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UNDERGROUND STORAGE TANK RETROFIT/ GAS STATION MODIFICATIONS NWS EARLE NJ
12/23/1993
KASELAAN AND D'ANGELO ASSOCIATES, INC.

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DEPARTMENT OF THE NAVY
NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
10 INDUSTRIAL HIGHWAY, MAIL STOP NO. 82
LESTER, PA 19113-2090

SPECIFICATION NO.
04-91-0489

CONTRACT NO.
N62472-91-C-0489
APPROPRIATION:
PA

UST RETROFIT/GAS STATION MODIFICATIONS

at the

NAVAL WEAPONS STATION, EARLE

COLTS NECK, NJ

DESIGNED BY:

KASELAAN & D'ANGELO ASSOCIATES, INC.

ONE LEVITT PARKWAY

WILLINGBORO, NJ

SPECIFICATION PREPARED BY:

Architectural:	Civil:	Structural:
Francis J. Gatlin AIA	Malcolm Barkan, P.E.	N/A
Electrical:	**Mechanical:**	**Submitted by:**
N/A	N/A	Valdur Kaselaan

Date: December 23, 1993

SPECIFICATION APPROVED BY: _____ DATE: _____

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SECTION 01010

GENERAL PARAGRAPHS

PART 1 GENERAL

1.1 REFERENCE

The publication listed below form a part of this specification to the extent referenced. The publication is referred to in the text by the basic designated only.

CODE OF FEDERAL REGULATIONS (CFR)

41 CFR 60.4 Construction Contractors - Affirmative Action Requirements

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-18, Records

a. Report of subcontracts G

b. Work performed by Contractor G

c. Certification of Contractor required insurance G

d. Schedule of prices G

e. As-built drawings G

f. Quantity surveys G

1.2.1.1 Report of Subcontracts

Provide, for contracts greater than $10,000, in accordance with paragraph "Affirmative Action Compliance."

1.2.1.2 Work Performed by Contractor

Provide in accordance with the paragraph titled, "Description of Work Performed by the Contractor."

1.3 GENERAL INTENTION

It is the declared and acknowledged intention and meaning to provide and secure underground storage tank retrofit, complete and ready for use.

1.4 GENERAL DESCRIPTION

The Contractor shall excavate and dispose the existing island office and canopy at Mainside and Waterfront, remove and dispose of all existing bulk overhead dispensers and install bulk overhead dispensers. The Contractor shall demolish C-20 and R-7 pump houses and remove all existing electrical wiring. The work includes the furnishing of a temporary fuel dispensing terminal during construction activities; the removal and disposal of concrete underground fuel overflow containment tanks; the pumping and disposal of residual product, sludge, water, and residues; tank cleaning and disposal of generated materials; excavation and disposal of fills, dispensers, vents, supply/return piping, valves, fittings, pads, and associated apparatus; excavation, transportation and disposal of contaminated soil; the provision of electronic leak detection systems for product inventory reconciliation and release, soil vapor monitoring systems, associated electronic sensors, cables, panels, electrical connections, hookups and alarms, product sumps for tanks, dispensers and remote fills, all fittings, manways, frames, connectors, covers, gaskets, cable, conduit, fittings, connectors, overfill boxes, frames, fittings, connectors; vapor recovery systems, piping, connectors, elbows and bends, equipment, new dispensers and hoses, nozzles with card type inventory reconciliation, doublewall piping, connectors, elbows, supports, and hangers; and incidental related work.

1.5 LOCATION

The work shall be located at the Naval Weapons Station, Earle, Colts Neck, New Jersey, approximately as shown. The exact location will be indicated by the Contracting Officer.

1.6 GOVERNMENT REPRESENTATIVES

a. The work will be under the general direction of an officer of the Civil Engineer Corps, United States Navy or another officer or representative of the Government, designated in block 26 of Standard Form 1442. Except in connection with the Disputes Clause of this contract, this designated person has complete charge of and exercise full supervision over the work so far as it affects the interests of the Government.

b. For the purposes of the Dispute Clause, the "Contracting Officer" is the Commander, Naval Facilities Engineering Command, or his representatives warranted for this purpose. Any claim submitted under the Dispute Clause shall be submitted to the Contracting Officer in care of the person designated in block 26 of Standard Form 1442 as the representative of the Contracting Officer authorized to receive the claim.

c. The provisions of this paragraph or provisions elsewhere in this contract regarding supervision, approval, or direction by the Contracting Officer or the designated person shall not relieve the Contractor of responsibility for accomplishing the work, with regard to sufficiency or time of performance, except as other wise provided.

1.7 AFFIRMATIVE ACTION COMPLIANCE

Notice of requirement for affirmative action to ensure equal employment opportunity (Apr 1984):

a. The offeror's attention is called to the Equal Opportunity clause and the Affirmative Action Compliance Requirements for Construction clause of this solicitation.

b. The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation for each trade	Goals for female participation for each trade
9.5%	6.9%

These goals are applicable to all the Contractor's construction work performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, the Contractor shall apply the goals established for the geographical area where the work is actually performed. Goals are published periodically in the Federal Register in notice form, and these notices may be obtained from any Office of Federal Contract Compliance Programs office.

c. The Contractor's compliance with Executive Order 11246 as amended, and the regulations in 41 CFR 60.4 shall be based on (1) its implementation of the Equal Opportunity clause, (2) specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction," and (3) its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade. The Contractor shall make

a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor, or from project to project, for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, Executive Order 11246, as amended, and the regulations in 41CFR 60.4. Compliance with the goals will be measured against the total work hours performed.

d. The Contractor shall provide written notification to the Director, Office of Federal Contract Compliance Programs, within 10 working days following award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the

(1) Name, address, and telephone number of the subcontractor;

(i) Employer identification number of the subcontractor;

(2) Estimated dollar amount of the subcontract; and

(3) Estimated starting and completion dates of the subcontract; and

(4) Geographical area in which the subcontract is to be performed.

e. As used in this Notice, and in any contract resulting from this solicitation, the "covered area" is Monmouth County, NJ.

1.8 ORAL MODIFICATION

No oral statement by any person other than the Contracting Officer or his representative, as provided in the Contract Clause entitled "Changes," will in any manner or degree modify or otherwise affect the terms of this contract.

1.9 INSURANCE

1.9.1 Minimum Requirements

The Contractor shall procure and maintain during the entire period of performance under this contract the following minimum insurance coverage:

a. Comprehensive general liability: $500,000 per occurrence

b. Automobile liability: $200,000 per person; $500,000 per occurrence, $20,000 per occurrence for property damage

c. Workmen's compensation: As required by Federal and State workers' compensation and occupational disease laws

d. Employer's liability coverage: $100,000, except in States where workers compensation may not be written by private carriers

e. Others as required by State law.

1.9.2 Insurance--Work on a Government Installation (APR 1984)

a. The Contractor shall, at its own expense, provide and maintain during the entire performance period of this contract at least the kinds and minimum amounts of insurance required in the Schedule or elsewhere in the contract.

b. Before commencing work under this contract, the Contractor shall certify to the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective (1) for such period as the laws of the State in which this contract is to be performed prescribe or (2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

c. The Contractor shall insert the substance of this clause, including this paragraph (c), in subcontracts under this contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the contract. The Contractor shall maintain a copy of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request. (FAR 52.228-5)

1.10 NO WAIVER BY THE GOVERNMENT

The failure of the Government in any one or more instances to insist upon strict performance to any of the terms of this contract or to exercise any option herein conferred shall not be construed as a waiver or relinquishment to any extent of the right to assert or rely upon such terms or option on any future occasion.

1.11 SCHEDULE OF PRICES

1.11.1 Data Required

Within 5 days after award of the contract, the Contractor shall prepare and deliver to the Officer in Charge of Construction a schedule of prices (construction contract) on the forms furnished for this purpose. The schedule of prices shall consist of a detailed breakdown of the contract price, giving the quantities for each of the various kinds of work; the unit prices; and the

total prices therefore. The required schedule must be based on the actual breakdown of the bid price. The format, content, and number of copies required will be prescribed by the Officer in Charge of Construction and will be subject to his approval. The submission of the required data shall not otherwise affect the contract terms.

1.11.2 Submittal Instructions

Furnish four copies of the schedule of prices in accordance with the paragraph entitled "Data Required." Payments will not be made pursuant to the Contract Clause entitled "Payments to Contractor" until the schedule of prices has been submitted to and approved by the Contracting Officer.

1.12 PAYMENTS TO THE CONTRACTOR

Payments made in accordance with the Contract Clause entitled "Payments Under Fixed-Price Construction Contract" will be made on submission of itemized requests by the Contractor and will be subject to reduction for overpayments or increase for underpayments on preceding payments to the Contractor.

1.12.1 Payment for Materials Offsite

Pursuant to the paragraph entitled "Payments to the Contractor," payments may be made to the Contractor for materials stored off construction sites. However, the following conditions must be met:

a. The conditions described in the paragraph entitled "Payments to the Contractor."

b. The material must be within a distance of 50 miles by streets and roads.

c. The materials shall be adequately insured and protected from theft and exposure.

d. The materials shall not be susceptible to deterioration or physical damage in storage or in transit to the jobsite. Items such as steel, machinery, pipe and fittings, and electrical cable are acceptable for progress payments; items such as gypsum wallboard, glass, insulation, and wall coverings are not. Payments will not be made for materials in transit to the jobsite or storage site.

1.12.2 Obligation of Government Payments

The obligation of the Government to make any of the payments required under any of the provisions of this contract shall, in the discretion of the Officer in Charge of Construction, be subject to:

a. Reasonable deductions on account of defects in material or workmanship; and

b. Any claims which the Government may have against the Contractor under or in connection with this contract. Any overpayments to the Contractor shall, unless otherwise adjusted, be repaid to the Government upon demand.

1.13 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

Requests for payment in accordance with the terms of the contract shall consist of:

a. The Contractor's invoice on the form furnished for this purpose, which shall show, in summary form, the basis for arriving at the amount of the invoice; and

b. The contract performance statement on the form furnished for this purpose, which shall show, in detail, the estimated cost percentage of completion and value of completed performance for each of the construction categories stated in this contract. The format, content, and number of copies required will be prescribed by the Officer in Charge of Construction and will be subject to his approval. The submission of the required data will not otherwise affect the contract terms.

1.14 EQUITABLE ADJUSTMENTS - WAIVER AND RELEASE OF CLAIMS

a. Whenever the-Contractor submits a claim for equitable adjustment under any clause of this contract which provides for equitable adjustment of the contract, such claim shall include all types of adjustments in the total amounts to which the clause entitles the Contractor, including, but not limited to, adjustments arising out of delays or disruptions or both caused by such change. Except as the parties may otherwise expressly agree, the Contractor shall be deemed to have waived: (1) any adjustments to which he otherwise might be entitled under the clause where such claim fails to request such adjustments; and (2) any increase in the amount of equitable adjustments additional to those requested in his claim.

b. The Contractor agrees that, if required by the Contracting Officer, he shall execute a release, in form and substance satisfactory to the Contracting Officer, as part of the supplemental agreement setting forth the aforesaid equitable adjustment. The Contractor further agrees that such release shall discharge the Government, including its officers, agents, and employees, from any further claims, including, but not limited to, further claims arising out of delays and/or disruptions caused by the aforesaid change.

1.15 CHANGES BOARD AND ESTIMATES

In determining any equitable adjustment under "Changes" clause, the Officer in Charge of Construction will appoint an Assistant Resident Officer or Assistant Resident Engineer who shall report to the Officer in Charge of Construction the amount of change in cost, time, or both, resulting from the ordered change. In making all equitable adjustments under the "Changes" clause, compensation for additions will be based upon estimated costs at the time the work is performed, and credit for deductions will be based upon estimated costs at the time the contract was made. In arriving at the amount of the change in price, if any, allowance may be made for profit, overhead and general expenses, plant rental, and other similar items.

1.16 AS-BUILT RECORDS

1.16.1 As-Built Drawings

Maintain at the jobsite two sets of full-size contract drawings marked to show any deviations which have been made from the contract drawings, including buried or concealed construction and utility features revealed during the course of construction. Record the horizontal and vertical location of all buried utilities that differ from the contract drawings. These drawings shall be available for review by the Contracting Officer at all times. Upon completion of the work, deliver the marked sets of prints to the Contracting Officer. Requests for partial payments will not be approved if the marked prints are not current, and request for final payment will not be approved until the marked prints are delivered to the Contracting Officer.

1.16.2 As-Built Record of Materials

A record of the materials used is not required.

1.17 CONTRACTOR'S DAILY REPORT

The Contractor shall deliver to the Contracting Officer a "Daily Report to the Inspector" on the form furnished for this purpose. The form shall be completed daily and delivered to the Officer in Charge of Construction. Data to be reported include data on workers by classification, the move-on and move-off of construction equipment furnished by the Contractor and subcontractors or furnished by the Government, and material and equipment delivered to the site.

1.18 QUANTITY SURVEYS

a. The Government will make original and final surveys and compute the quantities of work performed or finally in place.

b. The Contractor shall furnish surveys and computations, as necessary, to determine the quantities of work performed or placed during each period for which a progress payment is to be made. Original field notes, computations, and other records for the purpose of layout and progress surveys shall be furnished promptly to the Contracting Officer at the site of the work and will be used by the Contracting Officer to the extent necessary in determining the proper amount of progress payments due the Contractor. The Contractor shall retain a copy of the original notes, computations, and records furnished to the Contracting Officer. Unless waived by the Contracting Officer in each specific case, the Contractor shall make quantity surveys under the direction of the Contracting Officer.

1.19 Persons performing work shall be certified by the NJDEPE in performing those duties (ie: tank testing FRP installation). Copies of certifications shall be given to OIC.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 STATION REGULATIONS

The Contractor and his employees and subcontractor shall become familiar with and obey all station regulations, including fire, traffic, and security regulations. All personnel employed on the station shall keep within the limits of the work (and avenues of ingress and egress) and shall not enter any restricted areas unless required to do so and are cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.

3.1.1 Working Hours

Regular working hours shall consist of an 8 1/2-hour period established by the Contracting Officer between 7 a.m. and 4 p.m., Monday through Friday, excluding Government holidays. The Contractor shall make application for work outside regular working hours 15 calendar days prior to such work in accordance with the paragraph entitled "Work Outside Regular Hours."

3.1.2 Work Outside Regular Hours

If the Contractor desires to carry on work outside regular hours, including Saturdays, Sundays, and Government holidays, an application shall be delivered to the Officer in Charge of Construction. The Contractor shall allow ample time to enable satisfactory arrangements to be made by the Government for inspecting the work in progress. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Officer in Charge of

Construction. All utility cutovers shall be made after normal working hours or on Saturdays, Sundays, and Government holidays. Anticipated costs shall be included in the bid.

3.2 ORDER OF WORK

The Contractor shall schedule his work so as to cause the least amount of interference with station operations. Work schedules shall be subject to the approval of the Officer in Charge of Construction. Permission to interrupt any station roads, railroads, and/or utility service shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption. The Contractor shall begin and commence activities at one work area prior to starting work at another site on base. For areas which require disturbance of existing fuel distribution systems, the Contractor shall furnish a temporary fuel dispensing terminal.

3.3 WORK BY THE CONTRACTOR

3.3.1 Performance of Work by the Contractor (APR 1984)

The Contractor shall perform on the site, and with its own organization, work equivalent to at least twenty (20) percent of the total amount of work to be performed under the contract. This percentage may be reduced by a supplemental agreement to this contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government. (FAR 52,236-1)

3.3.2 Description of Work Performed by Contractor

In addition to the requirements of the paragraph entitled "Performance of Work by the Contractor (APR 1984)" and prior to the commencement of work at the site, furnish to the Contracting Officer a description of the work to be performed with the Contractor's own organization and the percentage of the total amount of work to be performed under the contract which this represents. Consider the value of materials as part of the work performed by the Contractor only if the materials are to be installed on the site by the Contractor's own organization.

3.4 EXISTING WORK

a. The removal or altering in any way of existing work shall be carried on in such a manner as to prevent injury or damage to any portion(s) of the existing work which remain(s).

b. All portions of existing work which have been altered in any way during construction operations shall be repaired or replaced in kind and in a manner to match existing or adjoining work, as approved by the Contracting Officer. All work of this nature shall be performed by the Contractor at the Contractor's expense and shall be performed as directed by the Officer in Charge of Construction. At the completion of all operations, existing work shall be in a condition equal to or better than that which existed before the new work started.

3.5 SANITATION

Adequate sanitary conveniences of a type approved for the use of persons employed on the work shall be constructed, properly secluded from public observation, and maintained by the Contractor in such a manner as required or approved by the Officer in Charge of Construction. These conveniences shall be maintained at all times without nuisance. Upon completion of the work, the conveniences shall be removed by the Contractor from the premises, leaving the premises clean and free from nuisance.

3.6 SPECIFICATIONS AND STANDARDS

The specifications and standards referenced in this project specification, including addenda, amendments, and errata listed, will govern in all cases where references thereto are made. In case of differences between these specifications or standards and this project specification or its accompanying drawings, this project specification and its accompanying drawings will govern to the extent of such differences. Otherwise, the referenced specifications and standards will apply. The requirement for packaging, packing, marking, and preparation for shipment or delivery included in the referenced specifications will apply only to materials and equipment that are furnished directly to the Government and not to materials and equipment that are to be furnished and installed by the Contractor.

3.7 OPTIONAL REQUIREMENTS

Where a choice of materials or methods, or both, is permitted in this contract, the Contractor will be given the right to exercise the option unless otherwise required by the specification.

3.8 GENERAL PROVISIONS

Any reference within this project specification to a General Provision shall be understood to be a reference to the Contract Clause(s) or the General Paragraph(s) addressing the subject matter of the particular reference.

3.9 TEMPORARY FUEL AND POWER PROVISIONS

Contractor shall provide temporary one 1,000 gallon above-ground fuel storage tanks for each type taken out of service during demolition, construction, and testing. Contractor shall provide temporary fuel dispensing terminals for vehicles which shall be connected to temporary fuel storage tanks. Contractor to notify Navy five (5) working days in advance of tank installation to allow Navy to provide fuel delivery. Contractor to ensure proper installation of such temporary facilities and shall operate these facilities with no exceptions. Temporary power shall also be provided to allow operation of temporary fuel dispensing terminals.

-- End of Section --

SECTION 01011

ADDITIONAL GENERAL PARAGRAPHS

PART 1 GENERAL

1.1 REFERENCES

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

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926.59	Hazard Communication

CORPS OF ENGINEERS (COE)

COE EM-385-1-1	1992 Safety and Health Requirements Manual

1.2 PROJECT INFORMATION

1.2.1 Bidding Documents

Bidders may obtain documents by calling Ms. S. Brown at (215) 595-0639. For bidding purposes prime contractors will be furnished two sets of half-size prints of the contract drawings and two copies of the specifications and principal subcontractors will be furnished one set of half-size prints of the contract drawings and one copy of the specifications. Additional sets of full size drawings may be acquired at the bidder's expense from the following reproduction agency:

Philadelphia Blueprint Company
725 Chestnut Street
Philadelphia, PA 19106
Tel. (215) 627-6493

Set of drawings and specifications are available for examination at the following site:

Officer in Charge of Construction
Naval Weapons Station, Earle
Colts Neck, NJ 07722
Tel. (201) 462-9500

1.2.2 Contract Drawings

The work shall conform to the following contract drawings which form a part of this specification. Drawings are the property of the Government and shall not be used for any purpose other than that contemplated by the specifications.

NAVFAC DRAWING NO.	TITLE
2162660	Sheet 1 - Cover Sheet
2162661	Sheet 2 - Soil Vapor Monitoring System Details
2162662	Sheet 3 - Tank and Pipe Details
2162663	Sheet 4 - Architectural and Structural Details
2162664	Sheet 5 - C-17 and R-6 Canopy Details
2162665	Sheet 6 - Dispenser Modifications, Stair and Handrail Details
2162666	Sheet 7 - New C-17 and R-6 Sections
2162667	Sheet 8 - C-50 Plan and Sections
2162668	Sheet 9 - C-50 Sections
2162669	Sheet 10 - E-14 Plan and Sections
2164368	Sheet 11 - E-14 Sections and Elevations
2164369	Sheet 12 - C-17 and C-20 Demolition Plan
2164370	Sheet 13 - C-17 Plan
2164371	Sheet 14 - R-6 and R-7 Demolition Plan
2164372	Sheet 15 - R-6 Plan
2164373	Sheet 16 - R-6 Sections
2164374	Sheet 17 - Electrical Notes, Symbols, Abbreviations, and Details
2164375	Sheet 18 - Electrical Details
2164376	Sheet 19 - Electrical Schedules and Line Diagrams
2164377	Sheet 20 - Electrical Line Diagrams

1.2.3 Drawing Error and Omission

Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.

1.2.4 Notification of Drawing Discrepancies

The Contractor shall check all drawings furnished him immediately upon their receipt and shall promptly notify the Contracting Officer of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings shall in general govern small scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

1.2.5 Number of Sets of Contract Documents Furnished

After award of the contract, the Contracting Officer will furnish to the Contractor one set of the contract drawings. In addition the Contracting Officer will furnish to the Contract 5 full size sets of the contract drawings and five copies of the specifications. The procurement of the applicable publications incorporated into the technical provision by reference shall be the responsibility of the Contractor.

1.2.6 Subsurface Data

Subsurface data, not specified or indicated, have been obtained by the Government at the station. The data are available for examination by prospective bidders at the station.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-18, Records

a. Construction schedule G

b. Equipment delivery schedule G

c. Monthly update to construction schedule and equipment delivery schedules G

d. Accident Prevention Plan G

1.3.1.1 Construction Schedule

Within 15 days after award of the Contract, prepare and submit to the Contracting Officer for approval a feasible construction schedule in accordance with the clause of the Contract Clauses entitled "Schedules for Construction Contract," except as modified in this contract.

1.3.1.2 Equipment Delivery Schedule

Within 28 days after award of the Contract, submit to the Contracting Officer for approval, a schedule showing the procurement plans for materials, plant, and equipment. Submit in the format prescribed by the Contracting Officer, and include as a minimum the following information:

a. Description

b. Date of the purchase order

c. Promised shipping date

d. Name of the manufacturer or supplier

e. Date delivery is expected

f. Date the material or equipment is required, according to the current progress schedule or network.

1.3.1.3 Monthly Update to Schedules

Update the construction schedule and equipment delivery schedule at monthly intervals or as directed. Reflect any changes occurring since the last update. Submit copies of the purchase orders and confirmation of the delivery dates as directed. Update the construction schedules and equipment schedules with each invoice for progress payment in accordance with.the clause of the Contract Clauses entitled "Schedules for Construction Contract."

1.4 ADDITIONAL INFORMATION REQUIRED OF THE CONTRACTOR

1.4.1 Subcontractors and Personnel

Reference is made to the clause of the Contract Clauses entitled "Subcontract (Labor Standards)." In addition to the data required by that clause, provide a list of the key personnel of the Contractor and subcontractors (including addresses and telephone numbers) for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.5 PROJECT SCHEDULE AND TIME CONSTRAINTS

1.5.1 Commencement, Prosecution, and Completion of Work (APR 84)

The Contractor shall be required to (a) commence work under this contract within 15 calendar days after award of the Contract, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 180 calendar days after the required commencement of work. The time stated for completion shall include final cleanup of the premises.

