inventory reconciliation and fuel delivery notification.

2.13 REMOTE FILL BOX

- A. The remote fill box shall provide containment and weather protection for the offloading connections (fuel and vapor recovery lines). It shall be constructed of 12 gauge epoxy-powder coated steel, with a lockable hatch and height adjustable legs.

2.14 ACCESSORIES

- A. Concrete Anchor Bolts: Concrete anchors shall conform to ASTM A307, Grade C, hot-dipped galvanized.

- B. Bolts and Studs: Carbon steel bolts and studs shall conform to ASTM A307, Grade B, hot-dipped galvanized. Stainless steel bolts and studs that conform to ASTM A193/A193M, Grade 8.
- C. Nuts: Carbon steel nuts shall conform to ASTM A563, Grade A, hex style, hot-dipped galvanized. Stainless steel nuts shall conform to ASTM A194/A194M, Grade 8.
- D. Washers: Provide flat circular washers under each bolt head and each nut. Washer materials shall be the same as the connecting bolt and nut. Carbon steel washers shall conform to ASTM F844, hot-dipped galvanized. Stainless steel washers shall conform to ASTM A194/A194M, Grade 8.
- E. Polytetrafluoroethylene (PTFE) Tape: Tape shall conform to ASTM D3308.

2.15 FINISHES

- A. Factory Coating: Unless otherwise specified, provide equipment and components fabricated from ferrous metal with the manufacturer's standard factory finish. For equipment and component surfaces subject to temperatures above 120 degrees F, the factory coating shall be appropriately designed for the temperature service.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Handle storage tanks with extreme care to prevent damage during placement and install in accordance with the manufacturer's installation instructions and NFPA 30 or NFPA 30A, as applicable. Inspect the exterior surface of each tank for obvious visual damage prior to and during the placement of each storage tank. Repair surface damage to a storage tank according to manufacturer's requirements before proceeding with the system installation. Provide the termination of fill lines within a tank with an antisplash deflector. Provide nylon dielectric bushings on pipe connections to a steel tank.
- 1. Equipment: Properly level, align, and secure equipment in place in accordance with manufacturer's instructions. Provide supports for equipment, appurtenances, and pipe as required. Install anchors, bolts, nuts, washers, and screws where required for securing the work in place. Sizes, types, and spacings of anchors and bolts not indicated or specified shall be as required for proper installation.

2. Install interstitial tank sensors and detectors at the tank's low end. Sensor installation shall be in accordance with the tank manufacturer's recommendations and shall not compromise the tank's secondary containment in any manner. Sensors shall be easily removed from a tank. Connection of metal conduit to steel tanks shall be with dielectric fittings.
3. Install sensors in the low point of a sump in accordance with sump and sensor manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

- A. Aboveground Storage Tank Tightness Tests: Perform tightness tests on each (including new and relocated tanks) aboveground storage tank prior to making piping connections. Perform testing in accordance with STI 700-50-5007 except as modified herein. Gauges used to monitor the tests shall have a scale with a maximum limit of 10 psig. Repair leaks discovered during the tightness tests in accordance with tank manufacturer's instructions. Following any repair, re-test the tank until the tank successfully passes the testing requirements of this paragraph.
- B. Tank Manufacturer's Tests: In addition to the tests required herein, perform any additional tests (i.e., leak tests, verification tests, etc.) on each storage tank that is required by the tank manufacturer's written test procedures. Manufacturer's tests that are redundant to tests already required by this Specification will only be performed once per tank. Repair all leaks discovered during the tests in accordance with manufacturer's instructions. Following tank repairs, re-test the tank until the tank successfully passes the manufacturer's testing requirements.

3.3 DEMONSTRATIONS

- A. Conduct a training session for designated Government personnel in the operation and maintenance procedures related to the equipment/systems specified herein. Include pertinent safety operational procedures in the session as well as physical demonstrations of the routine maintenance operations. Furnish instructors who are familiar with the installation/equipment/systems, both operational and practical theories, and associated routine maintenance procedures. The training session shall consist of a total of 4 hours of normal working time and shall start after the system is functionally completed, but prior to final system acceptance. Submit a letter, at least 14 working days

prior to the proposed training date, scheduling a proposed date for conducting the onsite training.

3.4 TANK FILL TESTS

- A. Tank fill tests shall not be performed until after the flushing, cleaning, and adjusting requirements as defined in Section 33 52 10 Service Piping, Fuel Systems. For the tank fill tests, initially fill the tank with fuel in order to verify the tank level alarm system operates properly and the tank overfill protection device functions as designed. Stop filling each tank immediately once the overfill devices operate. Do not overfill any storage tank more than the 98 percent level. Drain the system below the low liquid level setpoint to verify operation of the low level alarm. Correct and retest any problems with the level alarm system or the overfill device until each operate as specified herein. During the tests, verify that all tank gauges are calibrated and operating appropriately.