(FAR 52.212-3)

1.5.1.1 Definitions

a. The date the Contracting Officer signs the SF 1442 is the date of the award of the contract.

b. The period of 15 days, after which contract time commences, is to allow for the mailing of the SF 1442 and the Contractor's submission and approval of the required bonds, Certificates of Insurance and Certification as to the percentage of work to be performed by the Contractor.

c. The contract time for the purpose of fixing the completion date shall begin to run 15 days from the date of award on the SF 1442, regardless of when the performance and payment bonds are executed."

1.5.2 Liquidated Damages - Construction (APR 84)

(FAR 52.212-5(a))

1.5.2.1 Failure to Complete Work

If the Contractor fails to complete the work within the time specified in the contract, or any extension, the Contractor shall pay to the Government as liquidated damages, the sum of $200.00 for each day of delay.

(FAR 52.212-5(a))

1.5.2.2 Contractor Liability with Government Termination

If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.

(FAR 52.212-5(b))

1.5.2.3 Contractor Liability Without Government Termination

If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

(FAR 52.212-5(c))

1.6 CONTRACTOR QUALIFICATIONS

This Contract requires expertise in several different construction displines. The Contractor and Subcontractors shall meet the following minimum qualifications and shall submit proof of such qualifications and experience.

1.6.1 NJDEPE Soils Sampling Experience

Contractor shall have at least two (2) years experience in performing excavation, soils sampling, and disposal in accordance with NJDEPE regulations for Underground Storage Tanks.

1.6.2 Electrical Controls Installation Experience

Contractor shall have at least three (3) years experience in constructing electrical controls systems of the same level of complexity required by this project. Specifically, Contractor shall have experience in: installing Underground Storage Tank inventory systems installation such as tank level gages, sump probes, and alarm panels; and fuel management systems using card readers.

1.6.3 Monitoring Well Installation Experience

Contractor shall have at least five (5) years experience in installing monitoring wells.

1.5.4 Computer and Communications Experience

Contractor shall have at least five (5) years experience in installing computer systems and shall have similar experience in installing dial-up modems to phone systems. Refer to Specification 13004, "Data Processing Systems" and Section 16499, "Telephone Service and Communications" for additional experience requirements.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 FACILITIES AND SERVICES

3.1.1 Availability of Utilities Services

Pursuant to the clause of the Contract Clauses entitled "Availability and Use of Utilities Services," reasonable amounts of the following utilities will be made available to the Contractor without charge; Electricity, Potable Water, and Sanitary Sewer.

The point at which the Government will deliver such utilities or services and the quantity available shall be as directed by the Contracting Officer. The Contractor shall pay all costs incurred in connecting, converting, and transferring the utilities to the work. The Contractor shall make connections, including providing backflow-preventing devices on connections to domestic water lines and providing transformers, and make disconnections.

3.1.2 Contractor's Storage Area

The clause of the Contract Clauses entitled "Operations and Storage Areas" and the following apply:

3.1.2.1 Storage in Existing Buildings

The Contractor shall be working in and around existing buildings; the storage of material will not be allowed in the buildings.

3.1.2.2 Storage Size and Location

The open site available for storage shall be as directed by the Contracting Officer.

3.2 RESTRICTIONS ON EQUIPMENT

3.2.1 Radio Transmitter Restrictions

Conform to the restrictions and procedures for the use of radio transmitting equipment, as directed. Do not use transmitters without prior approval.

3.3 RESTRICTIONS ON OPERATIONS

3.3.1 Restrictions Upon Interrupting Utility Services

The clause of the Contract Clauses entitled "Schedules for Construction Contract"; the paragraph of Section 01010, "General Paragraphs," entitled "Order of Work"; and the following apply:

a. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.

b. Interruption to Electric Service: These shall be considered utility cutovers pursuant to the paragraph of Section 01010, "General Paragraphs," entitled "Work Outside Regular Hours." This limit includes time for deactivation and reactivation.

3.3.2 Coordination With Other Work

The clause of the Contract Clauses entitled "Other Contracts"; the paragraph of Section 01010, "General Paragraphs", entitled "Order of Work"; and the following apply:

3.3.2.1 Occupied Buildings

The Contractor shall be working in and around existing buildings which are occupied. Do not enter the buildings without prior approval of the Contracting Officer. Relocate movable furniture as required to perform the work, protect the furniture, and replace the furniture in their original locations upon completion of the work. Leave attached equipment in place, and protect them against damage, or temporarily disconnect, relocate, protect, and reinstall them at the completion of the work.

3.4 SECURITY REQUIREMENTS

No employee or representative of the Contractor will be admitted to the work site without satisfactory proof of United States citizenship or is specifically authorized admittance to the work site by the Officer in Charge of Construction.

3.5 ACCIDENT PREVENTION PLAN

Submit in writing an Accident Prevention Plan in accordance with Contract Clause titled "Accident Prevention" and the current edition of the U.S. Army Corps of Engineers "Safety and Health Requirements Manual" COE EM-385-1-1 in effect on the date of the solicitation. Prepare the Accident Prevention Plan following the guidelines found in Table 1-1, page 3 of COE EM 385-1-1. The Accident Prevention Plan shall also include a hazard communication program complying with the requirements of 29 CFR 1926.59 and COE EM-385-1-1. For each major phase of the work, prepare an activity hazard analysis as required by COE EM-385-1-1. The Contractor shall meet in conference with the Contracting Officer to discuss and develop mutual understandings relative to the overall safety program. Work at the construction site will not be permitted unitl the Accident Prevention Plan is approved by the Contracting Officer.

3.6 ACTIONS REQUIRED OF THE CONTRACTOR

3.6.1 Location of Underground Facilities

Verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed but indicated in locations to be traversed by piping, ducts, and other work to be installed. Verify the elevations before the new work is laid closer than the nearest manhole or other structure at which an adjustment in grade could be made. For additional work required by reason of conflict between new and existing work, an adjustment in contract price will be made in accordance with the clause of the Contract Clauses entitled "Differing Site Conditions."

3.6.2 Station Permits

Obtain these pursuant to the paragraph of Section 01010, "General Paragraphs," entitled "Station Regulations." Permits are required for, but are not necessarily limited to, welding, digging, and burning. Allow 7 calendar days for processing of the application.

3.6.3 Storm Protection

If a warning of gale force winds is issued, take precautions to minimize any danger to persons, and protect the work and any nearby Government property. Precautions shall include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work if storms of lesser intensity pose a threat to the work or any nearby Government property.

3.6.4 Unforeseen Hazardous Material

If material, not otherwise identified as hazardous, is encountered which may be dangerous to human health if disturbed during construction operations, the Contractor shall stop that portion of the work and avoid coming in contact with the material. The Contractor shall immediately notify the Contracting Officer concerning the possible existence of hazardous material. The intent is to identify materials such as friable and nonfriable asbestos, pollychlorinated biphenyls (PCBs) and paint testing to determine if the material is hazardous. If the material is not hazardous or poses no danger, the Contracting Officer will direct the Contrator to proceed without change. If the Material is hazardous and must be disturbed or handled to accomplish the work, the Contracting Officer will direct the Contractor to proceed without change. If the material is hazardous and must be disturbed or handled to accomplish the work, the Contracting Officer will direct a change pursuant to the Contract Clauses titled "Changes" and "Differing Site Conditions".

3.6.5 Hand Digging

Contractor shall make provisions in the work plan and cost estimates for the necessity of considerable hand digging during demolition and construction phases of this project.

-- End of Section --

SECTION 01012

SPECIAL PROVISIONS

PART 1 GENERAL

1.1 PROJECT INFORMATION

1.1.1 Extraordinary Security Requirements:

The clause of Contract Clauses titled "Identification of Employees"; the paragraph of Section 01011, "Additional General Paragraphs" titled "Security Requirements"; and the following shall apply.

All Contractor personnel on stie shall be certified by the Contractor to be U.S. citizens and the Contractor shall provide the Contracting Officer the names of all prospective on-site workers at least 96 hours in advance of their appearance on-site. Contractor employees will be required to show proof of citizenship (such as birth certificate) to obtain entry badges for on-site work. All employees, be they prime or subcontractor, shall report to the Security Office, Naval Weapons Station Earle, Colts Neck, New Jersey for photographs to be taken no less than 48 hours prior to their beginning work on the job site.

PART 2 EXECUTION

2.1 STATION REGULATIONS AFFECTING THE WORK

In addition to the requirements contained in paragraph titled "Station Regulations" of Section 01011, "Additional General Paragraphs" the following shall apply.

2.1.1 Use of explosives is prohibited.

2.1.2 Storage of fuels on the site is prohibited. The station fire truck shall be present during the refueling of all equipment on site. At least a 48 hour notice shall be given prior to refueling.

2.1.3 Where a site boundary fence is specified to be erected by the Contractor it shall consist of wire mesh fabric at least four feet high attached to posts every ten feet. The fence erected by the Contractor shall be removed upon completion of the work.

2.1.4 Regular Working Hours: See paragraph titled "Work Outside Regular Hours" of Section 01011, Additional General Paragraphs. Regular hours at the Naval Weapons Station Earle, Colts Neck, New Jersey are from 7:30 A.M. to 4:00 P.M.

2.1.5 No smoking is authorized except in designated areas as approved by the Contracting Officer. Where smoking is allowed, the Contractor shall provide adequate fire extinguishing equipment. A smoking permit shall be secured from the fire department and posted in the smoking area.

2.1.6 All vehicles entering and leaving the Station will be subject to search.

2.1.7 Parking for privately owned vehicles will be restricted. Limited parking area for vehicles will be designated near the work site by the Officer-in-Charge.

2.1.8 All alleged delays which are in addition to those specified shall be included in the Contractor's daily reports. The following information pertaining to these alleged delays shall be included.

a. Duration
b. Number of personnel directly affected
c. Equipment directly affected
d. Brief description of the cause of the delay

2.1.9 No alcoholic beverages all allowed on the construction site. Should alcohol be found, the employee involved shall be removed from the construction site.

2.1.10 Prior to all welding and burning on the job site, the Contractor shall obtain, on a daily basis, a burning permit from the Station fire department.

2.1.11 The Contractor must obtain ordnance badges for access to work sites within ordnance areas. Access into the ordnance area require:

a. Logging in and out by the Contractor at gates.
b. The Contractor must contact Security for access to and from the area north of Esperance Road and will experience at least a 1/2 hour delay each time. Escorts are not required.

3.1.12 Every morning by 11:00 A.M. the Contractor's Superintendent shall provide the Government's Inspector a list of all deliveries expected to be made on the following day. Where unscheduled deliveries are made, the Contractor's Superintendent shall proceed to the main gate of the Security Area to verify the material to be delivered.

2.1.13 All alleged delays which are in addition to those specified shall be included in the Contractor's daily reports. The following information pertaining to these alleged delays shall be included: (a) duration, (b) number of personnel directly affected, (c) equipment directly affected and, (d) brief description of the cause of the delay.

2.1.14 Prior to all welding, cutting, brazing, blowtorch and open flame work on the job site, the Contractor shall obtain, on a daily basis, a permit from the station fire department.

2.1.15 No flame producing devices, such as matches or cigarette lighters shall be permitted on the construction site.

2.1.16 No alcoholic beverages are allowed on the construction site. Should alcohol be found, the employee involved shall be removed from the construction site.

2.1.17 Once per month, security drills will be held by the Naval Weapons Station. The drills will require the Contractor's personnel to stop work and take cover for approximately one hour.

-- End of Section --

SECTION 01090

REFERENCES

PART 1 GENERAL

1.1 REFERENCES

Reference publications are cited in other sections of the specifications along with identification of their sponsoring organizations. The addresses of the sponsoring organizations are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AMERICAN CONCRETE INSTITUTE (ACI)
22400 W. 7 Mile Road
P.O. Box 19150
Detroit, MI 48219-0150
Ph: 313-532-2600 Fax: 313-538-0655

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1430 Broadway
New York, New York 10018
Ph: 212-354-3300 Fax: 212-302-1286

AMERICAN PETROLEUM INSTITUTE (API)
1220 L Street, N.W.
Washington, DC 20005
Ph: 202-682-8000 Fax: 202-682-8030

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
345 East 47th Street
New York, NY 10017
Ph: 212-705-7722 Fax: 212-705-7674

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1916 Race Street
Philadelphia, PA 19103
Ph: 215-299-5400 Fax: 215-977-9679

CODE OF FEDERAL REGULATIONS (CFR)
Order from:
Government Printing Office
Washington, DC 20402
Ph: 202-783-3238 Fax: 202-275-7703

CORPS OF ENGINEERS (COE)
Order from:
U.S. Army Engineer Waterways Experiment Station
Attn: Technical Report Distribution Section,
Services Branch, TIC - 3909 Halls Ferry Road
Vicksburg, MS 39180-6199
Ph: 601-634-2485 Fax: 601-634-2542

DEFENSE LOGISTICS AGENCY (DLA)
Cameron Station
Alexandria, VA 22304-6100
Ph: 703-274-6775
Autovan: 283-6775 Fax: 703-284-1927

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)
2001 Eye Street, N.W.
Washington, DC 20006
Ph: 202-457-4900 Fax: 202-457-4985

ENVIRONMENTAL PROTECTION AGENCY (EPA)
401 M Street, S.W.
Washington, DC 20460
Ph: 202-382-2118 Fax: 202-382-7883, 202-382-7884

FEDERAL STANDARD (FED-STD)
Order from:
Standardization Documents Order Desk
Building 4D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-2179
Autovon: 442-2179, 442-2667 Fax: 215-697-2978

OR

General Services Administration
Specification and Consumer Information Distribution Section (WFSLS)
7th and "D" Street, S.W., Room 6654
Washington, DC 20407
Ph: 202-708-9205 Fax: 202-708-9862

FEDERAL SPECIFICATIONS (FS)
Order from:
Standardization Documents Order Desk
Building 4D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-2179 Fax: 215-697-2978

OR

General Services Administration
Specification and Consumer Information
Distribution Section (WFSLS)
7th and "D" Street, S.W., Room 6654
Washington, DC 20407
Ph: 202-708-9205 Fax: 202-708-9862

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331
Ph: 201-562-3800 Fax: 201-981-9667

MILITARY SPECIFICATIONS (MIL)
Order from:
Standardization Documents Order Desk
Building 4D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-2179
Autovon: 442-2179, 442-2667 Fax: 215-697-2978

MILITARY STANDARDS (MIL-STD)
Order from:
Standardization Documents Order Desk Building 4D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-2179
Autovon: 442-2179, 442-2667 Fax: 215-697-2978

NAVAL ENERGY & ENVIRONMENTAL SUPPORT ACTIVITY (NEESA)
Officer in Charge
Port Hueneme, CA 93043-5014
Ph: 805-982-5751
Autovon: 551-5388 Fax: 805-982-5388

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
2101 L Street, N.W., Suite 300
Washington, DC 20037
Ph: 202-457-8474 Fax: 202-457-8468

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
One Batterymarch Park, P.O. Box 9101
Quincy, MA 02269-9101
Ph: 617-770-3000 Fax: 617-770-0700

NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH (NIOSH)
Publications Department
4676 Columbia Parkway
Cincinnati, OH 45226
Ph: 513-533-8287 Fax: 513-533-8287

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION & ENERGY
Division of Responsible Party
Site Remediation
Bureau of Underground Storage Tanks
CN 028
Trenton, NJ 08625-0028
Ph: 609-984-3156

UNDERWRITERS LABORATORIES, INC. (UL)
333 Pfingsten Road
Northbrook, IL 60062
Ph: 708-272-8800 Fax: 708-272-8129

PART 2 PRODUCTS

This is a list of equipment manufacturers. This is not a complete list of all manufacturers who supply such equipment, nor is it a pre-approved list.

GASBOY
William M. Wilsons Sons, Inc.
707 North Valley Forge Road
Lansdale, PA 19446
Ph: 215-855-4631
Dispensers, Fuel Management System, Tank Monitoring Systems

WAYNE-DRESSER, INC.
P.O. Box 1859
Salisbury, MD 21802
Ph: 301-546-6600
Dispensers, Fuel Management Systems

VEEDER-ROOT
125 Powder Forest Dirve
Post Office Box 2003
Simsbury, CT 05070-2003
Ph: 203-651-2700
Tank Monitoring Systems

PETROVEND, INC.
6900 Santa Fe Drive
Hodgkins, IL 60525-9909
Ph: 708-485-4200
Fuel Management Systems

ARIZONA INSTRUMENTS CORP. (AZI)
1100 East University Drive
P.O. Box 1930
Tempe, AZ 85280
Ph: 800-528-7411
Soil Vapor Monitoring Systems

MOHAWK IMAGE SYSTEMS
2175 Beechgrove Place
Utica, NY 13501
Ph: 315-793-3000
Canopies

FTC CANOPY
110 Canopy Drive
Ashley, IN 46705
Ph: 219-587-3211
Canopies

ENVIRON PRODUCTS, INC.
252 Welsh Pool Road
Lionville, PA 19341
Dispenser Pans, Dispenser/UST Acc's

EMCO-WHEATON
4001 Weston Parkway
Cary, NC 27513
Ph: 800-234-4394
Service Station Fittings

UNIVERSAL
Elizabeth, NJ
Ph: 908-351-0606
Service Station Fittings

OPW
P.O. Box 405003
Cincinnati, OH 45240
Ph: 513-870-3219
Service Station Fittings

FAIRFIELD INDUSTRIES, INC.
1275 Bloomfield Avenue
Fairfield, NJ 07006
Ph: 201-227-5321
Service Station Fittings

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 REFERENCES

Not used.

1.2 DEFINITIONS

1.2.1 Submittal

Shop drawings, product data, samples, administrative and closeout submittals, and additional data presented for review and approval. Contract Clauses "Material and Workmanship," paragraph (b); "Specifications and Drawings for Construction," paragraphs (d), (e), and (f) apply to all "submittals."

1.2.2 Types of Submittals

The following four groupings of submittals into which all submittal descriptions are classified, as designated in the paragraph entitled "Schedule of Submittal Descriptions."

a. Shop drawings: As used in this Section, drawings, schedules, diagrams, and other data prepared specifically for this Contract, by the Contractor or through the Contractor by way of a subcontractor, manufacturer, supplier, distributor, or other lower tier contractor, to illustrate a portion of the work.

b. Product data: Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate a portion of the work, but not prepared exclusively for this Contract.

c. Samples: Physical examples of products, materials, equipment, assemblies, or workmanship, physically identical to a portion of the work, illustrating a portion of the work or establishing standards for evaluating the appearance of the finished work or both.

d. Administrative and closeout submittals: Submittals of data for which reviews and approval will be to ensure that the administrative requirements of the project are adequately met but not to ensure directly that the work is in accordance with the design concept and in compliance with the Contract documents.

1.2.3 Approving Authority

The person who is authorized to approve a submittal.

1.2.4 Work

As used in this Section, on- and off-site construction required by the Contract documents, including labor necessary to produce the construction and materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.3 SUBMITTALS

Submit the following in accordance with the requirements of this section.

1.3.1 SD-18, Records

a. Submittal register G

1.3.1.1 Submittal Register

State for each submittal the Contractor's planned submittal date. Submit within 45 days after award of the contract. Insert dates on copies of the "Submittal Register." Obtain the original from the following source:

a. From the register with the submittal items filled in, attached.

1.4 PROCEDURES FOR SUBMITTALS

1.4.1 Reviewing, Certifying, Approving Authority

The QC organization shall be responsible for reviewing and certifying that submittals are in compliance with contract requirements. The approving authority on submittals is the QC Manager unless otherwise specified for the specific submittal. At each "Submittal" paragraph in the individual specification Sections, a notation "G", following a submittal item, indicates the Contracting Officer is the approving authority for that submittal item.

1.4.2 Constraints

a. Submittals listed or specified in the Contract shall conform to the provisions of this Section, unless explicitly stated otherwise.

b. Submittals shall be complete for each definable feature of work; components of the definable feature interrelated as a system shall be submitted at the same time.

c. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, the submittal will be returned without review.

d. Approval of a separate material, product, or component does not imply approval of assembly in which the item functions.

1.4.3 Scheduling

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of the work so that work will not be delayed by submittal processing. Allow for potential requirements to resubmit.

b. Except as specified otherwise, allow a review period, beginning with receipt by the approval authority, that includes at least 15 working days for submittals for QC Manager approval and 20 working days for submittals for Contracting Officer approval. The period of review for submittals with Contracting Officer approval begins when the Government receives the submittal from the QC organization. The period of review for each resubmittal is the same as for the initial submittal.

c. For submittals requiring approval by the Fire Protection Engineer, allow a review period, beginning when the Government receives the submittal from the QC organization, of 30 working days for return of the submittal to the Contractor. The period of review for each resubmittal is the same as for the initial submittal.

1.4.4 Variations

Variations from contract requirements require Government approval pursuant to Contract Clause entitled "Specifications and Drawings for Construction" and will be considered where advantageous to the Government. When proposing a variation, submit a written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to the Government. If lower cost is a benefit, also include an estimate of the cost saving. Identify the proposed variation separately and include the documentation for the proposed variation along with the required submittal for the item. When submitting a variation for approval, the Contractor warrants the following:

1.4.4.1 Variation Is Compatible

The Contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of the work.

1.4.4.2 Contractor Is Responsible

The Contractor shall take actions and bear the additional costs, including review costs by the Government, necessary because of the proposed variation.

1.4.4.3 Review Schedule Is Modified

In addition to the normal submittal review period, a period of 10 working days will be allowed for consideration by the Government of submittals with variations.

1.4.5 Contractor's Responsibilities

a. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and Contract documents.

b. Transmit submittals to the QC organization in orderly sequence, in accordance with the Submittal Register, and to prevent delays in the work, delays to the Government, or delays to separate contractors.

c. Advise the Contracting Officer of variation, as required by the paragraph entitled "Variations."

d. Correct and resubmit submittal as directed by the approving authority. Direct specific attention, in writing or on resubmitted submittal, to revisions not requested by the approving authority on previous submissions.

e. Furnish additional copies of submittals when requested by the Contracting Officer, to a limit of 20 submittals.

f. Complete work which must be accomplished as a basis of a submittal in time to allow the submittal to occur as scheduled.

g. Ensure no work has begun until submittals for that work have been returned as "approved," or "approved as noted", except to the extent that a portion of the work must be accomplished as a basis of the submittal.

1.4.6 QC Organization Responsibilities

a. Note the date on which the submittal was received from the contractor on each submittal for which the QC Manager is the approving authority.

b. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and Contract documents.

c. Review submittals for conformance with project design concepts and compliance with the Contract documents.

d. Act on submittals, determining the appropriate action based on the QC organization's review of the submittal.

(1) When the QC Manager is the approving authority, take the appropriate action on the submittal from the possible actions defined in the paragraph entitled, "Actions Possible".

(2) When the Contracting Officer is the approving authority or when a variation has been proposed, forward the submittal to the Government with the certifying statement or return the submittal marked "not reviewed" or "revised and resubmit" as appropriate. The QC organization's review of the submittal determines the appropriate action.

e. Ensure that material is clearly legible.

f. Stamp each sheet of each submittal with the QC certifying statement or approving statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.

(1) When the approving authority is the Contracting Officer, the QC organization will certify submittals forwarded to the Contracting Officer with the following certifying statement:

"I hereby certify that the (equipment), (material), (article) shown and marked in this submittal is that proposed to be incorporated into Contract Number N62472-91-C-0489, is in compliance with the Contract drawings and specification, can be installed in the allocated spaces, and is submitted for Government approval. Government approval of proposed variation, if any, is recommended.

Certified by Submittal Reviewer_____, Date_____
(Signature when applicable)

Certified by QC Manager _____, Date_____

(2) When the approving authority is the QC Manager, the QC Manager will use the following statement when returning submittals to the Contractor as "Approved" or "Approved as Noted."

"I hereby certify that the (material), (equipment), (article) shown and marked in this submittal and proposed to be incorporated with Contract Number N62472-91-C-0489, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is _____ approved for use, _____ approved for use subject to Government approval of proposed variation.

Certified by Submittal Reviewer_____, Date_____
(Signature when applicable)

Certified by QC Manager _____, Date_____

g. Sign the certifying statement or approval statement. The person signing the certifying statements shall be the QC organization member designated in the approved QC plan. The signatures shall be in original ink. Stamped signatures are not acceptable.

h. Update the submittal register as submittal actions occur and maintain the submittal register at the project site until final acceptance of all work by the Contracting Officer.

i. Retain a copy of approved submittals at the project site, including the Contractor's copy of approved samples.

j. When the approving authority is the QC Manager, forward two copies of each approved submittal, except "Samples," where one set is required, to the Contracting Officer.

1.4.7 Government's Responsibilities

When the approving authority is the Contracting Officer, the Government will:

a. Note the date on which the submittal was received from the QC Manager, on each submittal for which the Contracting Officer is the approving authority.

b. Review submittals for approval within the scheduling period specified and only for conformance with project design concepts and compliance with the Contract documents.

c. Identify returned submittals with one of the actions defined in the paragraph entitled "Actions Possible" and with markings appropriate for the action indicated.

d. Retain three copies of each submittal, except "Samples," where one copy will be retained.

1.4.8 Actions Possible

Submittals will be returned with one of the following notation:

a. Submittals marked "not reviewed" will indicate the submittal has been previously reviewed and approved, is not required as a submittal, does not have evidence of being reviewed and approved by the Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Returned submittals deemed to lack review by the Contractor or to be incomplete shall be resubmitted with appropriate action, coordination, or change.

b. Submittals marked "approved" "approved as submitted" authorize the Contractor to proceed with the work covered.

c. Submittals marked "approved as noted" authorize the Contractor to proceed with the work as noted provided the Contractor takes no exception to the notations.

d. Submittals marked "revise and resubmit" or "disapproved" indicate the submittal is incomplete or does not comply with the design concept or the requirements of the Contract documents and shall be resubmitted with appropriate changes.

1.5 FORMAT OF SUBMITTALS

1.5.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels, to the office of the approving authority. Transmit submittals with a transmittal form prescribed by the Contracting Officer and standard for the project. The transmittal form shall identify the Contractor, indicate the date of the submittal, and include information prescribed by the transmitted form and required in the paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample panels and sample installations.

1.5.2 Identifying Submittals

Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on the transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction Contract number.

c. The Section number of the Section by which the submittal is required.

d. The submittal description (SD) number of each component of the submittal.

e. When a resubmission, an alphabetic suffix on the submittal description, for example, SD-10A, to indicate the resubmission.

f. The name, address, and telephone number of the subcontractor, supplier, manufacturer and any other second tier contractor associated with the submittal.

g. Product identification and location in project.

1.5.3 Format for Product Data

a. Present product data submittals for each Section as a complete, bound volume. Include a table of contents listing page and catalog item numbers for product data.

b. Indicate, by prominent notation, each product which is being submitted; indicate the specification Section number and paragraph number to which it pertains.

c. Supplement product data with material prepared for the project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for the project.

1.5.4 Format for Shop Drawings

a. Shop drawings shall not be less than 8 1/2 by 11 inches nor more than 30 x 42 inches.

b. Present 8 1/2 x 11-sized shop drawings as part of the bound volume for the submittals required by the Section. Present larger drawings in sets.

c. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to the information required in the paragraph entitled "Identifying Submittals."

d. Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Identify materials and products for work shown.

1.5.5 Format of Samples

a. Furnish samples in the sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately the same size as specified:

(1) Sample of Equipment or Device: Full size.

(2) Sample of Materials Less than 2 by 3 Inches: Built up to 8 1/2 by 11 inches.

(3) Sample of Materials Exceeding 8 1/2 by 11 Inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

(4) Sample of Linear Devices or Materials: 10-inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.

(5) Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.

(6) Color Selection Samples: 2 inches by 4 inches.

(7) Sample Panel: 4 feet by 4 feet.

(8) Sample Installation: 100 square feet.

b. Samples Showing Range of Variation: Where variations are unavoidable due to the nature of the materials, submit sets of samples of not less than three units showing the extremes and middle of the range.

c. Reusable Samples: Incorporate returned samples into the work only if so specified or indicated. Incorporated samples shall be in undamaged condition at the time of use.

d. Recording of Sample Installation: Note and preserve the notation of the area constituting the sample installation but remove the notation at the final clean up of the project.

e. When a color, texture or pattern is specified in naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.5.6 Format of Administrative Submittals

a. When the submittal includes a document which is to be used in the project or become a part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document, but to a separate sheet accompanying the document.

b. Operation and Maintenance Manual Data: Submit in accordance with Section 01730, "Operation and Maintenance Data." Include components required in that Section and the various technical sections.

1.6 QUANTITY OF SUBMITTAL

1.6.1 Number of Copies of Product Data

a. Submit six copies of submittals of product data requiring review and approval only by the QC organization and seven copies of product data requiring review and approval by the Contracting Officer.

1.6.2 Number of Copies of Shop Drawings

a. For shop drawings presented on sheets larger than 8 1/2-inches by 14 inches, submit one reproducible and three prints of each shop drawing prepared for this project.

   (1) Transmit reproducibles rolled in mailing tubes.

   (2) After review, the approving authority will retain the prints and return only the reproducible with notation resulting from the review.

b. For shop drawings presented on sheets 8 1/2-inches by 14 inches or less, conform to the quantity requirements for product data.

1.6.3 Number of Samples

a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by the approving authority and one will be returned to the Contractor.

b. Submit one sample panel. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials.

1.6.4 Number of Copies of Administrative and Submittals

a. Unless otherwise specified, submit administrative and submittals which are 8 1/2 inches by 14 inches or smaller in size in the quantity required for product data.

b. Unless otherwise specified, submit administrative and submittals larger than 8 1/2 inches by 14 inches in size in the quantities required for shop drawings.

c. Submit administrative submittals under "SD-19, Operations and Maintenance Manuals" to conform to Section 01730, "Operations and Maintenance Data."

1.7 SCHEDULE OF SUBMITTAL DESCRIPTIONS (SD)

SD-01, Data

Submittals which provide calculations, descriptions, or other documentation regarding the work.

SD-02, Manufacturer's Catalog Data

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. A type of product data.

SD-03, Manufacturer's Standard Color Charts

Preprinted illustrations displaying choices of color and finish for a material or product. A type of product data.

SD-04, Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work. A type of shop drawing.

SD-05, Design Data

Design calculations, mix designs, analyses, or other data, written in nature and pertaining to a part of the work. A type of shop drawing.

SD-06, Instructions

Preprinted material describing installation of a product, system, or material, including special notices and Material Safety Data Sheets, if any, concerning impedances, hazards, and safety precautions. A type of product data.

SD-07, Schedules

A tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work. A type of shop drawing.

SD-08, Statements

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other lower tier contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality. A type of shop drawing.

SD-09, Reports

Reports of,inspection and laboratory test, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-10, Test Reports

A report signed by an authorized official of a testing laboratory that a material, product, or system identical to the material, product or system to be provided has been tested in accordance with requirements specified by naming the test method and material. The test report must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. Testing must have been within three years of the date of award of this Contract. A type of product data.

SD-11, Factory Test Reports

A written report which includes the findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for this project before it is shipped to the job site. The report must be signed by an authorized official of a testing laboratory and must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. A type of shop drawing.

SD-12, Field Test Reports

A written report which includes the findings of a test made at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation. The report must be signed by an authorized official of a testing laboratory or agency and must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. A type of shop drawing.

SD-13, Certificates

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system, or material meet specified requirements. The statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address. A type of shop drawing.

SD-14, Samples

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work. A type of sample.

SD-15, Color Selection Samples

Samples of the available choice of colors, textures, and finishes of a product or material, presented over a substrates identical in texture to that proposed for the work. A type of sample.

SD-16, Sample Panels

An assembly constructed at the project site in a location acceptable to the Contracting Officer and using materials and methods to be employed in the work; completely finished; maintained during construction; and removed at the conclusion of the work or when authorized by the Contracting Officer. A type of sample.

SD-17, Sample Installations

A portion of an assembly or material constructed where directed and, if approved, retained as a part of the work. A type of sample.

SD-18, Records

Documentation to ensure compliance with an administrative requirement or to establish an administrative mechanism. A type of administrative and closeout submittal.

SD-19, Operation and Maintenance Manuals

Data intended to be incorporated in an Operations and Maintenance Manual. A type of administrative and closeout submittal.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SUBMITTAL REGISTER
INSTRUCTIONS

1. Use Submittal Register Form for the project's Submittal Register and to track progress of submittals as they are processed. Users may arrange Parts "A" and "B" side-by-side in a 3-ring notebook.

2. The Government will supply submittal register forms, with columns (a) through (e) completed to the extent that will be required by the Government. Consider these forms as being for convenience only. Correct variations from requirements shown in specification sections; ensure Submittal Register conforms to specification sections.

   a. Column (a): List each specification section in which a submittal is required.

   b. Column (b): List each submittal description (SD No. and type, e.g. SD-04, Drawings) required in each specification section. Follow each submittal description with the list of material or products to be addressed in each submittal description.

   c. Column (c): List one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate submittal reviews. Do not consider entries in column (c) as limiting project requirements; do not consider that a blank must be filled in by Contractor or the Government.

   d. Column (d): Indicate approving authority for each submittal. A "G" indicates approval by Contracting Officer; a blank indicates approval by CQC Manager.

   e. Column (e): On submittals to be approved by Contracting Officer, indicate specific reviewers other than CQC organization. List reviewers only when Contracting Officer is approving authority. This column may or may not be filled out on the copy supplied by the Government.

3. Column (f) through column (i) will be used by Contractor, CQC organization and the Government on their own copies to record data established by the Contractor.

   a. Column (f): As submittals are processed, list a consecutive number assigned by Contractor for each group of submittals. Place this same number in the appropriate block of "Submittal Transmittal Form." For a resubmission, repeat transmittal control number of the original submittal with a suffix, e.g. No. "100B" is second resubmission of material originally transmitted under No. "100."

b. Column (g): List dates scheduled for approving authority to receive submittals. These dates are the scheduled beginnings of submittal review periods. The Contractor proposes these dates and the Contracting Officer approves them to establish the approved Submittal Register.

c. Columns (h) and (i): Use to record contractor's review when forwarding submittals to the CQC organization.

4. Column (j) through column (o) will be used by Contractor, CQC organization, and the Government on their own copies, in the following manner:

Contractor

a. Column (j): Enter date submittal is delivered to CQC organization if CQC manager is approving authority or to the Government via CQC organization if Contracting Officer is approving authority.

b. Columns (k) and (l): No entries are required on Contractor's copy.

c. Columns (m) and (n): Enter action and date of action by approving authority as shown on returned submittal.

CQC organization

a. Column (j): Enter date CQC organization receives submittal from Contractor.

b. Columns (k) and (l): If approving authority is Contracting Officer, enter date CQC organization forwards certified submittal to Contracting Officer.

c. Columns (m) and (n): If approving authority is Contracting Officer, enter the Government action and date of action as shown on return submittal. If approving authority is CQC Manager, enter CQC action and date of action.

d. Column (o): Enter date CQC organization returns submittal to Contractor, regardless of who is approving authority. If CQC Manager is approving authority, it is also the date the information copy is forwarded to the Government.

Government

a. Column (j): When Contracting Officer is approving authority, enter date submittal is received from CQC organization.

b. Columns (k) and (l): When Contracting Officer is approving authority, enter date submittal is routed or received from specialized reviewer, such as fire protection engineer, architect-engineer, etc.

c. Columns (m) and (n): When approving authority is Contracting Officer, enter the Government action and date of action. When approving authority is CQC organization, enter CQC Manager action and date of action, as indicated on information copy forwarded by CQC organization.

d. Column (o): When Contracting Officer is approving authority, enter date submittal is returned to Contractor via CQC organization.

-- End of Section --

Contract Number N62472-91-C-0489 Project Title: UST Retrofit/Gas St. Modifications

	SPEC SECTION NO.	SN NO, AND TYPE OF SUBMITTAL MATERIAL OR PRODUCT	SPEC PARA NO.	CLASSIF/ APPR BY CO *	GOVT OR A/E REVIEWER	TRANS CONTROL NO.	PLANNED SUBMITTAL DATE
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	01010	SD-18, Records	1.2.1				
2)		Report of Subcontractors	1.2.1.1	G	ROICC		
3)		Work Performed by Contractor	1.2.1.2	G	ROICC		
4)		Cert. of Contractor Required ins.	1.9.2	G	ROICC		
5)		Schedule of Prices	1.11	G	ROICC		
6)		As-Built Drawings	1.16.1	G	ROICC		
7)		Quantity Surveys	1.18	G	ROICC		
8)	01011	SD-18, Records	1.3.1				
9)		Construction Schedule	1.3.1	G	ROICC		
10)		Equipment Delivery Schedule	1.3.1.1	G	ROICC		
11)		Monthly Update	1.3.1.3	G	ROICC		
12)		Contractors Qualifications	1.6	G	ROICC		
13)		Accident Prev. Plan	3.5	G	ROICC		
14)	01300	SD-18, Records	1.3.1				
15)		Submittal Register	1.3.1.1	G	ROICC		
16)	01401	SD-18, Records	1.4.1				
17)		Qualifications of Testing Lab	3.1.5	G	ROICC		
18)	01560	SD-18, Records	1.3.1				
19)		Solid Waste Disposal Permit	1.3.1.1	G	ROICC		
20)		Disposal Permit for Haz. Waste	1.3.1.2	G	ROICC		
21)	02050	SD-08, Statements	1.3.1				
22)		Demolition Plan	1.3.1.1	G	ROICC		
23)	02220	SD-04, Drawings	1.3.1				
24)		Supporting System	1.3.1.1	G	A/E		
25)	02220	SD-05, Design Data	1.3.2				
26)		Supporting System	1.3.2.1	G	A/E		
27)	02220	SD-08, Statements	1.3.3				
28)		Supporting System		G	A/E		
29)		Dewatering		G	A/E		
30)	02220	SD-12, Field Test Reports	1.3.4				
31)		Fill and backfill	3.9.2.1	G	A/E		
32)		Select Material	3.9.2.2	G	A/E		
33)		Density Tests	3.9.2.4	G	A/E		
34)	03302	SD-13, Certificates	1.3.1				
35)		Cement	2.2.1	G	A/E		
36)		Aggregates	2.2.2	G	A/E		
37)		Admixtures	2.2.3	G	A/E		
38)		Reinforcement	2.2.4	G	A/E		
39)		Expansion-Joint Filler	2.2.5	G	A/E		
40)		Joint Sealant	2.2.6	G	A/E		
41)		Corrosion Protection Tape	2.2.7	G	A/E		
42)	03410	SD-02, Manuf. Catalog Data	1.3.1				
43)		Anchorage and Lifting inserts..	1.3.1.a	G	A/E		

* Navy Notes:
Approved by:
G: Contracting Officer
Blank: CQC Manager

Contract Number N62472-91-C-0489 Project Title: UST Retrofit/Gas St. Modifications

	SPEC SECTION NO.	SN NO, AND TYPE OF SUBMITTAL MATERIAL OR PRODUCT	SPEC PARA NO.	CLASSIF/ APPR BY CO *	GOVT OR A/E REVIEWER	TRANS CONTROL NO.	PLANNED SUBMITTAL DATE
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
44)		Bearing Pads	1.3.1.b	G	A/E		
45)	03410	SD-04, Drawings	1.3.2				
46)		Drawings of precast members	1.3.2.a	G	A/E		
47)	03410	SD-05, Design data	1.3.3.				
48)		Precast concrete members..	1.3.3.a	G	A/E		
49)		Concrete mix design	1.3.3.b	G	A/E		
50)	03410	SD-08, Statements	1.3.4				
51)		Fabrication	1.3.4.a	G	A/E		
52)	03410	SD-11, Factory Test Reports	1.3.5				
53)		Contractor Furnished mix des.	1.3.5.a	G	A/E		
54)	03410	SD-14, Samples	1.3.6				
55)		Surface Finish	1.3.6.a	G	A/E		
56)	03410	SD-18, Records	1.3.7				
57)		Conc. Batch Tickets info.	1.3.7.a	G	A/E		
58)	04200	SD-02, Manuf. Catalog DAta	1.2.1				
59)		Masonry accessories	1.2.1.a	G	A/E		
60)		Reinforcement	1.2.1.b	G	A/E		
61)		Pre-Mixed mortar	1.2.1.c	G	A/E		
62)		Control Joints	1.2.1.d	G	A/E		
63)		Expansion Joints	1.2.1.e	G	A/E		
64)		Water-repellant admixture	1.2.1.f	G	A/E		
65)		Flashing	1.2.1.g	G	A/E		
66)	04200	SD-04, Drawings	1.2.2				
67)		Reinforcing Steel	1.2.2.a	G	A/E		
68)	04200	SD-05, Design Data	1.2.3				
69)		Pre-mixed mortar	1.2.3.b	G	A/E		
70)	04200	SD-06, Instructions	1.2.4				
71)		Masonry	1.2.4.a	G	A/E		
72)	04200	SD-11, Factory Test Reports	1.2.5	G	A/E		
73)	04200	SD-13, Certificates	1.2.6	G	A/E		
74)	04200	SD-14, Samples	1.2.7				
75)		Masonry Units	1.2.7.a	G	A/E		
76)		Mortar color	1.2.7.b	G	A/E		
77)	04200	SD-16, Sample Panels	1.2.8				
78)		Masonry panel	1.2.8.1	G	A/E		
79)	04230	SD-02, Manuf. Catalog Data	1.2.1				
80)		Anchors, ties	1.2.1.a	G	A/E		
81)		Wire reinforcement	1.2.1.b	G	A/E		
82)		movement joints	1.2.1.c	G	A/E		
83)	04230	SD-04, Drawings	1.2.2				
84)		Details of Steel Reinf.	1.2.2.1	G	A/E		
85)		Lintels	1.2.2.2	G	A/E		
86)	04230	SD-08, Statements	1.2.3				

* Navy Notes:
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G: Contracting Officer
Blank: CQC Manager

Contract Number N62472-91-C-0489 Project Title: UST Retrofit/Gas St. Modifications

SN NO, AND TYPE OF SUBMITTAL	SPEC SECTION NO.	MATERIAL OR PRODUCT	SPEC PARA NO.	CLASSIF/ APPR BY CO *	GOVT OR A/E REVIEWER	TRANS CONTROL NO.	PLANNED SUBMITTAL DATE
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
87)		Cold weather installation	1.2.3.a	G	A/E		
88)		Hot weather installation	1.2.3.b	G	A/E		
89)	04230	SD-10, Test Reports	1.2.4				
90)		Unit Strength method	1.2.4.a	G	A/E		
91)		Prism test	1.2.4.b	G	A/E		
92)		mortar properties	1.2.4.c	G	A/E		
93)		grout	1.2.4.d	G	A/E		
94)		water repellant admixture	1.2.4.e	G	A/E		
95)	04230	SD-11, Factory Test Reports	1.2.5				
96)		Concrete masonry units	1.2.5.a	G	A/E		
97)		Clay or shale bricks	1.2.5.b	G	A/E		
98)		Mortar and grout admixtures	1.2.5.c	G	A/E		
99)	04230	SD-12, Field test reports	1.2.6				
100)		Grout strength	1.2.6.a	G	A/E		
101)		Mortar strength and properties	1.2.6.b	G	A/E		
102)	04230	SD-13, Certificates	1.2.7				
103)		Concrete masonry units	1.2.7.a	G	A/E		
104)		Clay or shale bricks	1.2.7.b	G	A/E		
105)		Mortar and grout admixtures	1.2.7.c	G	A/E		
106)	04230	SD-14, Samples	1.2.8				
107)		Concrete Masonry units	1.2.8.a	G	A/E		
108)		Brick units	1.2.8.b	G	A/E		
109)		colored units	1.2.8.c	G	A/E		
110)		colored mortar	1.2.8.d	G	A/E		
111)		precast concrete finish	1.2.8.e	G	A/E		
112)	04230	SD-16, Sample Panels	1.2.9				
113)		Sample Panels	1.2.9.a	G	A/E		
114)	07530	SD-02, Manuf. Catalog Data	1.2.1				
115)		EPDM Sheet	1.2.1.a	G	A/E		
116)		Adhesive	1.2.1.b	G	A/E		
117)		Fasteners	1.2.1.c	G	A/E		
118)		Water cutoff mastic water blck	1.2.1.d	G	A/E		
119)		Lap cleaner, sealant..	1.2.1.e	G	A/E		
120)		flashing	1.2.1.f	G	A/E		
121)		flashing accessories	1.2.1.g	G	A/E		
122)		roof insulation	1.2.1.h	G	A/E		
123)	07530	SD-06, Instructions	1.2.3				
124)		EPDM Sheet	1.2.3.a	G	A/E		
125)		Adhesive	1.2.3.b	G	A/E		
126)		Water cutoff mastic water blck	1.2.3.c	G	A/E		
127)		Lap cleaner, sealant..	1.2.3.d	G	A/E		
128)		flashing	1.2.3.e	G	A/E		
129)		flashing accessories	1.2.3.f	G	A/E		

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Contract Number N62472-91-C-0489 Project Title: UST Retrofit/Gas St. Modifications