3.5 DISPENSER TESTS

- A. As part of the final commissioning, demonstrate proper E85 dispensing and vapor recovery operations.
- Verify fuel delivery into a vehicle is approximately 12 gpm.
 - Verify proper dispenser and fuel system manager integration.
 - Demonstrate system permissives such as: invalid operators and/or vehicle codes, inability to fuel off-hours, fuel inventory integration.

3.5 FIELD PAINTING

- A. Painting required for surfaces not otherwise specified shall be field painted as specified in Section 33 52 10 Service Piping, Fuel Systems. Do not paint stainless steel and aluminum surfaces. Do not coat equipment or components provided with a complete factory coating. Prior to any field painting, clean surfaces to remove dust, dirt, rust, oil, and grease.

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SECTION 34 71 13
VEHICLE BARRIERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes furnishing and installation of steel pipe bollards for vehicle barriers.

1.2 RELATED WORK

- A. Section 32 12 16, ASPHALT PAVING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Product Data Sheets: For each type of product indicated.
- C. Description of proposed surface preparation and coating application procedures for coating of steel pipe bollards
- D. Manufacturer's Material Safety Data Sheet(s) for coating material.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Referenced publications shall be the current version as of the date of advertisement of the project.
- B. ASTM International (ASTM):
 - A53.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - C33.....Standard Specification for Concrete Aggregates
 - C150.....Standard Specification for Portland Cement
- C. Steel Structures Painting Council (SSPC):
 - SSPC SP 2.....Hand Tool Cleaning

1.5 QUALITY ASSURANCE

- A. Manufacturers shall have manufacturing and quality control facilities capable of producing and assuring the quality of products specified.
- B. Surface preparation and coating application materials and methods shall comply with all applicable health and safety regulations during all phases of the work, including disposal. Copies of MSDS's for all coating materials to which the applicator's and Contractor's personnel may be exposed shall be kept on site and available for review by the Contracting Officer's Representative (COR).

1.6 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be inspected upon delivery to the Site. Damaged or defective materials shall be rejected and shall be replaced with new materials at no additional expense to the Owner.
- B. Coating materials shall be in the manufacturers' original, unopened, sealed containers that legibly show the designated name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including warnings and special precautions, and name of manufacturer.
- C. Coating materials shall be kept dry, protected from weather and stored under cover in accordance with manufacturer's recommendations.

1.7 COORDINATION

- A. Coordinate installation of bollards with asphalt pavement construction specified in Section 32 12 16.

1.8 PROJECT CONDITIONS

- A. Coatings shall be applied only when the ambient temperatures, relative humidity, and surface temperatures are as recommended by the coating manufacturer.

PART 2 - PRODUCTS

2.1 STEEL PIPE BOLLARDS

- A. Bollards shall be constructed of 6-inch diameter ASTM A 53, Type E, Grade B, Schedule 80 steel pipe, filled with concrete. Length shall be 8 feet to provide required bury depth and exposed height as specified.
- B. Removable bollards shall be as indicated on the Drawings. Furnish required sleeves and other accessories for installation in pavement.

2.2 CONCRETE

- A. Concrete for post footings and inside bollards shall consist of Type I Portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and clean water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 3,000 pounds per square inch (psi) using 1/2-inch maximum size aggregate.

2.3 PAINT

- A. Approved coating system is listed in the following Coating Schedule. Alternate coating systems may be used only upon pre-approval by the COR.

COATING SCHEDULE

Item(s)	<i>Surface Preparation</i>	Paint System
Exterior Steel: Bollards	SSPC-SP 2 minimum;	Primer: One coat Epoxy Primer Topcoat: One or two coats Epoxy or polyurethane topcoat

B. Topcoat color shall be as indicated on the Drawings.

PART 3-EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF BOLLARDS

- A. Steel pipe bollards shall be constructed at locations shown on the Drawings.
- B. Excavate 18-inch minimum diameter holes for post footings in firm, undisturbed or compacted soil to depth indicated on the Drawings.
- C. Center and align posts above bottom of hole to provide minimum bury depth of 48 inches. Height of bollards above finish grade shall be set at four feet.
- D. Place concrete around posts in continuous pour, and vibrate or tamp for consolidation. Check each post for vertical alignment, and hold in position during placement and finishing operations.
- E. Fill posts with concrete in a continuous pour, and vibrate or tamp for consolidation. Provide smooth domed crown to concrete surface.
- F. Allow concrete to properly cure a minimum of seven days.

3.3 INSTALLATION OF REMOVABLE BOLLARDS

- A. Removable bollards shall be installed at locations shown on the Drawings and in conformance with manufacturer's written instructions.
- B. Sleeves for bollards shall be cast into concrete as indicated.

3.4 PAINTING

- A. Apply protective coating over all exposed carbon steel after completion of steel erection.
- B. Prepare surfaces in accordance with the paint manufacturer's recommendations. Remove dirt, loose rust, scale, grease, moisture or other condition detrimental to formation of a durable paint film.
- C. Apply primer and topcoat in accordance with paint manufacturer's recommendations.

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