SN NO. AND TYPE OF SUBMITTAL	SPEC SECTION NO.	MATERIAL OR PRODUCT	SPEC PARA NO.	CLASSIF/ APPR BY CO *	GOVT OR A/E REVIEWER	TRANS CONTROL NO.	PLANNED SUBMITTAL DATE
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
130)	07530	SD-08, Statements	1.2.4				
131)		Qualifc. of Applicator	1.2.4.a	G	A/E		
132)	07530	SD-18, Records	1.2.5				
133)		Information card	1.2.5.a	G	A/E		
134)		Instructions to Gov't Pers.	1.2.5.b	G	A/E		
135)	13001	SD-02, Manuf. Catalog Data	1.5.6.b	G	A/E		
136)		Product Data Sheets	1.5.e.6	G	A/E		
137)	13001	SD-04, Drawings	1.5.e.a/b	G	A/E		
138)	13001	SD-06, Instructions	1.5.e				
139)		Site prep.	1.5.e.1	G	A/E		
140)		System setup	1.5.e.2	G	A/E		
141)		System operations	1.5.e.3	G	A/E		
142)		Indiv. sensor inst.	1.5.e.4	G	A/E		
143)		probe inst.	1.5.e.5	G	A/E		
144)		Indiv. module inst.	1.5.e.6	G	A/E		
145)	13001	SD-13, Certificates	1.5.d	G	A/E		
146)	13001	SD-19, Operation & Maint. Man.	1.5.c	G	A/E		
147)		Troubleshooting & Rep.	1.5.e.8	G	A/E		
148)		Serial Comm. Manual	1.5.e.10	G	A/E		
149)	13002	SD-02, Manuf. Catalog Data	1.5.6	G	A/E		
150)		Product Data Sheets	1.5.d.8	G	A/E		
151)	13002	SD-04, Drawings	1.5.d.10	G	A/E		
152)	13002	SD-06, Instructions	1.5.e				
153)		Site prep.	1.5.d.1	G	A/E		
154)		System setup	1.5.d.2	G	A/E		
155)		System operations	1.5.d.3	G	A/E		
156)		Line leak detec.	1.5.d.4	G	A/E		
157)		Line leak detec. checkout	1.5.d.5	G	A/E		
158)	13002	SD-13, Certificates	1.5.d	G	A/E		
159)	13001	SD-19, Operation & Maint. Man.	1.5.c	G	A/E		
160)		Serial Comm. Manual	1.5.e.9	G	A/E		
161)	13003	SD-02, Manuf. Cat. Data	1.4.b	G	A/E		
162)	13003	SD-04, Drawings	1.4.b	G	A/E		
163)	13003	SD-19, Operation & Maint. Man.	1.4.c	G	A/E		
164)	13004	SD-02, Manuf. Cat. Data	1.4.b	G	A/E		
165)	13004	SD-04, Drawings	1.4.b	G	A/E		
166)	13004	SD-19, Operation & Maint. Man.	1.4.c	G	A/E		
167)	13004	SD-13, Certificates	3.3	G	A/E		
168)	13005	SD-02, Manuf. Cat. Data	1.3.b	G	A/E		
169)	13005	SD-04, Drawings	1.3.b	G	A/E		
170)	13005	SD-08, Statement	3.2	G	A/E		
171)	13005	SD-08, Statement	3.3	G	A/E		
172)	13005	SD-19, Operation & Maint. Man.	1.3.c	G	A/E		

* Navy Notes:
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G: Contracting Officer
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Contract Number N62472-91-C-0489 Project Title: UST Retrofit/Gas St. Modifications

SN NO, AND TYPE OF SUBMITTAL	SPEC SECTION NO.	MATERIAL OR PRODUCT	SPEC PARA NO.	CLASSIF/ APPR BY CO *	GOVT OR A/E REVIEWER	TRANS CONTROL NO.	PLANNED SUBMITTAL DATE
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
173)	13006	SD-02, Manuf. Cat. Data	1.3.1	G	A/E		
174)	13006	SD-04, Drawings	1.3.2	G	A/E		
175)	13006	SD-05, Design Data	1.3.3	G	A/E		
176)	13006	SD-13, Certificates	1.3.5	G	A/E		
177)	13006	SD-19, Operation & Maint. Man.	1.3.4	G	A/E		
178)	13211	SD-02, Manuf. Catalog Data	1.2.1				
179)		Dispenser System Upgrades	1.2.1.a	G	A/E		
180)		Disp. Replacement - Gas Sta.	1.2.1.b	G	A/E		
181)		Stage II Vapor Recovery Sys.	1.2.1.c	G	A/E		
182)		Valves, Check & Float Type	1.2.1.d	G	A/E		
183)		Valves - 2 Inch & Smaller	1.2.1.e	G	A/E		
184)		Flexible Connectors	1.2.1.f	G	A/E		
185)		Contain. Sump/ Disp sump,..	1.2.1.g	G	A/E		
186)		UST Manway Sump	1.2.1.h	G	A/E		
187)		Double Wall Piping	1.2.1.i	G	A/E		
188)	13211	SD-04, Drawings	1.2.1				
189)		Dispenser System Upgrades	1.2.2.a	G	A/E		
190)		Disp. Replacement - Gas Sta.	1.2.2.b	G	A/E		
191)		Stage II Vapor Recovery Sys.	1.2.2.c	G	A/E		
192)		Contain. Sump/ Disp sump,..	1.2.2.d	G	A/E		
193)		UST Manway Sump	1.2.2.e	G	A/E		
194)	13211	SD-06, Instructions	1.2.3				
195)		Pipe Leak Detection System	1.2.3.a	G	A/E		
196)		Dispenser Replacement	1.2.3.b	G	A/E		
197)		Stage II Vapor Recovery Sys.	1.2.3.c	G	A/E		
198)		Double Wall Piping	1.2.3.d	G	A/E		
199)	13211	SD-13, Certificates					
200)		Dispenser System Upgrades	1.2.4.a	G	A/E		
201)		Disp. Replacement - Gas Sta.	1.2.4.b	G	A/E		
202)		Valves, Check & Float Type	1.2.4.c	G	A/E		
203)		Valves - 2 Inch & Smaller	1.2.4.d	G	A/E		
204)		Flexible Connectors	1.2.4.e	G	A/E		
205)		Contain. Sump/ Disp sump,..	1.2.4.f	G	A/E		
206)		Double Wall Piping	1.2.4.g	G	A/E		
207)	13211	SD-10, Operations & Maint. Man.	1.2.3				
208)		Dispenser System Upgrades	2.1	G	A/E		
209)		Dispenser Replacement	2.2	G	A/E		
210)		Stage II Vapor Recovery Sys.	2.3	G	A/E		
211)	13219	SD-02, Manuf. Catalog Data	1.2.1				
212)		Cleaning Agents	2.2	G	A/E		
213)		Gas-Oil-Resisting Rubber Gloves	2.2	G	A/E		
214)		Cotton coveralls	2.2	G	A/E		
215)		Respiratory Protec. Equip.	2.2	G	A/E		

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	(a)	(b)	(c)	(d)	(e)	(f)	(g)
216)		Disinfectant	2.2	G	A/E		
217)		Abrasive for blasting	2.2	G	A/E		
218)	13219	SD-06, Instructions	1.2.2				
219)		Tank/Cleaning Agent	2.1.1	G	A/E		
220)	13219	SD-08, Statements	1.2.3				
221)		Safety Plan	1.2.3.1	G	A/E		
222)		Work Plan	1.2.3.2	G	A/E		
223)		Haz. Waste Disposal Plan	1.2.3.3	G	A/E		
224)		Tank Certification of Safety	1.2.3.4	G	A/E		
225)		Name, Location & Permit # of..	1.2.3.5	G	A/E		
226)		Disposal Facility		G	A/E		
227)	13219	SD-10, Test Reports	1.2.4				
228)		Blasting Abrasive/Test	1.2.4.a	G	A/E		
229)		Tank contents/Test	1.2.4.b	G	A/E		
230)	13219	SD-13, Certificates	1.2.5				
231)		Resp. Protec. Equip.	2.2	G	A/E		
232)		Breathing-Air Supply Source	2.2	G	A/E		
233)		Combustible Gas Indicator	2.2	G	A/E		
234)		Lead-in-air Analyzer	2.2	G	A/E		
235)		H2S Indicator	2.2	G	A/E		
236)		Oxygen Meter	2.2	G	A/E		
237)		Velometer	2.2	G	A/E		
238)		Lighting	2.2	G	A/E		
239)		First Aid Kit	2.2	G	A/E		
240)		Tan/Exhaust/Blower	2.2	G	A/E		
241)		Approp. Instrumentation	2.2	G	A/E		
242)	13219	SD-18, Records	1.2.6				
243)		Safety Permits	1.3.3	G	A/E		
244)	15358	SD-02, Manuf. Catalog Data	1.4.1a-cc	G	A/E		
245)		Other requirements	1.5.1	G	A/E		
246)	15358	SD-04, Drawings	1.4.2	G	A/E		
247)		Fire Exting. Syst	1.4.2.a	G	A/E		
248)		Other Rquirements	1.5.2	G	A/E		
249)	15358	SD-05, Design Data	1.4.3a-d	G	A/E		
250)	15358	SD-08, Statements	1.4.4a-b	G	A/E		
251)	15358	SD-10, Test Reports	1.4.5.a	G	A/E		
252)	15358	SD-11, Factory Test Report	1.4.6.a	G	A/E		
253)	15358	SD-12, Field Test reports	1.4.7.a-b	G	A/E		
254)	15358	SD-13, Certificates	1.4.8.a	G	A/E		
255)	15358	SD-18, Records	1.4.9.a	G	A/E		
256)	15358	SD-19, Operation & Maint. Man.	1.5.8	G	A/E		
257)	15780	SD-02, Manuf. Catalog Data	1.2.1	G	A/E		
258)	15780	SD-06, Instructions	1.2.2.a	G	A/E		

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	SPEC SECTION NO.	SN NO, AND TYPE OF SUBMITTAL MATERIAL OR PRODUCT	SPEC PARA NO.	CLASSIF/ APPR BY CO *	GOVT OR A/E REVIEWER	TRANS CONTROL NO.	PLANNED SUBMITTAL DATE
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
259)	15780	SD-12, Field Test Reports	1.2.3.a	G	A/E		
260)	15780	SD-18, Records	1.2.4.a	G	A/E		
261)	15780	SD-19, Operation & Maint. Man.	1.2.5.a	G	A/E		
262)	16011	SD-02, Manuf. Catalog Data	1.4.1	G	A/E		
263)	16011	SD-04, Drawings	1.4.2	G	A/E		
264)	16011	SD-06, Instructions	1.4.3	G	A/E		
265)	16011	SD-09, Reports	1.4.4.1-2	G	A/E		
266)	16011	SD-19, Operation & Maint. Man.	1.4.5	G	A/E		
267)	16208	SD-02, Manuf. Catalog Data	1.4.1.a-d	G	A/E		
268)	16208	SD-04, Drawings	1.4.2.1-2	G	A/E		
269)	16208	SD-08, Statements	1.4.3.1-2	G	A/E		
270)	16208	SD-10, Test Reports	1.4.5.1	G	A/E		
271)	16208	SD-11, Factory Test Reports	1.4.6.a-c	G	A/E		
272)	16208	SD-12, Field Test Reports	1.4.7.a-f	G	A/E		
273)	16208	SD-18, Records	1.4.8.a	G	A/E		
274)	16208	SD-19, Operation & Maint. Man.	1.4.9.a-e	G	A/E		
275)	16375	SD-02, Manuf. Catalog Data	1.4.1.a-l	G	A/E		
276)	16375	SD-04, Drawings	1.4.2.a-j	G	A/E		
277)	16375	SD-06, Instructions	1.4.3.a-d	G	A/E		
278)	16375	SD-08, Statements	1.4.4.a	G	A/E		
279)	16375	SD-10, Test Reports	1.4.5.1	G	A/E		
280)	16375	SD-11, Factory Test Reports	1.4.6.a-b	G	A/E		
281)	16375	SD-12, Field Test Reports	1.4.7.a-g	G	A/E		
282)	16375	SD-13, Certificates	1.4.8.a-e	G	A/E		
283)	16499	SD-02, Manuf. Catalog Data	1.3.b	G	A/E		
284)	16510	SD-02, Manuf. Catalog Data	1.5.1.a-q	G	A/E		
285)	16530	SD-02, Manuf. Catalog Data	1.4.1.a-h	G	A/E		
286)	16530	SD-04, Drawings	1.4.2.a-b	G	A/E		
287)	16530	SD-12, Field Test Reports	1.4.3.a	G	A/E		
288)	16582	SD-02, Manuf. Catalog Data	1.3.1.a-f	G	A/E		
289)	16582	SD-04, Drawings	1.3.2.a	G	A/E		
290)	16582	SD-19, Operation & Maint. Man.	1.4.3.a-c	G	A/E		
291)							
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SECTION 01401

CONTRACTOR INSPECTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740	1988 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as
ASTM E 329	1990 Evaluation of Testing and Inspection
ASTM E 543	1989 (Rev. A) Determining the Qualification of Nondestructive Testing Agencies
ASTM E 548	1984 Preparation of Criteria for Use in the Evaluation of Testing and Inspection Bodies

1.2 QUALITY CONTROL

Quality control of this contract shall be accomplished under the Contract Clause entitled, "Inspection of Construction."

1.3 DEFINITIONS

1.3.1 Approval

When the words "approval" and "approved" or words of similar meaning or import are used, they shall mean approval by the approving authority. In the individual specification sections, a notation "G" following a submittal item, indicates the Contracting Officer is the approving authority for that submittal item.

1.3.2 Factory Tests

Tests made on various products and component parts prior to shipment to the job site, including but not limited to such items as transformers, boilers, air conditioning equipment, electrical equipment, and precast concrete.

1.3.3 Field Tests

Tests or analyses made at, or in the vicinity of, the job site in connection with the actual construction.

1.3.4 Product

The term "product" includes the plural thereof and means a type or a category of manufactured goods, constructions, installations, and natural and processed materials or those associated services whose characterization, classification, or functional performance determination is specified by standards.

1.3.5 Person

The term "person" means associations, companies, corporations, educational institutions, firms, government agencies at the Federal, State, and local level, partnerships, and societies, as well as divisions thereof, and individuals.

1.3.6 Testing Laboratory

The term "testing laboratory" means any "person," as defined above, whose functions include testing, analyzing, or inspecting "products," as defined above, evaluating the designs or specifications of such "products" according to the requirements of applicable standards.

1.3.7 Certified Inspection Reports

Reports signed by approved inspectors attesting that the items inspected meet the specification requirements other than any exception included in the report.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.4.1 SD-18, Records

a. Qualifications of testing laboratories G

1.5 PROJECT SUBMITTAL SCHEDULES

The Contractor shall maintain at the job site an up-to-date log showing the status of all submittals required by the contract.

1.6 TESTING

1.6.1 Test Results

Reports shall cite the contract requirements, the test or analysis procedures used, the actual test results, and include a statement that the item tested or analyzed conforms or fails to conform to the specification requirements. Each report shall be conspicuously stamped on the cover sheet in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements as the case may be. All test reports shall be signed by a representative of the testing laboratory authorized to sign certified test reports. The Contractor shall arrange for immediate and direct delivery of the signed original of all reports, certifications, and other documentation to the Contracting Officer.

1.6.2 Tabulation of Factory Tests and Field Tests

Prior to final payment, the Contractor shall obtain from each laboratory a tabulation of all tests it has performed in connection with the construction contract. Conforming, nonconforming, and retesting shall be tabulated. The tabulation(s) shall be certified as complete, and signed by the authorized representative of the laboratory, and shall be delivered to the Contracting Officer.

1.6.3 Formwork, Falsework, and Erection Procedures Certification

When the Contractor is required by a specification section to submit a design certification for erection procedures, the appropriate daily inspection reports must indicate each time the work is inspected and approved by a Professional Civil or Structural Engineer registered in any jurisdiction for conformance to the certification. A specific statement for these items rather than a general statement is required.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 QUALITY CONTROL REQUIREMENTS

The Contractor shall inspect and test all work under the contract and maintain records of the inspections and tests. Approvals, except those required for field installations, field applications, and field tests, shall be obtained before delivery of materials and equipment to the project site. Surveillance of the inspection system will be performed by the Contracting Officer.

3.1.1 Factory Tests

Unless otherwise specified, the Contractor shall arrange for factory tests when they are required under the contract.

3.1.2 Factory Inspections by the Contractor

Unless otherwise specified, the Contractor shall arrange and perform all factory inspections specifically required in the technical sections of the specifications. These inspections shall be reported in the Daily Report to Inspector.

3.1.3 Field Inspections and Tests by the Contractor

The Contractor shall furnish all equipment, instruments, qualified personnel, and facilities necessary to inspect all work and perform all tests required by the contract. All inspections and tests performed and test results received each day shall be included in the Daily Report to Inspector.

3.1.3.1 Inspection Procedures

Inspection procedures shall include, as a minimum:

a. Preparatory Inspection: Preparatory inspection shall be performed before beginning work and, in addition, before beginning each segment of work. Preparatory inspection shall include a review of the contract requirements, the review and approval of shop drawings and other submittal data, a check to assure that required control testing will be provided, a physical examination to assure that all materials and equipment conform to approved shop drawings and submittal data, and a check to assure all required preliminary work has been completed. The Contracting Officer shall be notified at least 24 hours in advance of the preparatory inspection.

b. Initial Inspection: Initial inspection shall be performed as soon as a representative segment of the particular item of work has been accomplished. Initial inspection shall include performance of scheduled tests, examination of the quality of workmanship, a review for omissions or dimensional errors, and approval or rejection of the initial segment of the work. The Contracting Officer shall be notified at least 24 hours in advance of the initial inspection.

c. Follow-Up Inspections: Follow-up inspections shall be performed daily and more frequently as necessary, and shall include continued testing and examinations to assure continued compliance with the contract requirements.

3.1.4 Field Inspections and Tests by the Government

If deemed necessary by the Contracting Officer, field inspections and tests will be made in accordance with the Contract Clause entitled, "Inspection of Construction."

3.1.5 Approval of Testing Laboratories

All laboratory work under this contract shall be performed by a laboratory approved by the Government. The basis of approval includes the following:

a. Testing laboratories performing work in connection with concrete shall comply with ASTM E 329.

b. Testing laboratories engaged in the testing and inspection of soils and rock or performing non-destructive testing shall comply with ASTM D 3740 and ASTM E 543, respectively.

c. Testing laboratories performing work not in connection with concrete, steel, bituminous materials, soils and non-destructive testing shall comply with ASTM E 548.

3.1.5.1 Laboratory Inspection

Prior to approval, the laboratory shall submit in writing the following:

a. Functional description of the laboratory's organizational structure, operational departments, and support departments and services.

b. A list and resumes of the personnel assigned to the proposed testing, including the person charged with engineering managerial responsibility.

c. Affidavit of compliance with the applicable ASTM publication and certification that the laboratory performs work in accordance with technical requirements as required by the contract specifications.

d. A list of test and inspection equipment for each of the proposed test procedures and certification that the equipment is calibrated at prescribed intervals to ensure the validity of the test and inspection data.

e. A copy of the latest Laboratory Inspection Report by an independent agency with laboratory certification that deficiencies (if any) have been corrected.

3.1.6 Repeated Tests and Inspections

The Contractor shall repeat tests and inspections after each correction made to nonconforming materials and workmanship until tests and inspections indicate the materials, equipment, and workmanship conform to the contract requirements. The retesting and reinspections shall be performed at no additional cost to the Government.

3.1.7 Daily Report to Inspector

The signed "Daily Report to Inspector" Form NAVFAC 4330/34 shall be delivered to the Contracting Officer by 10:00 a.m. on the working day following the day the work was performed.

3.1.8 Monthly Report to Contracting Officer

A summary report shall also be delivered at the end of each month. This shall contain the work done during that month, test results, diagrams, etc.

-- End of Section --

SECTION 01560

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

The Contractor shall be responsible for the cleanup and disposal of all hazardous substance spills in accordance with 40 CFR 203 and 40 CFR 264. The Contractor shall report to the OIC the time, substance and amount of the spillage immediately.

1.1 REFERENCES

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

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
49 CFR 178	Shipping Container Specifications

1.2 DEFINITIONS

1.2.1 Sediment

Soil and other debris that have eroded and have been transported by runoff water or wind.

1.2.2 Solid Waste

Rubbish, debris, garbage, and other discarded solid materials, except hazardous waste as defined in paragraph entitled "Hazardous Waste," resulting from industrial, commercial, and agricultural operations and from community activities.

1.2.3 Rubbish

Combustible and noncombustible wastes such as paper, boxes, glass, crockery, metal, lumber, cans, and bones.

1.2.4 Debris

Combustible and noncombustible wastes such as ashes and waste materials resulting from construction or maintenance and repair work, leaves, and tree trimmings.

1.2.5 Chemical Wastes

This includes salts, acids, alkalies, herbicides, pesticides, organic chemicals, and spent products which serve no purpose.

1.2.6 Sanitary Wastes

1.2.6.1 Sewage

Wastes characterized as domestic sanitary sewage.

1.2.6.2 Garbage

Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2.7 Hazardous Waste

Hazardous substances as defined in 40 CFR 261 or as defined by applicable state and local regulations. The Contractor shall be responsible for the cleanup and disposal of all hazardous substance spills in accordance with 40 CFR 263 and 40 CFR 264. The Contractor shall report to the OIC the time, substance, and amount of the spillage immediately.

1.2.8 Oily Waste

Petroleum products and bituminous materials.

1.2.9 Asbestos and Asbestos Materials

Asbestos means actinolite, amosite, anthophyllite, chyrysotile, crocidolite, and tremolite. Asbestos material means asbestos or any material containing asbestos such as asbestos waste, scrap, debris bags, containers, equipment, and asbestos-contaminated clothing consigned for disposal. Friable asbestos material means any material that contains more than one percent asbestos by weight and that can be crumbled, pulverized, or reduced to powder, when dry, by hand pressure.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-18, Records

a. Solid waste disposal permit G

b. Disposal permit for hazardous waste G

1.3.1.1 Solid Waste Disposal Permit

Submit one copy of a state and local permit or license showing such agencies' approval of the disposal plan.

1.3.1.2 Disposal Permit for Hazardous Waste

Submit a copy of the applicable EPA and state permits or licenses for transportation, treatment, storage, and disposal of hazardous waste by permitted facilities.

1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, state, and local regulations pertaining to the environment, including but not limited to water, air, and noise pollution.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified.

3.1.1 Land Resources

Do not remove, cut, deface, injure, or destroy trees or shrubs without the Contracting Officers permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the Contracting Officer. Where such use of attach ropes, cables, or guys is authorized, the Contractor shall be responsible for any resultant damage.

3.1.1.1 Protection

Protect existing trees which are to remain and which may be injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas. By approved excavation, remove trees with 30 percent or more of their root systems destroyed.

3.1.1.2 Repair or Restoration

Repair or restore to their original condition all trees or other landscape features scarred or damaged by the equipment or operations. Obtain approval of the repair or restoration from the Contracting Officer prior to its initiation.

3.1.1.3 Temporary Construction

Oliterate all signs of temporary construction facilities such as work areas, stockpiles of excess or waste materials, and all other vestiges of construction. Temporary use areas shall be graded in conformance with surrounding areas, tilled, and seeded. Included topsoil or nutriment during the seeding operation as necessary to reestablish a suitable stand of grass. The seeding operation shall be as specified in Section 02220.

3.1.2 Water Resources

3.1.2.1 Oily Wastes

Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. Surround all temporary fuel oil or petroleum storage tanks with a temporary earth berm of sufficient size and strength to contain the contents of the tanks in the event of leakage or spillage.

3.1.3 Fish and Wildlife Resources

Do not disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as indicated or specified.

3.2 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Carefully protect in-place and report immediately to the Contracting Officer historical and archaeological items or human skeletal remains discovered in the course of work. Stop work in the immediate area of the discovery until directed by the Contracting Officer to resume work.

3.3 EROSION AND SEDIMENT CONTROL MEASURES

3.3.1 Burnoff

Burnoff of the ground cover is not permitted.

3.3.2 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified. Immediately protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

3.3.3 Temporary Protection of Erodible Soils

Use the following methods to prevent erosion and control sedimentation:

3.3.3.1 Mechanical Retardation and Control of Runoff

Mechanically retard and control the rate of runoff from the construction site. This includes construction of diversion ditches, benches, and berms to retard and divert runoff to protected drainage courses.

3.3.3.2 Vegetation and Mulch

Provide temporary protection on sides and back slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

3.4 CONTROL AND DISPOSAL OF SOLID AND SANITARY WASTES

Pick up solid wastes, and place in containers which are regularly emptied. Do not prepare, cook, or dispose of food on the project site. Prevent contamination of the site of other areas when handling and disposing of wastes. On completion, leave the areas clean. Control and dispose of waste.

3.4.1 Disposal of Rubbish, Garbage, and Debris

Remove and dispose rubbish, garbage, and debris from Government property.

3.4.2 Sewage, Odor, and Pest Control

Dispose of sewage through connection to station sanitary sewage system. Where such system is not available, use chemical toilets or comparably effective units, and periodically empty wastes into station sanitary sewage system, or construct and maintain an approved type of adequate sanitary convenience for the use of persons employed on the work in accordance with the General

Paragraphs titled, "Sanitation." Include provisions for pest control and elimination of odors.

3.5 CONTROL AND DISPOSAL OF HAZARDOUS WASTE

3.5.1 Hazardous Type Waste

Store hazardous waste in approved containers (49 CFR 178) properly labeled to identify the type of waste and the date the container was filled. Remove the containers from the project site, and store and dispose of hazardous waste in accordance with 40 CFR 263 and 40 CFR 264. For oil and hazardous material spills, notify the Contracting Officer immediately.

3.5.2 Petroleum Products

Conduct the fueling and lubricating of equipment and motor vehicles to protect against spills and evaporation. Dispose of lubricants to be discarded and all excess oil.

3.5.3 Lead-Acid Battery Electrolyte

Dispose of electrolyte solution from lead-acid batteries. Do not dump electrolyte onto the ground or into storm drains or sanitary sewers. Use one of the following alternatives for disposal of waste electrolyte:

a. An industrial waste treatment plant, if available and approved by the Contracting Officer for neutralizing and disposing of battery acid electrolyte.

b. Transport the electrolyte to a state-approved hazardous waste disposal site. The method of transportation and equipment shall comply with applicable Federal and state regulations.

3.5.4

All contaminated soil shall be excavated in accordance with Appendix 10 of the NJDEPE Bureau of UST Regulations.

3.6 DUST CONTROL

Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster.

3.7 NOISE

Make the maximum use of low-noise emission equipment in accordance with EPA regulations. Blasting or use of explosives will not be permitted.

3.8 HAZARDOUS WASTE GENERATION

Handle generated hazardous waste in accordance with 40 CFR 262.

3.9 HAZARDOUS WASTE DISPOSAL

Dispose of hazardous waste in accordance with 40 CFR 263 and 40 CFR 264.

-- End of Section --

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 REFERENCES

The publication listed below forms a part of this specification to the extent referenced. The publication is referred to in the text by the basic designation only.

DEFENSE LOGISTICS AGENCY (DLA)

DLA H4/H8	Federal Cataloging Handbook Commercial and Government Entity (CHEE), Sections A and B, United States and Canada, Sections C and D, NATO, Supply Code for Manufacturers

1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit operation and maintenance (O&M) data which is specifically applicable to this contract and a complete and concise depiction of the provided equipment or product. Data containing extraneous information to be sorted through to find applicable instructions will not be accepted. Present information in sufficient detail to clearly explain user O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with Section 01300, "Submittals."

1.2.1 Quantity

Submit five copies of the manufacturers' information specified herein for the components, assemblies, subassemblies, attachments, and accessories. The items for which O&M data is required are listed in the technical sections which specify that particular item.

1.2.2 Package Content

For each product, system, or piece of equipment requiring submission of O&M data, submit the package required in the individual technical section. Package content shall be as required in the paragraph entitled "Schedule of Operations and Maintenance Data Packages."

1.2.3 Delivery

Submit O&M data to the Contracting Officer for review and acceptance; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

1.2.4 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent,to acceptance of the O&M data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.3.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation:

1.3.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.3.1.2 Operator Prestart

Include requirements to set up and prepare each system for use.

1.3.1.3 Startup, Shutdown, and Postshutdown Procedures

Include a control sequence for each of these operations.

1.3.1.4 Normal Operations

Include control diagrams with data to explain operation and control of systems and specific equipment.

1.3.1.5 Emergency Operations

Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.

1.3.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.

1.3.1.7 Environmental Conditions

Include a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

1.3.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair.

1.3.2.1 Lubrication Data

Include lubrication data, other than instructions for lubrication in accordance with paragraph entitled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications;

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and

c. A lubrication schedule showing service interval frequency.

1.3.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft.

1.3.3 Corrective Maintenance

Include manufacturer's recommendations on procedures and instructions for correcting problems and making repairs.

1.3.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.3.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation numbering.

1.3.3.3 Maintenance and Repair Procedures

Include instructions and list tools required to restore product or equipment to proper condition or operating standards.

1.3.3.4 Removal and Replacement Instructions

Include step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.3.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.

1.3.3.6 Corrective Maintenance Man-Hours

Include manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

1.3.4 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.3.4.1 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the

illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.

a. Manufacturer's standard commercial practice: The parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as a master parts catalog, in accordance with the manufacturer's standard commercial practice.

b. Other than manufacturer's standard commercial practice: End item manufacturer may add a cross-reference to implement components' assemblies and parts requirements when implementation in manual form varies significantly from the style, format, and method of manufacturer's standard commercial practice. Use the format in the following example:

End Item Manufacturer's Alphanumeric Sequence	Actual Manufacturer's Name and FSCM	Actual Manufacturer Part No.
100001	John Doe & Co. 00000	2000002

List FSCM in accordance with DLA H4/H8.

1.3.4.2 Warranty Information

List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force.

1.3.4.3 Personnel Training Requirements

Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.

1.3.4.4 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.3.4.5 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each subcontractor installing the product or equipment. Include local representatives and service organizations most convenient to the project site. Provide the name, address, and telephone number of the product or equipment manufacturers.

1.4 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&H data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.4.1 Data Package 1

a. Safety precautions

b. Maintenance and repair procedures

c. Warranty information

d. Contractor information

1.4.2 Data Package 2

a. Safety precautions

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan and schedule

f. Maintenance and repair procedures

g. Removal and replacement instructions

h. Spare parts and supply list

i. Parts identification

j. Warranty information

k. Contractor information

1.4.3 Data Package 3

a. Safety precautions

b. Normal operations

c. Emergency operations

d. Environmental conditions

e. Lubrication data

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring diagrams and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Parts identification

m. Warranty information

n. Testing equipment and special tool information

o. Contractor information

1.4.4 Data Package 4

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and postshutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Lubrication data

i. Preventive maintenance plan and schedule

j. Troubleshooting guides and diagnostic techniques

k. Wiring diagrams and control diagrams

l. Maintenance and repair procedures

m. Removal and replacement instructions

n. Spare parts and supply list

o. Corrective maintenance man-hours

p. Parts identification

q. Warranty information

r. Personnel training requirements

s. Testing equipment and special tool information

t. Contractor information

1.4.5 Data Package 5

a. Safety precautions

b. Environmental conditions

c. Preventive maintenance plan and schedule

d. Troubleshooting guides and diagnostic techniques

e. Wiring and control diagrams

f. Maintenance and repair procedures

g. Spare parts and supply list

h. Warranty information

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 02050

DEMOLITION AND REMOVAL

PART 1 GENERAL

1.1 REFERENCES

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6	1983 Demolition Operations-Safety Requirements

1.2 GENERAL REQUIREMENTS

The Contractor shall demolish and remove the C-20 and R-7 pump houses, existing gas island and canopy. Remove bulk overhead dispenser at all locations. The Contractor shall remove the concrete spill catchment tanks at both locations. Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings. Store materials that cannot be removed daily in areas specified by the Contracting Officer.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-08, Statements

a. Demolition plan G

Submit proposed demolition and removal procedures for approval before work is started.

1.3.1.1 Required Data

Demolition plan shall include procedures for coordination with other work in progress, a disconnection schedule of utility services, and a detailed description of methods and equipment to be used for each operation and of the sequence of operations.

1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," safety requirements shall conform with ANSI AIO.6, "Demolition Operations - Safety Requirements."

1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris to occupied portions of the buildings and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust work areas in the buildings daily. Sweep pavements as often as necessary to control the spread of debris.

1.6 PROTECTION

1.6.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning such work.

1.6.2 Existing Work

Protect existing work which is to remain in place, be reused, or remain the property of the Government. Repair items which are to remain and which are damaged during performance of the work to their original condition, or replace with new. Do not overload structural elements and pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Contracting Officer approval.

1.6.3 Weather Protection

Protect building interior and materials and equipment from the weather at all times.

1.6.4 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

1.7 BURNING

Burning will not be permitted.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by the Contracting Officer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Remove piping as indicated.

3.1.2 Remove underground concrete tanks, buildings and other structures as indicated.

3.1.3 Remove concrete sumps as indicated.

3.1.4 Paving

Paving shall be removed as required for the installation of new equipment and the removal of existing underground items to be removed and as indicated on drawings.

3.1.4.1 Concrete Pavements

Where it is necessary to excavate a trench across or make a cut in concrete paved areas the Contractor shall first score the concrete in neat straight lines to a depth of not less than 2 inches with an approved concrete cutting saw prior to removing concrete. Concrete pavements shall also be removed where indicated on drawings.

3.1.4.2 Bituminous Pavements

Where it is necessary to excavate a trench across or make a cut in bituminous paved areas and where indicated on drawings, the Contractor shall cut paving along neat straight lines using an approved pneumatic spade.

3.1.4.3 Restoration of Paved Areas

Restore all paved areas to their original condition using material of like type and quality as the removed paving approved by the Contracting Officer. Repaired surfaces shall match existing adjacent paving.

3.1.5

All contaminated soil shall be excavated in accordance with Appendix 10 of the NJDEPE Bureau of UST Regulations.

3.2 PATCHING

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

a. Holes and depressions left as a result of removals in existing masonry walls to remain shall be completely filled with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

3.3 FILLING

Fill holes and other hazardous openings in accordance with Section 02220.

3.4 DISPOSITION OF MATERIAL

3.4.1 Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after notice to proceed. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.4.2 Reuse of Materials and Equipment

Remove and store materials and equipment indicated to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.5 CLEANUP

3.5.1 Debris and Rubbish

Remove and transport debris and rubbish in a manner that will prevent spillage on pavements, streets or adjacent areas. Clean up spillage from pavements, streets and adjacent areas. Conform to other applicable requirements under Section 01560.

-- End of Section --

SECTION 02220

GENERAL EXCAVATION, FILLING, AND BACKFILLING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	1984 (Rev. A) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 698	Moisture - Density Relations of Soils and Soil-Aggregate Mixtures
ASTM D 1140	1954 (R 1971) Amount of Material in Soils Finer Than the No. 200 (75-um) Sieve
ASTM D 1556	1982 Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	1978 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
ASTM D 2487	1985 Classification of Soils for Engineering Purposes
ASTM D 2922	1981 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	1988 Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 4253	1991 Test Method for Maximum Index Density in Unit Weight of Soils Using Vibratory Table
ASTM D 4254	1991 Test Method for Maximun Density in Unit Weight of Soil in Calculation of Related Density
ASTM D 4318	1984 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ENVIRONMENTAL PROTECTION AGENCY PUBLICATIONS

EPA - SW-846	"Test Methods for Evaluating Solid Waste. Physical/Chemical Methods," Third Edition, November 1986.
EPA-600/2-80-018	"Samplers and Sampling Procedures for Hazardous Waste Streams". Resource, Conservation and Recovery Act (RCRA)

CORPS OF ENGINEERS (COE)

COE EM-385-1-1	1987 Safety and Health Requirements Manual

FEDERAL SPECIFICATIONS (FS)

FS O-F-241	(Rev. D) Fertilizer, Mixed, Commercial

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION & ENERGY

NJSA 58:10A	Regulations implemententing the New Jersey Underground Storage of Hazardous Substances Act
NJAC 7:26E	Site Remediation Program

1.2 DEFINITIONS

1.2.1 Backfill

Material used in refilling a cut or other excavation.

1.2.2 Bituminous Material/Mixes

As used in construction include all types of asphalts and tars for paving purposes. Mixes include bituminous stabilized soils, base course, binders, leveling, surface course and mastic mixes.

1.2.3 Cohesive Materials

Materials ASTM D 2487 classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

1.2.4 Cohesionless Materials

Materials ASTM D 2487 classified as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.2.5 Compaction

The process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degrees of Compaction" is expressed as a percentage of the maximum density obtained by the test procedure described in D 1557 for general soil types or ASTM D 4253 and ASTM D 4254 for isolated cohesionless material, abbreviated in this specification as "95 percent ASTM D 1557 maximum density".

1.2.6 Concrete

As used in construction, embraces all portland cement concrete used in construction and its aggregates.

1.2.7 Excavation

The removal of soil, rock, or hard material to obtain a specified depth or elevation.

1.2.8 Fill

Specified or unspecified material placed at a specified degree of compaction to obtain an indicated grade or elevation.

1.2.9 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.10 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.11 Soil

The loose surface material of the earth's crust resulting from the chemical and mechanical weathering of rock and organic material.

1.2.12 RCRA Classification Parameters

Chemical analysis for Ignitability, Corrosivity, Reactivity and Toxicity Characteristic Leaching Procedure (TCLP), Pesticides and Herbicides, and PCBs in accordance with EPA-SW846 test methods.

1.2.13 Groundwater Contamination Parameters

Chemical analysis for pH, specific conductance, total organic carbon, total organic halogens, volatile organics, base neutrals organics and total petroleum hydrocarbons in accordance with EPA-SW846 test methods.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-04, Drawings

a. Supporting system drawings G

1.3.1.1 Required Drawings

Submit drawings and calculation by a registered professional engineer. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal.

1.3.2 SD-05, Design Data

a. Supporting system calculations G

1.3.2.1 Required Data

Submit drawings and calculations by a registered professional engineer. Calculations shall include data and references used.

1.3.3 SD-08, Statements

a. Supporting systems work plan G

b. Dewatering work plan G

Submit before starting work.

1.3.4 SD-12, Field Test Reports

a. Fill and backfill test G

b. Select material test G

c. Density tests G

1.3.5

The Contractor shall submit to the OIC a dewatering plan. The Contractor shall dispose of the ground water in accordance with 40 CFR 263, 264.

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Blasting will not be permitted. Remove material in an approved manner.

c. 20 cu. yds. of contaminated soil need to be removed and disposed of.

d. Many areas of excavation shall require considerable hand digging to accomplish the task. This is due to physical site restrictions and conditions which may be encountered.

1.6 SHORING AND SHEETING PLAN

Describe materials or shoring system to be used. Indicate whether or not any components will remain after filling or backfilling. Provide plans, sketches, or details along with calculations by a registered professional engineer. Indicate sequence and method for installation and removal.

1.7 PERMITS FOR BURNING

Permits for burning are issued by Earl Fire Department on a daily basis based on need.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.1 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.2 Backfill and Fill Material

ASTM D 2487, classification SW, or SP, with a maximum ASTM D 4318 liquid limit of 35, maximum ASTM D 4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.3 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.1.4 Select Material

ASTM D 2487, classification GW, GP, SW, SP with a maximum of 10 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.5 Unacceptable Soil Materials

Unacceptable soil materials include existing in-situ soil or other material which can be identified as having insufficient strength characteristics or stability to carry intended loads in fill or embankment without excessive consolidation as PT, OH or OL by ASTM D 2487. Unsatisfactory materials also include man-made fills, refuse, frozen material, uncompacted backfills from previous construction, unsound rock or soil lenses, or other deleterious or objectionable material.

2.2 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

2.3 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 specified 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

Yellow:	Gas. Oil and Dangerous Materials
Red:	Electric
Orange:	Telephone and Other Communications

2.3.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi otherwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.3.2 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 SURFACE PREPARATION

3.1.1 Stripping

Strip existing topsoil to a depth of 4 inches without contamination by subsoil material. Stockpile topsoil separately from other excavated material and locate convenient to finish grading area.

3.1.2 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.2 PROTECTION

3.2.1 Protection Systems

Provide shoring, bracing, cribbing, underpinning, and sheeting in accordance with COE EM-395-1-1, except that banks may be sloped only when approved by the Contracting Officer. Provide additional supporting systems where indicated.

3.2.2 Site Drainage

Provide for the collection and disposal of surface and subsurface water encountered during tank removal/retrofitting activities. Contractor shall obtain all applicable permits and approvals.

3.2.2.1 Surface Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. Provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein.

3.2.2.2 Subsurface Drainage

The Contractor shall submit to the OIC a dewatering plan. The Contractor shall dispose of the groundwater in accordance with 40 CFR 263, 264. Based on site surface and subsurface conditions, available soil, and hydrological datas. Remove water by pumping or other methods to prevent softening of surfaces exposed by excavation. Use filters on dewatering devices to prevent removal of fines from soil. Provide erosion control at outlet of piping to prevent erosion. Operate dewatering system continuously until construction work below existing water levels is complete. After placement of initial slabs and backfill, water level may be allowed to rise, but never above one foot below the prevailing level of excavation or backfill. Submit performance records weekly.

3.2.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall contact the Public Works Department, the Naval Hospital Engineering Division, and the Contracting Officer for assistance in locating existing utilities.

3.2.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. It should be noted that at many of the areas where excavation is to occur, much of this work must be performed by hand digging. This is due to physical site restrictions, utilities, and unknown subsurface conditions. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Refill with select material and compact to 95 percent of ASTM D 1557 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with select material and compact to 95 percent of 1557 maximum density.

3.3.1 Pipe Trenches

Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement.

3.3.2 Hard Material, Rock, Concrete and Fill Excavation

Remove hard material, concrete and fill as indicated in a manner that will leave foundation material in an unshattered and solid condition. Removal of hard material beyond lines and grades authorized by the Contracting Officer will not be grounds for a claim for additional payment.

3.4 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.4.1 Common Fill Placement

Provide for general site. Place in 6 -inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.4.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6-inch lifts. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.4.3 Select Material Placement

Provide under structures not pile supported. Place in 6-inch lifts. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

3.4.4 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6-inch lifts to top of trench and in 6-inch lifts to one foot over pipe outside structures and paved areas.

3.5 BURIED WARNING AND IDENTIFICATION TAPE

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.

3.6 COMPACTION

Expressed as a percentage of maximum density. Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be reduced by 5 percent.

3.6.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5-foot line of the structure to 85 percent of ASTM D 1557.

3.6.2 Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D 1557. Compact common fill, backfill material and select material to 95 percent of ASTM D 1557.

3.6.3 Adjacent Area

Compact areas within 5 feet of structures to 90 percent of ASTM D 1557.

3.6.4 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D 1557. Compact fill and backfill materials to 95 percent of ASTM D 1557.

3.7 FINISH OPERATIONS

3.7.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.7.2 Seed

Scarify existing subgrade. Provide 4 inches of topsoil for newly graded finish earth surfaces and areas disturbed by the Contractor. If there is insufficient on-site topsoil meeting specified requirements for topsoil, provide topsoil required in excess of that available. Seed shall match existing vegetation. Provide seed at 5 pounds per 1000 square feet. Provide FS O-F-241, Type I,

Class 2, 10-10-10 analysis fertilizer at 25 pounds per 1000 square feet. Provide commercial agricultural limestone of 94-80-14 analysis at 70 pounds per 1000 square feet. Provide mulch and water to establish an acceptable stand of grass.

3.7.3 Restoration Sod

Restore unpaved surfaces disturbed during the installation of pipes and sumps conduit to their original elevation and condition except where indicated differently on drawings. Preserve sod and topsoil carefully and replace after the backfilling is completed. Replace sod that is damaged using sod of quality equal to that removed. Where surface is disturbed in a newly seeded area, re-seed the area with the same quality and formula of seed as that used in the original seeding.

3.7.4 Restoration of Pavement

Patch pavement, sidewalks, curbs and gutters where existing surfaces are removed for construction. Saw cut pavement edges. Graded aggregate base course shall have a maximum aggregate size of 1-1/2 inches. Prime base course with liquid asphalt, ASTM D 2028, grade RC - 70 prior to paving. Match base course thickness to existing but shall be not less than 6 inches. Asphalt aggregate size shall be 1/2-inch, asphalt cement shall conform to ASTM D 3381, grade AR - 2000. Match asphalt concrete thickness to existing but shall be not less than 2 inches. Repair portland cement concrete pavement, sidewalks, curbs and gutters using 4,000 psi concrete conforming to ASTM C 94 Type III, "Cast-In-Place Concrete". Match existing pavement, sidewalk, curb and gutter thicknesses.

3.7.5 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.8 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.9 FIELD QUALITY CONTROL

3.9.1 Sampling

Take the number and size of samples required to perform the following tests.

3.9.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.9.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 4318 for liquid limit and for plastic limit; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.9.2.2 Select Material Testing

Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 1557 for moisture density relations, as applicable.

3.9.2.3 Density Tests

Test density in accordance with ASTM D 1556, or ASTM D 2922 and ASTM D 3017. When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 1556 density test at a location already ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 1556 density test at the start of the job, and for every 10 ASTM D 2922 and ASTM D 3017 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut.

3.9.3 Excavation Areas

The Contractor shall, in accordance with the New Jersey Department of Environmental Protection and Energy (NJDEP&E) and the United States Environmental Protection Agency (USEPA), Underground Storage Tank Regulations, prepare and submit on acceptable tank closure plan. All subsequent closure activities, testing, retrofitting and reinstallation shall be performed by individuals certified by the NJDEP&E in their respective discipline(s). Once approved and implemented, the Contractor shall collect soil and water samples in the Excavation area. Post excavation samples shall be collected in accordance with procedures and specifications set forth in the publication EPA-600/2-80-018 or as required by the NJDEP&E's Underground Storage Tank Program. Samples shall be analyzed for applicable parameters in accordance with approved methods. The methods are taken from the USEPA "SW-846" November 1986 Third Editions. At completion, the Contractor shall submit a Closure Report to the Contracting Officer and the NJDEP&E describing and interpreting the analytical results and providing all data as requested by the NJDEP&E in their Site Assessment requirements.

prior to the start of work

Contractor shall, in accordance with the NJDEPE and the USEPA prepare and submit a tank closure plan that will be acceptable by the USEPA and NJDEPE. The Contractor shall submit the closure approval plan to the OIC. The Contractor shall collect soil and water samples in accordance with the approved NJDEPE Closure Plan. The Contractor shall submit all sampling reports, documents to NJDEPE, and submit a copy to the OIC.

3.9.4 Stockpiled Soil

The Contractor shall excavate contaminated soils in accordance with Appendix 10 of the NJDEP&E Bureau of UST Regulations. The Contractor shall also collect soil samples for waste classification/disposal purposes of the excavated soils. Each sample collected from the pile shall be in accordance with EPA-600/2-80-018, or as required by the NJDEP&E's Waste Classification group or other applicable governing regulatory bodies. Each sample shall be analyzed for RCRA waste classification parameters and total petroleum hydrocarbons in accordance with EPA-SW 846 or as required by the disposal facility for acceptance. The Contractor shall dispose the stock piled soils in accordance with 40 CFR 263, 264.

The Contractor shall cover all excavated material with 10 mil plastic, all excavated material shall be placed on 10 mil plastic. The 10 mil plastic shall be anchored. The Contractor shall verify in writing that the 10 mil plastic did not break during this time.

-- End of Section --

SECTION 03302

CAST-IN-PLACE CONCRETE (MINOR CONSTRUCTION)

PART 1 GENERAL

1.1 REFERENCES

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

FEDERAL SPECIFICATIONS (FED SPEC)

L-T-1512A	Tape Pressure Sensitive Adhesive, Pipe Wrapping

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 301	1989 Structural Concrete for Buildings
ACI 304R	1989 Measuring, Mixing, Transporting and Placing Concrete
ACI 305R	1989 Hot Weather Concreting
ACI 306R	1988 Cold Weather Concreting

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	1990 Steel Welded Wires Fabric, Plain, for Concrete Reinforcement
ASTM A 497	1990 Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615	1990 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 617A 617M	1987 Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C 33	1990 Concrete Aggregates
ASTM C 94	1990 Ready-Mixed Concrete
ASTM C 143	1990 (Rev. A) Slump of Portland Cement Concrete

ASTM C 150	1989 Portland Cement
ASTM C 171	1969 (R 1986) Sheet Materials for Curing Concrete
ASTM C 172	1990 Sampling Freshly Mixed Concrete
ASTM C 231	1990 Air Content for Freshly Mixed Concrete by the Pressure Method
ASTM C 260	1986 Air Entraining Admixtures for Concrete
ASTM C 920	1987 Elastomeric Joint Sealants
ASTM D 570	E1-81 Water Absorption of Plastics (R 1988)
ASTM D 1190	1974 (R 1980) Concrete Joint Sealer, Hot Poured Elastic Type
ASTM D 1850	1974 (R 1979) Concrete Joint Sealer, Cold Application Type
ASTM D 1752	1984 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1000	1988 Pressure Sensitive Adhesive Coated Tapes used for Electrical and Electronic Application

1.2 GENERAL REQUIREMENTS

In the ACI publications referred to herein, the advisory provisions shall be considered to be mandatory, as through the word "shall" has been substituted for "should" wherever it appears; reference to the "Building Official, "the "Structural Engineer," and the "Architect/Engineer" shall be interpreted to mean the Contracting Officer.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-13, Certificates

a. Cement G

b. Aggregates G

c. Admixtures G

d. Reinforcement G

e. Expansion-joint filler G

f. Joint sealant G

g. Corrosion protection tape G

1.4 DELIVERY

Do not deliver concrete until ready for concrete placement.

1.5 STORAGE

Store concrete aggregates to prevent contamination or segregation. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil and dirt. Provide for accurate identification after bundles are broken and tags removed.

PART 2 PRODUCTS

2.1 CONCRETE

2.1.1 Contractor Mix Design

ACI 301, except as modified herein. Concrete shall have a 28-day compressive strength of 4000 psi. Slump shall be between 2 and 4 inches in accordance with ASTM C 143. Provide ASTM C 33 aggregate Size No. 57 and 4 to 6 percent air entrainment for concrete exposed to freeze-thaw conditions. Accomplish air-entrainment using an air-entraining admixture.

2.1.2 Ready Mixed Concrete

ASTM C 94, except as modified herein. Ready-mixed concrete is defined in this specification as concrete produced regularly by a commercial establishment and delivered to the purchaser in the plastic state.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type I blended cement, except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and one of the following materials. ASTM C 618 pozzolan or fly ash, or ASTM C 989 ground iron blast furnace slag. The pozzolan/fly ash content shall not exceed 25 percent nor the ground iron blast furnace slag 50 percent by weight of the total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N,F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Type N and F. Add with cement.

2.2.1.2 Ground Iron Blast Furnace Slag

ASTM C 989, Grade 120.

2.2.2 Water

Water shall be potable.

2.2.3 Aggregates

ASTM C 33. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.2.4 Admixtures

ASTM C 260 for air-entrained concrete.

2.2.5 Reinforcement

2.2.5.1 Reinforcing Bars

ASTM A 615 and ASTM A 617/A 617M, Grade.

2.2.5.2 Welded Wire Fabric

ASTM A 497 or ASTM A 185, 6 by 6, 5/5 unless otherwise indicated.

2.2.6 Materials for Curing Concrete

2.2.6.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene coated burlap.

2.2.7 Corrosion Protection Tape

Corrosion protection tape shall be used to fully enwrap and protect all pipes that must penetrate cast-in-place reinforced concrete dike walls. Both metal and fiberglass reinforced plastic (FRP) pipes shall be protected for the full depth of concrete wall penetration. Fittings and joints shall similarly be protected, where they occur within or adjacent to a concrete dike.

Corrosion protection tape shall be polyvinylchloride (PVC) plastic base tape with high-tack adhesive backing. Tape and adhesive shall be formulated to resist corrosion from chemicals in concrete and from metal corrosion due to environmental conditions. PVC-based tape shall be highly conformable for all weather conditions, non-sag, width thickness not less than 10 mil or 0.254 mm. A 20 mil thick PVC-based tape shall also be available where required.

Resistance shall be documented, using ASTM-D-1000 test method, to corrosion from salt water, soil acids, alkalis and salts, plus resistance to effects from sunlight exposure (ultraviolet rays), outdoor weathering, abrasion, puncture, tears, commonly encountered chemicals and chemical vapors.

Under ASTM-D-1000 tests, elongation before breaking shall equal or exceed 200% at 74 degrees F, or 80% elongation at 10 degrees F. Breaking strength shall be not less than 20 pounds per inch for 10 mil thickness and 40 pounds per inch for 20 mil thickness tape. Adhesion to tape backing shall equal or exceed 30 oz per inch at 10 degrees F, and 20 oz per inch at 74 degree F.

Within Federal Test Method 1476, vapor transmission rate shall not exceed 1.0 grams per 100 square inches in 24 hours for 10 mil thick tape or 2.0 for 20 mil thick tape. Moisture absorption, under ASTM-D-570 test method, shall not exceed absorption 0.30% for 10 mil thick tape or 0.35% for 20 mil thick tape. Ultraviolet light resistance to tape deterioration shall equal or exceed 28 days (equivalent to 9 years) as subject to tests by means of GE UA III lamp output.

Dielectric strength of PVC tape shall equal or exceed 1000 volts per mil for both thickness of tape. Normal service temperature range shall equal or exceed (-) 55 degrees F to (+) 175 degrees F for both thicknesses. Applicable Federal Specifications L-T-1512 A shall be Type III for 10 mil tape, but Type for 20 mil tape. Tape color is typically black, but tape is not limited to black outer color.

2.2.7.1 Corrosion Protection Putty

Corrosion protection insulation putty, shall be used as a build-up compound for irregular surfaces, for such items as fittings and valves and pipe joints, to provide a smooth and waterproof surface for subsequent application of corrosion protection PVC tape.

Pipe insulation putty shall remain soft and pliable for not less than 15 minutes at 75 degrees F. Application of insulation putty shall not require special tools, being pliable enough for adhesion with finger pressure only.

2.2.7.2 Corrosion Protection Pipe Primer

Corrosion protection pipe primer shall be of non-sag, rubber base consistency, quick-drying yet remain fully useable for not less than 2 minutes at 75 degrees F. Application shall be required for metallic surface pits and irregularities as preparation for subsequent corrosion protection tape application.

Pipe primer shall be formulated from a rubber base to enhance surface preparation and add extra strength adhesion for tape at low additional cost. Solids content shall equal or exceed 40%, width weight not less than 7 pounds per gallon. coverage at one mil dry film thickness per gallon. Coverage at one mil dry film thickness shall equal or exceed 700 square feet per gallon of primer.

2.2.8 Expansion Joint Filler

ASTM D 1751 or ASTM D 1752, 12 inch thick, unless otherwise indicated. Shall be coated with epoxy and polyurethane as shown on plans.

2.2.9 Joint Sealant

2.2.9.1 Horizontal Surfaces (3 percent slope, maximum)

a. Outside Buildings: ASTM D 1190.

b. Inside Buildings: ASTM D 1190 or ASTM D 1850.

2.2.9.2 Vertical Surfaces (greater than 3 percent slope)

ASTM C 920, Type M, Grade NS, Class 25, Use T.

PART 3 EXECUTION

3.1 FORMS

ACI 301. Set forms true to line and grade and make mortar tight. Chamfer above grade exposed joints, edges, and external corners of concrete 3/4 inch, unless otherwise indicated. Before concrete placement, coat the contact surfaces of forms with a nonstaining form coating compound. Do not use mineral oil on formed surfaces to be painted. Prevent concrete damage during form removal. Excavation width shall be a minimum of 4 inches greater than finished dimensions indicated.

3.2 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301. Provide bars, wire fabric, and other reinforcing materials including wire ties, supports, and other devices necessary to install and secure the reinforcement.

3.2.1 Cover and Splicing

ACI 301, unless otherwise indicated.

3.2.2 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.2.3 Vapor Barrier

Provide beneath the on-grade concrete floor slab. Lap 12 inches minimum. Remove torn, punctured, or damaged vapor barrier material and provide with new material prior to placing concrete. Place concrete to prevent damage to the vapor barrier material.

3.2.4 Construction Joints

ACI 301. Continue reinforcement across joints, unless otherwise indicated. Fusion weld waterstop splices.

3.2.5 Expansion Joints and Contraction Joints

ACI 301. For slabs on grade, provide at edges of interior floor slabs, adjacent to walls, and as indicated. Make expansion joints 0.5 inch wide, except as indicated otherwise. Fill expansions joints exposed to weather with joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint, unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool to the indicated depth after the surface has been finished. Sawed

joints shall be completed within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.3 MEASURING, MIXING, TRANSPORTING, AND PLACING CONCRETE

ACI 304R, except as modified herein. ASTM C 94; machine mix concrete and provide mandatory batch ticket information for each load of ready mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 85 degrees F. Reduce mixing time to 60 minutes if the air temperature is greater than 85 degrees F. Additional water may be added, provided that both the specified maximum slump and water cement ratio are not exceeded. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, and water, snow, and ice from within the forms. Consolidate concrete slabs greater than 4 inches depth with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by tamping, spading, and settling with a heavy leveling straight edge.

3.3.1 Cold Weather

ACI 306. Provide and maintain 50 degrees F minimum concrete temperature. Do not place concrete when the ambient temperature is below 40 degrees F. Cover concrete and provide with a source of heat sufficient to maintain 50 degrees F minimum while curing.

3.3.2 Hot Weather

ACI 305R. Concrete temperature from initial mixing through final cure shall not exceed 90 degrees F. Cool ingredients before mixing, or substitute chip ice for part of required mixing water or use other suitable means to control concrete temperature to prevent rapid drying of newly placed concrete. Shade the fresh concrete and start curing as soon as the surface of the fresh concrete is sufficiently hard to permit curing without damage.

3.4 SURFACE FINISHES

ACI 301 for repair and finish, unless otherwise specified. Slope floors uniformly to drains where drains are provided. After troweling is completed, apply a liquid chemical sealer hardener to interior slabs that do not receive floor covering.

3.4.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area of 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb (including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 301. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish, unless otherwise specified.

3.4.2 Steel Troweled Finish

Provide for curbs and dispenser islands. First, provide a floated finish. When slab has attained a proper set, trowel to a smooth, hard, dense finish. Finished surfaces shall be free of trowel marks, uniform in texture, flat within 0.01 foot (approximately 1/8 inch) in 10 feet. Hand-finish portions of the slab not accessible to power finishing equipment (e.g., edges, corners) to match the remainder of the slab. Power trowel once and finally hand trowel where a finished floor covering (e.g., tile, carpet) is specified. Power trowel twice and finally hand trowel for exposed concrete floors.

3.4.3 Broomed Finished

Provide for driveway and around curbs, unless otherwise indicated. Provide a floated finish, then finish with a flexible bristle broom. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.5 MISCELLANEOUS CONSTRUCTION

3.5.1 Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum, unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum, unless otherwise indicated. Provide a broom finish.

3.6 CURING AND PROTECTION

ACI 301. Protect concrete from injurious action by sun, rain, wind, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the curing period. Forms may be removed 48 hours after concrete placement.

3.6.1 Moist Curing

Provide for the removal of water without erosion or damage to the structure.

3.6.1.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water temperature shall not be more than 20 degrees F than the temperature of the concrete. For temperature between 40 and 50 less degrees F, increase the curing period by 50 percent.

3.6.1.2 Fog Spraying or Sprinkling

Provide uniform and continuous application of water throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.6.1.3 Pervious Sheeting

Cover the entire surface of the concrete with two thicknesses of wet sheeting. Mats shall be at least as long as the width of the surface to be cured. During application, do not drag the mats over the finished concrete nor over mats already placed. Completely cover surface and edges of the concrete, with a 6-inch overlap over adjacent mats. Wet mats thoroughly and keep continuously wet throughout the curing period.

3.6.2 Curing Periods

Allow 7 days.

3.7 SAMPLING AND TESTING

3.7.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified.

3.7.2 Testing

3.7.2.1 Slump Tests

ASTM C 143. Take samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement and for each batch (minimum) or every 10 cubic yards (maximum) of concrete.

3.7.2.2 Air Content

ASTM C 173 or ASTM C 231. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

-- End of Section --

SECTION 03410

PRECAST CONCRETE (NON-PRESTRESSED)

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB14	1990 Highway Bridges

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 304R	1989 Measuring, Mixing, Transporting and Placing Concrete
ACI 305R	1991 Hot Weather Concreting
ACI 306.1	1990 Cold Weather Concreting
ACI 309R	1987 Guide for Consolidation of Concrete
ACI 318	1992 Building Code Requirements for Reinforced Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 27/A 27M	1991 Steel Castings, Carbon, for General Application
ASTM A 36/A 36M	1991 Structural Steel
ASTM A 47	1990 Ferritic Malleable Iron Castings
ASTM A 123	1989 (Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	1982 (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 185	1990 (Rev. A) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

ASTM A 307	1991 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	1990 (Rev. C) High-Strength Bolts for Structural Steel Joists
ASTM A 497	1990 (Rev. B) Steel Welded Wire Fabric, Deformed, or Concrete Reinforcement
ASTM A 563	1991 (Rev. C) Carbon and Alloy Steel Nuts
ASTM A 615	1990 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	1990 Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM A 780	1990 Repair of Damaged Hot-Dip Galvanized Coatings
ASTM C 33	1990 Concrete Aggregates
ASTM C 94	1990 Ready-Mixed Concrete
ASTM C 150	1989 Portland Cement
ASTM C 260	1986 Air-entraining Admixtures for Concrete
ASTM C 330	1989 Lightweight Aggregates for Structural Concrete
ASTM C 494	1990 Chemical Admixtures for Concrete
ASTM C 595	1989 Blended Hydraulic Cements
ASTM C 618	1991 Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 1107	1991 Packaged Dry, Hydraulic-Cement Grout (Nonshrinkable)
ASTM F 436	1991 Hardened Steel Washers

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4	1979 Structural Welding Code Reinforcing Steel

PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	1985 Quality Control for Plants and Production of Precast and Prestressed Concrete Products
PCI MNL-120	1985 Design Handbook - Precast and Prestressed Concrete (Third Edition)
PCI MNL-124	1989 Fire Resistance of Precast Prestressed Concrete

UNDERWRITERS LABORATORIES, INC. (UL)

UL FRD	1991 Fire Resistance Directory

1.2 PRECAST MEMBERS

The work includes the provision of precast non-prestressed concrete herein referred to as precast members. Precast members shall be the product of a manufacturer specializing in the production of precast concrete members. In the ACI publications, the advisory provisions shall be considered to be mandatory, as though the work "shall" has been substituted for "should" wherever it appears; reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" shall be interpreted to mean the Contracting Officer.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Anchorage and lifting inserts and devices

b. Bearing pads

1.3.2 SD-04, Drawings

a. Drawings of precast members

1.3.2.1 Drawing Information

Submit drawings indicating complete information for the fabrication, handling, and erection of the precast member. Drawings shall not be reproductions of contract drawings. Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:

a. Marking of members for erection

b. Connections for work of other trades

c. Connections between members, and connections between members and other construction

d. Location and size of openings

e. Headers for openings

f. Joints between members, and joints between members and other construction

g. Reinforcing details

h. Material properties of steel and concrete used

i. Lifting and erection inserts

j. Dimensions and surface finishes of each member

k. Erection sequence and handling requirements

l. All loads used in design (such as live, dead, handling, and erection)

m. Bracing/shoring required

n. Areas to receive toppings, topping thickness.

1.3.3 SD-05, Design Data

a. Precast concrete members design calculations

b. Concrete mix design

1.3.3.1 Design Calculations

Submit calculations reflecting design conforming to requirements of paragraph entitled "Precast Concrete Member Design." Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication.

1.3.3.2 Concrete Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Include a complete list of materials including type; brand; source and amount of cement, pozzolan, and admixtures; and applicable reference specifications.

1.3.4 SD-08, Statements

a. Fabrication

Submit quality control procedures established in accordance with PCI MNL-116 by the precast manufacturer.

1.3.5 SD-11, Factory Test Reports

a. Contractor-furnished mix design

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval before concrete placement.

1.3.6 SD-14, Samples

a. Surface finish

Submit two 12- by 12- by 2-inch thick sample panels representative of the color and finish for each type of precast member requiring a finish Grade A surface finish.

1.3.7 SD-18, Records

a. Concrete batch ticket information

1.3.7.1 Record Requirement

ASTM C 94. Submit mandatory batch ticket information for each load of ready-mixed concrete.

1.4 QUALITY ASSURANCE

1.4.1 Precast Concrete Member Design

ACI 318 and the PCI MNL-120. Design precast members (including connections) for the design load conditions and spans indicated, and for additional loads imposed by openings and supports of the work of other trades. Design precast members for handling without cracking in accordance with the PCI MNL-120. Precast members where indicated shall have a fire rating of 3 hours as indicated in accordance with UL FRD, or as designed in accordance with PCI MNL-124. Concrete toppings shall not be used in establishing the design strength of the precast members.

1.4.2 Factory Fabrication, Sampling, and Testing

PCI MNL-116. At the precast manufacturer's option, in lieu of core samples, ACI 318, full scale load tests may be performed. Perform on randomly selected members, as directed by the Contracting Officer.

1.5 DELIVERY AND STORAGE

Lift and support precast members at the lifting and supporting points indicated on the shop drawings. Store precast members off the ground. Separate stacked precast members by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload.

1.6 FACTORY INSPECTION

At the option of the Contracting Officer, precast units may be inspected by the Contracting Officer precast units shall be inspected by the CQC Representative prior to being transported to the job site. The Contractor shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

PART 2 PRODUCTS

2.1 CONTRACTOR-FURNISHED MIX DESIGN

ACI 318. The minimum compressive strength of concrete at 28 days shall be 5000 psi, unless otherwise indicated. Add air-entraining admixtures at the mixer to produce between 4 and 6 percent air by volume.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type I, II, or III; or ASTM C 595 Type IP(MS) or IS(MS) ASTM C 150, Type II; or ASTM C 595 Type IP(MS) or IS(MS) blended cement, except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and one of the following materials: ASTM C 618 pozzolan or fly ash, or ASTM C 989 ground iron blast furnace slag. The pozzolan/fly ash content shall not exceed 25 percent by weight of the total cementitious material. For exposed concrete, use on manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Type N and F.

2.2.1.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 100 or 120.

2.2.2 Water

Water shall be fresh, clean, and potable.

2.2.3 Aggregates

2.2.3.1 Aggregates Selection

ASTM C 33, Size 67, except as modified herein. Obtain aggregates for concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.2.3.2 Aggregates for Lightweight Concrete

ASTM C 330.

2.2.4 Grout

2.2.4.1 Nonshrink Grout

ASTM C 1107.

2.2.4.2 Cementitious Grout

Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

2.2.5 Admixtures

2.2.5.1 Air-Entraining

ASTM C 260.

2.2.5.2 Accelerating

ASTM C 494, Type C or E.

2.2.5.3 Water Reducing

ASTM C 494, Type A, E, or F.

2.2.6 Reinforcement

2.2.6.1 Reinforcing Bars

ASTM A 706/A 706M, Grade 60; ASTM A 615, Grade 40 60; ASTM A 617/A 617M with the bars marked A, Grade 40 60; or ASTM A 616/A 616M with the bar marked R, Grade 50 60.

2.2.6.2 Welded Wire Fabric

ASTM A 185 or ASTM A 497.

2.2.7 Metal Accessories

Provide ASTM A 123 or ASTM A 153 galvanized.

2.2.7.1 Inserts

ASTM A 47, Grade 32410 or Grade 35018, or ASTM A 27/A 27M Grade U-60-30.

2.2.7.2 Structural Steel

ASTM A 36/A 36M.

2.2.7.3 Bolts

ASTM A 307; ASTM A 325.

2.2.7.4 Nuts

ASTM A 563.

2.2.7.5 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436 washers for ASTM A 325 bolts.

2.2.8 Bearing Pads

2.2.8.1 Elastomeric

AASHTO HB14, for plain neoprene bearings.

2.2.8.2 Hardboard (Interior Only)

PS-58, class as specified by the precast manufacturer.

2.3 FABRICATION

PCI MNL-116 unless specified otherwise.

2.3.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 3/4 inch, unless otherwise indicated. Provide threaded or snap-off type form ties.

2.3.2. Reinforcement Placement

ACI 318 for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between precast and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections.

2.3.3 Concrete

2.3.3.1 Concrete Mixing

ASTM C 94. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

2.3.3.2 Concrete Placing

ACI 304R, ACI 305R for hot weather concreting, ACI 306.1 for cold weather concreting, and ACI 309R, unless otherwise specified.

2.3.3.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 50 and 190 degrees F. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts.

2.3.4 Surface Finish

Repairs located in a bearing area shall be approved by the Contracting Officer prior to repairs. Precast members containing hairline cracks which are visible and are less than 0.02 inches in width, may be accepted, except that cracks larger than 0.005 inches in width for surfaces exposed to the weather shall be repaired. Precast members which contain cracks greater than 0.02 inch in width shall be approved by the Contracting Officer, prior to being repaired. Any precast member that is structurally impaired or contains honeycombed section deep enough to expose reinforcing shall be rejected.

2.3.4.1 Unformed Surfaces

Provide a steel troweled finish.

2.3.4.2 Formed Surfaces

PCI MNL-116 (Appendix A - Commentary, Chapter 3, for grades of surface finishes.

a. Unexposed Surfaces: Provide a standard grade surface finish.

b. Exposed Surfaces: Provide a finish Grade B surface finish. The combined area of acceptable defective areas shall not exceed 0.2 percent of the exposed to view surface area, and the patches shall be indistinguishable from the surrounding surfaces when dry.

PART 3 EXECUTION

3.1 SURFACE REPAIR

Prior to erection, and again after installation, precast members shall be checked for damage, such as cracking, spalling, and honeycombing. As directed by the Contracting Officer, precast members that do not meet the surface finish requirements specified in Part 2 in paragraph titled, "Surface Finish" shall be repaired, or removed and replaced with new precast members.

3.2 ERECTION

Precast members shall be erected after the concrete has attained the specified compressive strength, unless otherwise approved by the precast manufacturer. Erect in accordance with the approved shop drawings. PCI MNL-116 and PCI MNL-120 (Chapter 8), for tolerances. Brace precast members, unless design calculations submitted with the shop drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place precast members level, plumb, square, and true within tolerances. Align member ends.

3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the precast member and adjacent precast members or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Do not use hardboard bearing pads in exterior locations. Place precast members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

3.4 ANCHORAGE

Provide anchorage for fastening work in place. Conceal fasteners where practicable. Make threaded connections up tight and nick threads to prevent loosening.

3.5 WELDING

AWS D1.4 for welding connections and reinforcing splices. Protect the concrete and other reinforcing from heat during welding. Weld continuously along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections. Grind smooth visible welds in the finished installation.

3.6 OPENINGS

Holes or cuts requiring reinforcing to be cut, which are not indicated on the approved shop drawing, shall only be made with the approval of the Contracting Officer and the precast manufacturer. Drill holes less than 12 inches in diameter with a diamond tipped core drill.

3.7 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanized surfaces damaged by handling, transporting, cutting, welding, bolting, or acid washing. Do not heat surfaces to which repair paint has been applied.

3.8 GROUTING

Clean and fill indicated keyways between precast members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

3.9 SEALANTS

Provide as indicated and as specified in Section 07920, titled "Sealants."

3.10 CONCRETE TOPPING

Provide as indicated and as specified in Section 03300, titled "Cast-In-Place Concrete."

-- End of Section --

SECTION 04200

UNIT MASONRY

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	1990 (Rev. A) Steel Wire, Plain for Concrete Reinforcement
ASTM A 90	1981 (R 1991) Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
ASTM A 153	1982 (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615	1990 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM B 370	1988 Copper Sheet and Strip for Building Construction
ASTM C 27	1984 (R 1988) Fireclay and High-Alumina Refractory Brick
ASTM C 55	1985 Concrete Building Brick ASTM 621991 (Rev. B) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 67	1991 Sampling and Testing Brick and Structural Clay Tile
ASTM C 73	1985 (R 1989) Calcium Silicate Face Brick (Sand-Lime Brick)
ASTM C 90	1990 Load-Bearing Concrete Masonry Units
ASTM C 91	1991 Masonry Cement
ASTM 129	1985 (R 1990) Non-Load-Bearing Concrete Masonry Unit

ASTM C 144	1991 Aggregate for Masonry Mortar Units
ASTM C 150	1992 Portland Cement
ASTM C 207	1991 Hydrated Lime for Masonry Purposes
ASTM C 216	1991 (Rev. B) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	1991 (Rev. A) Mortar for Unit Masonry
ASTM C 476	1991 Grout for Masonry
ASTM C 1072	1986 Masonry Flexural Bond Strength
ASTM E 514	1990 Water Penetration and Leakage Through Masonry

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Masonry accessories

b. Reinforcement

c. Pre-mixed mortar

d. Control joints

e. Expansion joints

f. Water-repellant admixture

g. Flashing

Submit for each type.

1.2.2 SD-04, Drawings

a. Reinforcing steel

1.2.2.1 Drawing Requirements

Indicate splicing, laps, shapes, dimensions, and details of reinforcing steel and accessories. Include details of anchors, adjustable wall ties, positioning devices, bond beams, and lintels. Do not scale drawings to determine lengths of bars.

1.2.3 SD-05, Design Data

a. Pre-mixed mortar

1.2.4 SD-06, Instructions

a. Masonry cement

When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

1.2.5 SD-11, Factory Test Reports

a. Efflorescence test

Submit efflorescence test reports on masonry units that are to be exposed to weathering.

1.2.6 SD-13, Certificates

a. Water-repellant admixture

Certify that the additive does not adversely offset bond strength as tested under ASTM C 1072.

1.2.7 SD-14, Samples

a. Masonry units

b. Mortar color

Submit two sets of each type masonry units, showing full range of color, texture, finish, and dimensions and two samples of each color of mortar.

1.2.8 SD-16, Sample Panels

a. Masonry panel

1.2.8.1 Panel Requirements

At the job site submit for approval by the Contracting Officer, a sample masonry panel approximately 4 feet long by 4 feet high showing the workmanship, coursing, bond, weep holes, flashing, thickness, anchors, joint reinforcing, wall ties, rigid-board insulation, intersection of walls, bond beams, expansion and control joints, and tooling of joints, range of color, texture of masonry, and mortar color. The sample panel shall be protected from damage and shall remain at the site until masonry work is complete and approved, at which time the panel shall be removed from the site. Masonry work shall match the approved sample.

1.3 QUALITY ASSURANCE

1.3.1 Appearance

Do not change source or supply of materials after work has started if the appearance of the finished work would be affected.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver cementitious materials to the site in unbroken containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious materials in dry, weathertight sheds or enclosures and handle so as to prevent entry of foreign materials and damage by water or dampness. Store masonry units off the ground and handle with care to avoid chipping and breakage. Protect materials from damage and, except for sand, keep dry until used. Cover sand to prevent intrusion of water and foreign materials and to prevent drying. Do not use materials containing frost or ice. Store Type II, concrete masonry units at the site before using for a minimum of 28 days for air cured units, 10 days for atmospheric steam or water cured units, and 3 days for units cured with steam at a pressure of 120 to 150 psi and at a temperature of 350 to 365 degrees F for at least 5 hours.

1.5 ENVIRONMENTAL CONDITIONS

1.5.1 Cold Weather Construction

When the air temperature is below 40 degrees F and falling, or when it appears that the air temperature will drop to 40 degrees F or below within 24 hours, do not lay masonry unless the work is protected from freezing as specified below. Surfaces receiving mortar shall be free of ice and frost. Comply with the requirements specified below for the respective air temperatures.

a. Air Temperature 40 to 32 Degrees F: Heat sand or mixing water to produce mortar temperature between 40 and 120 degrees F.

b. Air Temperature 32 to 25 Degrees F: Heat sand and mixing water to produce mortar temperature between 40 and 129 degrees F.

1.5.2 Cold Weather Protection

Protection newly laid masonry as specified below for the respective mean daily air temperature (MDAT), that is, the average of the daytime high temperature and the forecasted nighttime low temperature.

a. MDAT 40 to 32 Degrees F: Protect masonry from rain and snow by covering the top 4 feet with weather-resistive membrane for 24 hours after laying.

b. MDAT 32 to 25 Degrees F: Completely cover newly-laid masonry with weather-resistive membrane for 24 hours.

1.6 SCHEDULING

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching.

PART 2 PRODUCTS

2.1 MASONRY PRODUCTS

2.1.1 Building Brick

ASTM C 62; Grade SW for vertical surfaces in contact with the earth, exposed vertical surfaces in the severe weathering region, as defined in ASTM C 62, and for all nonvertical surfaces; Grade SW or MW for other locations. Average dimensions of brick shall be 3 3/4 inches thick, 2 1/4 inches high, and 8 inches long (standard), or 3 5/8 inches thick, 2 1/4 inches high, and 7 5/8 inches long (modular), subject to the tolerances specified in ASTM C 62. Color, texture, and range of building brick provided in the exterior face of walls shall match the brick of adjacent buildings at NWS, Earle.

2.1.2 Facing brick

ASTM C 216, Grade SW, Type FBS, 3 3/4 inches thick, 2 1/4 inches high, and 8 inches long (standard) [or 3 5/8 inches thick, 2 1/4 inches high, and 7 5/8 inches long (modular). Color, texture, and range of facing brick shall match the brick of adjacent buildings at NWS, Earle. Brick shall be of uniform light beige, buff color with a wire cut texture.

ASTM C 216 Grade SW, Type FBS, with light buff color and wire cut texture to match the color and texture of the control buildings below, 2 1/4 by 3 5/8 or 3 3/4 11 5/8 inches. Brick shall not be lighter in color than the lightest brick on the control buildings listed below. Brick shall be manufactured at one time and stockpiled before beginning shipments to the job site. At the Contractor's option, 2 1/4 by 3 5/8 or 3 3/4 by 8 inches long facing brick may be provided. The control buildings are as follows:

a. Nuclear Power Training Buildings I and II

b. Applied Instruction Building

2.1.3 Concrete Masonry Units

Units of modular dimensions and air, water, or steam cured. Surfaces of units which are to be plastered or stuccoed shall be sufficiently rough to provide bond; elsewhere, exposed surfaces of units shall be smooth and of uniform texture. Exterior concrete masonry units shall have water-repellant admixture added during manufacture.

a. Hollow Load-Bearing Units: ASTM C 90, Grade N-I or N-II, made with lightweight or normal weight aggregate. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Concrete Building Brick: Grades S-I or S-II, except brick exposed to weather shall be Grade N-I or N-II, and made with lightweight or normal weight aggregate. Concrete brick shall match the concrete masonry units in color and surface characteristics.

c. Solid Load-Bearing Units: ASTM C 90, Grade S-I or S-II, except units exposed to weather shall be Grade N-I or N-II, and made with lightweight or normal weight aggregates. Provide solid units for masonry bearing under structural framing members as indicated.

d. Special Shapes: Provide special shapes such as closures, header units, and jamb units as necessary to complete the work. Special shapes shall conform to the requirements for the units with which they are used.

2.1.4 Precast Masonry Lintels

Some materials and surface texture as adjacent masonry units, with a 28-day compressive strength of not less than 3000 psi. Provide reinforcing as indicated. Provide lintels of sizes indicated, with at least 8 inches of bearing at each end.

2.2 MORTAR

2.2.1 Portland Cement

ASTM C 150, Type I, II, or III.

2.2.2 Hydrated Lime

ASTM C 207, Type S.

2.2.3 Masonry Cement

ASTM C 91 except that for masonry cement provided for mortar for exterior walls, the air content of the mortar specimen shall be not more than 16 percent by volume in lieu of 22 percent. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

2.2.4 Sand

ASTM C 144.

2.2.5 Water

Clean, potable, and free from substances which could adversely affect the mortar.

2.2.6 Mortar Types

ASTM C 270, Type M for foundation walls, basement walls, and piers; Type N or S for non-load-bearing, non-shear-wall interior masonry; approved commercial fire clay mortar or refractory cement (calcium-aluminate) mortar for fire brick and flue liners; and Type S for remaining masonry work; except where higher compressive strength is indicated on structural drawings. Air content shall not be less than 11 percent. Where colored mortar is indicated, add pigment to obtain the mortar color indicated. The quantity of metallic oxide pigment relative to the cementitious content of the mortar mix shall be 10 to 15 percent by weight. Carbon black shall be no more than 2 percent by weight.

2.2.7 Pre-Mixed Mortar

ASTM C 270 Type M, compressive strength of 2500 psi in 28 days. Air content shall not be less than 11 percent. Admixture may be provided in mortar to retard curing and provide up to 36 hours of workability, as long as the admixture does not adversely affect bonding or compressive strength.

2.3 MASONRY ACCESSORIES

2.3.1 Horizontal Joint Reinforcement

Fabricate from cold drawn steel wire, ASTM A 82. Wire shall be hot-dipped galvanized after fabrication in accordance with ASTM A 153 Class B-2, 1.5 oz. of zinc per square foot. Reinforcement shall be truss type with two or more longitudinal wires welded to a continuous diagonal cross wire, or ladder type with perpendicular cross wires not more than 16 inches o.c. Provide flat sections 10 feet long, and preformed corners and tees approximately 30 inches long. Overall width shall be approximately 2-inches less than nominal thickness of wall.

2.3.1.1 Brick-Faced or Composition Walls

For brick-faced or composition walls, provide three 3/16-inch (0.1875-inch) longitudinal wires, one for each face shell of concrete masonry units and one for the brick wythe, and 3/16-inch cross wires.

2.3.2 Anchors and Wall Ties

Provide approved designs of zinc-coated steel, or noncorrosive metal having the equivalent total strength of steel types. Zinc coat steel by the hot-dip process after fabrication to a minimum of 1.25 ounces of zinc per square foot of surface when tested in accordance with ASTM A 90.

a. Corrugated Metal Ties: Not less than 7/8-inch wide by approximately 7 inches long and not lighter than 22 gage.

b. Rigid Steel Anchors: Not less than 1 1/2 inches wide, 3/16, an 24 inches long with each end bent not less than 2 inches.

c. Dovetail Flat Bar or Wire Anchors: Flat bar: sheet steel, not lighter than 16 gage, and 7/8-inch wide, with end turned up 1/4 inch. Wire: not lighter than 6 gage, 7/8-inch wide with wire looped and closed. Dovetail slots and inserts are specified in Section 03300, "Cast-in-Place Concrete."

2.3.3 Fastenings

Build in bolts, metal wall plugs, and other metal fastenings furnished under other sections for securing furring and other items.

2.3.4 Reinforcing Bars

ASTM A 615 or ASTM A 616/A 616M.

2.3.5 Through-Wall Flashing

Provide one of the following types except that flashing indicated to terminate in reglets shall be metal or coated-metal flashing and except that the material shall be one which is not adversely affected by dampproofing material.

a. Coated-Copper Flashing: 16-ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, elastic bituminous compound. Factory apply coating to a weight of not less than 6 ounces per square foot (approximately 3 ounces per square foot on each side).

2.3.6 Wicking for Weep Holes

Fiberglass, 1/4 inch in diameter, each piece not less than 18 inches long. Prefabricated aluminum, plastic or wood blocking sized to form the proper cutting, fitting, and patching to accommodate the work of others shall be performed by masonry mechanics. Cut masonry with masonry saws for exposed work. Structural steelwork, bolts, anchors, inserts, plugs, ties, lintels, and miscellaneous metalwork specified elsewhere shall be placed in position as the work progresses. Provide chases of approved dimensions for pipes and other purposes where indicated and where necessary. Cover tops of exposed walls and partitions not being worked on with a waterproof membrane secured in place and extended down at least 2 feet on both sides. Inspect scaffolding regularly to ensure that it is amply strong, well braced, and securely tied in position. Do not overload scaffolding.

3.3 MORTAR MIXING

Measure mortar materials in 1 cu. ft. containers to maintain control and accuracy of proportions. Do not measure materials with shovels. Mix mortar in a mechanical batch mixer for not less than 3 nor more than 5 minutes after all ingredients are in so as to produce a uniform mixture. Add water gradually as required to produce a workable consistency. Do not load mixer beyond its rated capacity. Keep mortar boxes, pans, and mixer drums clean and free of debris and dried mortar. Retemper mortar which has stiffened because of evaporation by adding water and mixing to obtain a workable consistency. Do not use or retemper mortar which has not been placed in final position within 2 1/2 hours after the initial mixing. Do not use antifreeze compounds, salts, or other substances to lower the freezing point of mortar.

a. Mortar: Mix mortar in accordance with ASTM C 270 to obtain type mortar required. Where colored mortars are required, pigments may be added at the site or provided as part of prepackaged mortar mix. When masonry cement is provided, conform to masonry cement manufacturer's printed mixing instructions. During mixing, add water-repellant admixture in quantity recommended by the admixture manufacturer to mortar which will be used in exterior concrete masonry unit walls.

b. Grout: ASTM C 476. Provide fine grout in grout spaces less than 2 inches in any horizontal dimension or in which clearance between reinforcing and masonry is less than 3/4 inch. Provide coarse grout in grout spaces 2 inches or greater in all horizontal dimensions provided the clearance between reinforcing and masonry is not less than 3/4 inch.

3.4 MORTAR JOINTS

Uniform thickness of 3/8-inch unless otherwise indicated. Tool exposed joints slightly concave with a round or other suitable jointer when the mortar is thumbprint hard. For horizontal joints, jointers shall be at least 12 inches long for brickwork and 16 inches long for concrete masonry. Jointers shall be slightly larger than the width of the joint so that complete contact is made along the edges of the units, compressing and sealing the surface of the joint. Strike flush joints that will not be exposed. Tool vertical joints first. Brush joints to remove all loose and excess mortar. Horizontal joints shall be level; vertical joints shall be plumb and in alignment from top to bottom of wall within a tolerance of plus or minus 1/2 inch in 40 feet.

3.5 TOLERANCES

Masonry work shall be within the following limits:

a. Pilasters and Columns: 1/4 inch from true line.

b. Face of Brick: 1/32 inch from face of adjacent brick.

c. Face of Concrete Masonry Unit: 1/16 inch from face of adjacent unit.

d. Variation From True Plane: 1/4 inch in 10 feet and 1/2 inch maximum in 20 feet or more.

e. Variation From Plumb: 1/4 inch in each story, noncumulative and 1/2 inch maximum in two stories or more.

f. Variation From Level: 1/8 inch in 3 feet, 1/4 inch in 10 feet, and 1/2 inch maximum.

g. Variation in Wall Thickness: Plus or minus 1/4 inch.

3.6 BRICKWORK

Provide brickwork that conforms to requirements of paragraph entitled "Tolerances" of this section. Select and place brick so that better face of stretchers and headers are exposed.

a. Testing: Except during cold weather, as defined under paragraph entitled "Environmental Conditions", test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested. Ensure that each brick is nearly saturated, but surface dry when laid. During cold weather, keep masonry units dry until laid.

b. Application: Unless indicated or specified otherwise, lay brick in running bond. Completely fill joints between bricks with mortar. Form bed joints of a thick layer of mortar slightly furrowed. Form head joints by applying a full coat of mortar on the brick to be laid. Slushing of head joints will not be permitted. Lay closure bricks with mortar on each bedding surface of unit to be laid and units in place, Place brick carefully without disturbing brick previously laid. Dry or butt joints will not be permitted. Provide grouting as specified. Lay fire brick by dipping each brick in a soft mixture of fire clay and water and then rubbing the brick into place with joints as thin as practicable or provide refractory mortar with joints not more than 3/8 inch thick.

c. Brick-Faced Walls: Bond the two wythes in every sixth brick course with continuous horizontal joint reinforcement. Provide additional bonding ties spaced not more than 3 feet apart around the perimeter of and within 12 inches of all openings.

(1) Collar Joints: Fill collar joints solid with mortar as each course of brick is laid. Do not disturb units in place.

(2) Brick Sills: Lay brick on edge, slope, and project not less than 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.

d. Lay exterior wythe of brick to the height of each grout pour. Provide metal ties to prevent spreading of the wythe and to maintain vertical alignment of walls. Position reinforcing as indicated. Wire vertical reinforcing securely in position as the brickwork progresses. Use puddling rod or vibrator to consolidate the grout. The minimum clear distance between parallel bars shall be the nominal diameter of the bars; the minimum clear distance between masonry and reinforcing shall be 1/4 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together. Stagger splices in adjacent horizontal bars.

3.7 CONCRETE MASONRY UNIT WORK

Lay the first course in a full bed of mortar for the full width of the unit. Lay succeeding courses in running bond unless otherwise indicated. Form bed-joints by applying mortar to entire top surfaces of inner and outer face shells. Form head joints by applying mortar for a width of about I inch to ends of adjoining Linits. Mortar shall be of such thickness that it will be forced out of the joints as the units are placed in position. Where anchors, bolts, and ties occur within the cells of the units, place metal lath in the joint at the bottom of such cells and fill cells with mortar or grout as work progresses. Provide concrete brick for bonding walls, working out the coursing, topping out walls under sloping slabs, distributing concentrated loads, backing brick headers, and elsewhere as required. Do not dampen concrete masonry units before or during laying.

b. Reinforced Concrete Masonry Unit Walls: Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.8 BONDING AND ANCHORING

Unless indicated otherwise, extend partitions from the floor to the bottom of the construction above. Structurally bond or anchor walls and partitions to each other and to concrete walls, beams, and columns. Securely anchor non-load-bearing partitions and interior walls to the construction above as indicated in a manner that provides lateral stability while permitting unrestricted deflection of construction above. Completely embed anchors in mortar joints.

a. Corners of Load-Bearing Walls: Provide a true masonry bond in each course, except where indicated or specified otherwise.

b. Intersections of Load-Bearing Walls: Provide a true masonry bond in each course, or anchor with rigid steel anchors not more than 2 feet apart vertically, unless otherwise indicated.

c. Masonry Walls Facing or Abutting Concrete Members: Anchor masonry to concrete with dovetail or wire-type anchors inserted in slots or inserts built into concrete. Locate anchors not more than 18 inches o.c. vertically and not more than 24 inches o.c. horizontally.

3.9 THROUGH-WALL FLASHING

Provide as indicated. Unless indicated otherwise, extend flashing from a point 1/4-inch outside of exterior face of walls, upward in collar joint across wall cavity not less than 6 inches and into reglets mortar of bed joint for exterior wythe. Bend down exterior edge to form a drip. Flashing shall be terminated 3/4-inch back from interior face of walls and turned back on itself not less than 1/2-inch extended beyond interior face of wall and turned up not less than 2 inches. Secure flashing in reglets to ensure a permanent watertight joint as indicated. Provide flashing in lengths as long as practicable. Lap ends not less than 1-1/2 inches for interlocking type and 4 inches for other types. Seal laps as necessary to ensure watertight construction. Provide dams at ends of flashing where masonry abuts concrete and where flashing ends within the masonry.

3.10 WEEP HOLES

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior. Weep holes shall be open head joints 24 inches o.c., clear round holes not less than 1/4 inch in diameter and 24 inches o.c.

3.11 HORIZONTAL JOINT REINFORCEMENT

Provide reinforcement where indicated in every other course and in the first two courses above and below openings in walls and partitions of concrete masonry units. Reinforcement shall be continuous except at control joints and expansion joints. Reinforcement above and below openings shall extend not less than 24 inches beyond each side of openings. Provide reinforcement in the longest available lengths, utilizing the minimum number of splices. Overlap ends not less than 6 inches. Provide welded L-shaped assemblies and welded T-shaped assemblies to match the straight reinforcement, at corners and intersections of walls and partitions. Provide mortar cover for the wire of at least 5/8 inch for exterior face of wall and 1/2 inch for interior face of wall.

3.12 CONCRETE MASONRY UNIT LINTELS AND BOND BEAMS

Provide special units, fill cells solidly with grout or concrete, and provide not less than two No. 5 reinforcing bars, unless indicated otherwise. Reinforcing shall overlap a minimum of 40 bar diameters at splices. Terminate bond beams and reinforcing on each side of expansion joints and control joints. Concrete masonry units provided for linters and bond beams shall have exposed surfaces of the same material and texture as the adjoining masonry units. Lintels shall be straight and true and shall have at least 8 inches of bearing at each end. Allow linters to set at least 6 days before shoring is removed.

3.13 CONTROL JOINTS

Provide where indicated in concrete masonry-unit walls. Provide sawed type or built-in type as required. Joints shall occur directly opposite each other on both faces of the wall and shall be filled with sealant as a properly formed synthetic rubber or vinyl plastic sealing strip as indicated.

3.14 EXPANSION JOINTS

Provide where indicated in brick walls. Fill joints with a permanently flexible preformed filler material and a sealant as specified in 3.13 above.

3.15 GROUT PLACEMENT

Place grout from the interior side of walls, unless approved otherwise. Protect sills, ledges, offsets, and other surfaces from grout droppings. Remove grout from such surfaces immediately. Grout shall be well mixed to prevent segregation and shall be sufficiently fluid to flow into joints and around reinforcing without leaving voids. Place grout by pumping or pouring from buckets equipped with spouts in lifts not exceeding 4 feet. Keep pours at 1-1/2 inches below top of masonry units in top course, except at finish course. Float bricks into grout to a position not less than 1/2 inch nor more than 2 inches from surrounding bricks. Puddle or agitate grout thoroughly to eliminate voids. Remove masonry displaced by grouting operation and re-lay in alignment with fresh mortar.

3.16 FORMS AND SHORING

Construct to the shape, lines, and dimensions of members indicated and make sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry. Do not remove until members have cured.

3.17 PARGING

Parge outside of masonry basement walls in contact with earth with two coats of Type M mortar, each 3/8-inch thick. Cross-scratch first coat and allow to cure at least 24 hours. Trowel smooth second coat, bevel at top, and cove out to edge of footing. Extend parging not more than 4 inches above grade, unless indicated otherwise, and keep damp for at least 3 days.

3.18 CLEANING

3.18.1 Protection

During cleaning operations, protect work which may be damaged, stained, or discolored.

3.18.2 Pointing

Upon completion of masonry work and before cleaning, cut out defective mortar joints and tuck point joints and all holes solidly with prehydrated mortar.

3.18.3 Cleaning

Clean exposed masonry surfaces with clear water and stiff fiber brushes and rinse with clear water. Where stains, mortar, or other soil remain, continue scrubbing with warm water and detergent. Where soil still remains on brickwork, continue cleaning as follows: Thoroughly wet exposed surfaces of dark-colored brickwork with clear water and scrub with stiff fiber brushes and a solution of not more than 1 part of muriatic acid to 9 parts of water applied to an area of 15 to 20 square feet at a time. Clean light-colored brickwork surfaces with non-acid or buffered-acid cleaners as recommended by the brick manufacturer. Use cleaners in accordance with the instructions and recommendations of the brick and cleaner manufacturers. Immediately after cleaning each area, rinse thoroughly with clear water. Restore damaged, stained, and discolored work to original condition or provide new work.

-- End of Section --

SECTION 04230

REINFORCED MASONRY

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 315	1992 Details and Detailing of Concrete Reinforcement
ACI 318	1992 Building Code Requirements for Reinforced Concrete
ACI 530.1	1992 Masonry Structures (ASCE 6-92)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	1990 (Rev. A) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153	1982 (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 185	1990 (Rev. A) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 497	1990 (Rev. B) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 525	1991 (Rev. B) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 615	1990 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 617/A 617M	1990 Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 641	1991 Zinc-Coated (Galvanized) Carbon Steel Wire

ASTM A 706/A 706M	1990 Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM B 370	1988 Copper Sheet and Strip for Building Construction
ASTM C 55	1985 Concrete Building Brick
ASTM C 62	1991 (Rev. B) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 90	1990 Load-Bearing Concrete Masonry Units
ASTM C 94	1991 (Rev. A) Ready-Mixed Concrete
ASTM C 129	1985 (R 1990) Non-Load-Bearing Concrete Masonry Units
ASTM C 216	1991 (Rev. C) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	1991 (Rev. A) Mortar for Unit Masonry
ASTM C 476	1991 Grout for Masonry
ASTM C 652	1991 (Rev. C) Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
ASTM C 744	1973 (R 1985) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	1991 Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 920	1987 Elastomeric Joint Sealants
ASTM C 1019	1989 (Rev. A) Sampling and Testing Grout
ASTM C 1072	1986 Masonry Flexural Bond Strength
ASTM C 994	1971 (R 1982) Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D 1056	1985 Flexible Cellular Materials - Sponge or Expanded Rubber

ASTM D 2287	1981 (R 1988) Non-rigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 447	1984 (R 1991) Compressive Strength of Masonry Prisms
ASTM E 514	1990 Water Penetration and Leakage Through Masonry

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC	Uniform Building Code

PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	1985 Quality Control for Plants and Production of Precast and Prestressed Concrete Products

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Anchors, ties

b. Wire reinforcement

c. Movement joints

1.2.2 SD-04, Drawings

a. Details of steel reinforcement

b. Lintels

1.2.2.1 Details of Steel Reinforcement

Provide drawings showing all fabrication dimensions and locations for placing of the reinforcing steel and accessories.

1.2.3 SD-08, Statements

a. Cold weather installation

b. Hot weather installation

Submit procedures for meeting the requirements for installation under cold or hot weather conditions.

1.2.4 SD-10, Test Reports

a. Unit strength method

b. Prism test

c. Mortar properties

d. Grout

e. Water-repellant admixture

1.2.4.1 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method", ACI 530.1. Submit calculations and certifications of unit and mortar strength.

1.2.4.2 Prism Test

Submit test reports on three prisms in accordance with ASTM E 447, Method B modified as specified in ACI 530.1.

1.2.5 SD-11, Factory Test Reports

a. Concrete masonry units

b. Clay or shale bricks

c. Mortar and grout admixtures

1.2.5.1 Mortar and Grout Admixtures

Submit test reports indicating that mortar and grout properties are as specified when the admixtures are used.

1.2.6 SD-12, Field Test Reports

a. Grout strength

b. Mortar strength and properties

1.2.7 SD-13, Certificates

a. Concrete masonry units

b. Clay or shale bricks

c. Movement joints

d. Masonry inspector

1.2.8 SD-14, Samples

a. Concrete masonry units G

b. Brick units G

c. Colored mortar G

d. Precast concrete finish G

1.2.8.1 Brick Units and Concrete Masonry Units

Submit five stretcher units showing full range of color and texture and one of each special shape.

1.2.8.2 Colored Mortar

Submit sample of colored mortar with applicable masonry unit.

1.2.9 SD-16, Sample Panels

a. Sample panel

1.3 QUALITY ASSURANCE

1.3.1 Inspection

Employ a qualified masonry inspector approved by the Contracting Officer in addition to the Contractor Quality Control Representative to perform continuous inspection of the masonry work. Acceptance by a State or municipality having a program of examining and certifying masonry inspectors will be considered adequate qualification. The masonry inspector shall be at the site continuously during masonry construction.

1.3.2 Sample Panel

After material samples are approved, and prior to starting masonry work, construct one sample panel of each type and color of masonry for approval by Contracting Officer. Do not build sample panels as part of structure, but locate where directed. Provide panels not less than 4 feet long by 4 feet high, except that prefaced concrete masonry unit panels may be 4 feet long by 2 feet high. Construct panels which show full color range, texture, bond, pattern, mortar joints including tooling, anchors, joint reinforcement, wall ties, reinforcing bars, grouting, and cleaning of masonry. If a sealer is specified, apply to sample panel. Use approved sample panels as standard of workmanship. Protect from weather and construction operations until masonry work is complete and approved. Remove sample panels after completion of work.

1.3.3 Appearance

After work has started, do not change source of materials if appearance of finished work would be affected.

1.3.4 Testing

ACI 530.1, "Quality Assurance" except that the cost of the testing shall be paid by the Contractor.

1.4 DELIVERY, STORAGE, AND HANDLING

a. Handle masonry units to avoid chipping and breaking. Deliver cement and lime in unbroken bags, barrels, or other sealed containers. Plainly mark and label containers with manufacturer's name and brand.

b. Protect masonry units from contact with the soil. Protect moisture-controlled units from rain or ground water. Keep anchors, ties, and reinforcement free of loose rust and scale. Keep cementitious materials dry. Store and handle cement to prevent inclusion of foreign materials. Store aggregates in a manner to avoid contamination or segregation.

1.5 SPARE VIBRATOR

Maintain at least one spare vibrator on site at all times.

1.6 BRACING AND SCAFFOLDING

Provide all bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

2.1.1 Hollow Load Bearing Units

ASTM C 90, (Type 1), normal weight. Nominal size 16" x 8" x 8".

2.1.3 Concrete Building Brick

ASTM C 55, (Type I), Grade (S). Nominal size 16" x 8" x 8".

2.1.4 Prefaced Concrete Units

ASTM C 744.

2.2 CLAY OR SHALE BRICKS

2.2.1 Building Brick

ASTM C 62, Grade (MW). Nominal size 7 5/8" x 3 5/8" x 3 5/8".

2.2.2 Facing Brick

ASTM C 216, Type FBX.

2.3 MORTAR

2.3.1 Mortar Properties

ASTM C 270, Type S. Strength (f'm) as indicated. Test in accordance with ASTM C 780. Use Type I portland cement. Use Type IPM blended hydraulic cement.

2.3.2 Admixtures

Do not use admixtures containing chlorides.

2.3.2.1 Air Entrainment

When structural reinforcement is incorporated, maximum air-content 12 percent in cement-lime mortar and 18 percent in masonry cement mortar.

2.3.2.2 Water-Repellant Admixture

Polymeric type formulated to reduce porosity and water transmission. When tested in accordance with ASTM C 1072, panel shall have flexural strength not less than that specified or indicated. When tested in accordance with ASTM E 514, panel shall exhibit no water visible on back and through the panel after 24 hours. Not more than 25 percent of wall area shall be damp after 72 hours.

2.3.2.3 Lime Alternates

Lime alternates which have a current ICBO, ICBO UBC, Evaluation Report number whose findings state it may be used as an alternate to lime for Type M, S, N, and O mortars will be deemed acceptance provided the user follows the manufacturer's proportions and mixing instructions as set forth in report.

2.3.4 Water

Water for mixing shall be potable.

2.4 GROUT

ASTM C 476, fine coarse. Slump between 8 and 11 inches. Provide minimum grout strength of 2000 psi in 28 days, as tested by ASTM C 1019.

2.4.1 Admixtures

Do not use air-entrainment, anti-freeze or chloride admixtures.

2.4.2 Ready Mixed Grout

ASTM C 94.

2.5 ANCHORS, TIES

Stainless steel, ASTM A 167 Type 304, or zinc-coated steel, galvanized after fabrication, ASTM A 153, B-2, for wire not totally embedded. Optionally, for completely embedded wire, ASTM A 641, Class 1 or 3. Provide cavity wall ties with integral drip located in cavity. Do not use corrugated wall ties.

a. Plate, headed and bent bar anchors, ASTM A 36/A 36M.

b. Sheet metal anchors and ties, ASTM A 366/A 366M, ASTM A 525.

c. Wire mesh ties, ASTM A 185.

d. Wire ties and anchors, ASTM A 82.

2.5.1 Wire Reinforcement

2.5.1.1 Horizontal Joint Reinforcement

Fabricate from cold drawn steel wire, ASTM A 82. Hot-dip galvanize after fabrication, ASTM A 153, B-2. Provide ACI 530.1 truss type reinforcement with two or more longitudinal wires welded to continuous diagonal cross wire, or ladder type with perpendicular cross wires not more than 16 inches o.c.

2.5.1.2 Wire Fabric

ASTM A 185 smooth, ASTM A 497 deformed.

2.6 REINFORCING BARS

2.6.1 Bars

ASTM A 615, ASTM A 616/A 616M, ASTM A 617/A 617M, or ASTM A 706/A 706M.

2.6.2 Fabrication

ACI 530.1.

2.6.3 Bar Positioners

Provide positioners that prevent displacement of reinforcing during construction.

2.7 PRECAST CONCRETE ITEMS

PCI MNL-116. Provide lifting devices for items weighing over 80 pounds.

2.7.1 Design

ACI 318 for flexural and shear strength. Concrete shall have a minimum 28-day compressive strength of 3000 pounds per square inch using 1/2 inch to No. 4 nominal-size coarse aggregate. Reinforcement ASTM A 615, Grade 60. Limit lintel deflection due to dead plus live load to L/600 or 0.3 inches. Provide top and bottom bars for lintels over 36 inches in length. Provide 1 1/2 inch minimum cover, top and bottom.

2.7.2 Exposed Surfaces

Provide standard grade surface finish.

2.7.3 Sills

Cast sills with washes. Cast sills for windows and mullions in sections with head joints at mullions and 1/4-inch allowance for mortar joints. Provide rounded nosings on treads of exterior door sills. Roughen ends of sills, except for 3/4-inch-wide margin at exposed surfaces, for bond. Reinforce sills with not less than two No. 4 bars.

2.7.4 Lintels

Maintain minimum clearance of 3/4 inch between reinforcement and interior faces of units. Reinforce for full length and sufficient length beyond end of item to allow splicing or tying to building reinforcement. Provide splices per ACI 315.

2.7.4 Splash Blocks

Provide splash blocks approximately 36 inches long, 14 inches wide, and 8 inches deep, with 4-inch depression formed in top surface to drain away from building, reinforced as standard with manufacturer.

2.8 PREFABRICATED MASONRY ELEMENTS

ASTM C 901. Mark panels for proper location and orientation.

2.9 THROUGH-WALL FLASHING

2.9.1 Copper

ASTM B 370, 16 ounce minimum. Provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations. Use lead-free solder.

2.10 MOVEMENT JOINTS

2.10.1 Contraction Joint Material

2.10.1.1 Rubber Shear Key

ASTM D 2000, 2AA-805. Minimum durometer hardness of 80.

2.10.1.2 PVC Shear Key

ASTM D 2287, Type PVC 654-4. Minimum durometer hardness of 85.

2.10.1.3 Elastomeric Joint Sealant

ASTM C 920.

2.10.1.4 Joint Detail

Size and shape indicated.

2.10.2 Expansion Joint Material

ASTM D 994, ASTM D 1056 Class RE 41, ASTM C 920. Resistant to oils and solvents.

2.10.2.1 Joint Detail

Size and shape indicated.

2.11 INSERTS FOR WEEP HOLES

Prefabricated aluminum, plastic or wood blocking sized to form the proper size opening in head joints. Provide aluminum and plastic inserts with grill or screen-type openings designed to allow the passage of moisture from cavities and to prevent the entrance of water or insects.

PART 3 EXECUTION

3.1 INSPECTION

Prior to start of work, masonry inspector shall verify the foundation conditions listed in ACI 530.1.

3.2 SPECIAL PREPARATION

3.2.1 Cold Weather Installation

When either of the following conditions exist:

a. Ambient temperature falls below 40 degrees F, or

b. Temperature of masonry units is below 40 degrees F, implement cold weather procedures of ACI 530.1.

3.2.2 Hot Weather Installation

When either of the following conditions exist:

a. Ambient air temperature exceeds 100 degrees F, or

b. Ambient air temperature exceeds 90 degrees F and wind velocity is more than 8 m.p.h., implement hot weather procedures of ACI 530.1.

3.3 ERECTION OF MASONRY UNITS

3.3.1 Mortar

Mix all cementitious materials and aggregates between 3 and 5 minutes in mechanical batch mixer with sufficient amount of water to produce workable consistency. Do not hand mix without approval of Masonry Inspector. Do not retemper after 2 1/2 hours. Do not retemper colored mortar.

3.3.1 Bond

Construct masonry in running overlap bond pattern. Construct masonry in bond pattern indicated.

3.3.2 Solid Units

ACI 530.1, place with fully mortared bed and head joints.

3.3.3 Hollow Units

ACI 530.1.

3.3.4 All Units

a. Place clean units while mortar is soft and plastic. Any unit disturbed to the extent that initial bond is broken shall be removed and relaid in fresh mortar.

b. Cut exposed edges or faces of masonry units smooth or position so that all exposed faces or edges are unaltered manufactured surfaces.

c. At end of each day, cover new work. Step back masonry; do not tooth.

3.3.4 Tolerances

ACI 530.1.

3.3.5 Prefabricated Units

Erect as indicated.

3.3.6 Embedded Items and Accessories

a. Construct chases as masonry units are laid.

b. Coordinate installation of pipes and conduits passing through walls, piers, or beams as indicated. Use steel sleeves where indicated.

c. Install and secure anchors, flashing, weep holes, nailing blocks, and other accessories as indicated.

3.3.7 Bed and Head Joints

Joints shall be 3/8 inch thick, except that bed joint of starting course placed over foundations may be 1/4 inch to 3/4 inch thick.

3.3.8 Finishing Joints

a. In exposed and below grade masonry, fill holes created by line pins with mortar.

b. Tool joints with round or vee jointer when mortar is thumbprint hard. After joints are tooled, trim off mortar burrs with trowel. Tool the exterior joints of the interior wythe of cavity walls.

c. Remove masonry protrusions extending 1/2 inch or more into cells or cavities to be grouted.

3.3.9 Collar Joints

Solidly fill collar joints less than 3/4 inch wide with mortar as job progresses.

3.3.10 Through-Wall Flashing

Provide as indicated and at all obstructions such as bond beams, sills, lintels, and concrete tie beams. Extend flashing from a point 1/4-inch outside of exterior face of walls, upward in collar joint across wall cavity not less than 6 inches and into reglets mortar of bed joint for backing wythe. Bend down exterior edge to form a drip. Flashing shall be terminated 3/4-inch back from interior face of walls and turned back on itself not less than 1/2-inch extended beyond interior face of wall and turned up not less than 2 inches. Secure flashing in reglets to ensure a permanent watertight joint as indicated. Provide flashing in lengths as long as practicable. Lap ends not less than 1 1/2-inches for interlocking type and 4 inches for other types. Seal laps as necessary to ensure watertight construction. Provide dams at ends of flashing where masonry abuts concrete and where flashing ends within the masonry.

3.3.11 Weep Holes

Wherever through-wall flashing occurs, provide weep holes spaced 20 inches o.c. for brick faced walls. Weep holes shall be full open head joints for brick-faced walls and 2 inch high minimum open head joints for masonry unit construction.

3.4 REINFORCEMENT

3.4.1 Preparation

At time mortar or grout is placed, all reinforcement shall be free of mud, oil or other materials that might reduce bond.

3.4.2 Placing Tolerances

a. Place steel in walls and flexural elements within 1/2 inch when the distance (d) from centerline of steel to opposite face of masonry is equal to 8 inches or less, within 1 inch for d between 8 and 24 inches, and within 1 1/2 inches when d is greater than 24 inches.

b. Place vertical bars in wall within 2 inches of indicated location along length of wall.

c. Bars may be moved as necessary to avoid interference with other reinforcing, conduits, or embedded items. If bars are moved more than specified tolerance, notify Contracting Officer for approval for resulting arrangement.

3.4.3 Securing Reinforcement

Support and fasten reinforcement to prevent displacement by construction loads or placement of grout or mortar. Lap or hook corner bars.

3.4.4 Details of Reinforcement

a. Clear distance between reinforcing bars and any face of masonry unit or formed surface, shall be as indicated but not less than 1/2 inch.

b. Get approval from Contracting Officer for all splices not indicated.

c. Do not bend embedded reinforcement.

d. Place joint reinforcement so that longitudinal wires are embedded in mortar with minimum cover of 1/2 inch when not exposed to weather or earth and 5/8 inch when exposed to weather or earth.

3.4.5 Wall Ties

Embed ends of wall ties in mortar joints.

3.4.5.1 Hollow Units

Wall tie ends shall engage outer face shells by at least 1/2 inch.

3.4.5.2 Solid Units

Embed wire wall ties at least 1-1/2 inch into mortar bed.

3.4.5.3 Minimum Number of Ties

Bond with No. 9 gage ties, one tie per 2.67 square feet. Bond wythes with 3/16 inch diameter ties, one tie per 4.50 square feet. Maximum spacing between ties, 36 inches horizontally and 24 inches vertically. The spacing for ties with an integral drip shall be one-half the spacing given.

3.4.5.4 Adjustable Ties

a. Use one tie for each 1.77 square feet of wall area.

b. Do no exceed 16 inch spacing horizontally or vertically.

c. 1-1/4 inch maximum misalignment of bed joints from one wythe to the other.

d. 1/16 inch maximum clearance between connecting parts of ties.

e. Ties shall have at least two 3/16 inch diameter pintle legs.

3.5 DAMPPROOFING

Apply dampproofing to the cavity face of the interior concrete block wythe. Parge the first laid wythe with minimum 3/8 inch coat of Type S mortar.

3.6 GROUTING

3.6.1 Preparation

Ensure that spaces to be grouted are free of mortar droppings, debris, loose aggregates and any material deleterious to masonry grout. Reinforcement and ties shall be in place before grouting.

3.6.2 Cleanouts

a. When grout pour exceeds 5 feet in height, provide cleanouts in bottom course of masonry in each grout pour.

b. Provide 3 inch minimum cleanout openings.

c. After cleaning, close cleanout openings and brace to resist grout pressure.

3.6.3 Placing Time

Place grout within 1-1/2 hours of introducing water to mixture. Sample and test grout, ASTM C 1019, for each 5,000 square feet of wall.

3.6.4 Pour Height

ACI 530.1.

3.6.5 Lift Height

Place grout in lifts not exceeding 5 feet. For 8 inch block wall, maximum lift is 2 feet.

3.6.6 Consolidation

Consolidate grout at time of placement.

a. Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.

b. Consolidate pours exceeding 12 inches in height by mechanical vibration. Reconsolidate by mechanical vibration after initial water loss and settlement have occurred.

3.7 FIELD QUALITY CONTROL

3.7.1 Mortar Strength and Properties

ASTM C 780, for the first 3 consecutive days, and each third day thereafter.

3.7.2 Grout Strength

ASTM C 1019, for the first 3 consecutive days, and each third day thereafter, or each batch of ready mixed grout.

3.7.3 Prism Test

Make at least one prism test sample for each 5,000 square feet of wall, but not less than three such samples for any building.

3.8 CLEANING

a. Keep exposed surfaces clean during construction. Avoid smearing mortar on face of units.

b. Clean masonry with potable water. Detergents may be used.

c. Do not use acid, caustic solutions, or sandblasting.

d. Masonry shall be free of stains, efflorescence, mortar or grout droppings, and debris.

-- End of Section --

SECTION 07530

ELASTOMERIC SHEET ROOFING SYSTEM (EPDM)

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 448	1986 Sizes of Aggregate for Road and Bridge Construction
ASTM D 4637	1987 Valcanized Rubber Sheet Used in Single-Ply Roof Membrane
ASTM E 108	1991 (Rev. A) Fire Tests of Roof Coverings

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM D/STAB1-29	1984 (R 1986) Loose Laid Ballasted Single Ply Roof Coverings
FM P7825	1992 Approval Guide

SINGLE PLY ROOFING INSTITUTE (SPRI)

SPRI RP 4	1988 Wind Design Guide for Ballasted Single Ply Roofing Systems

UNDERWRITERS LABORATORIES INC. (UL)

UL RMSD	1992 Roofing Materials and Systems Directory
UL 790	1983 Fire Resistance of Roof Covering Materials

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, Submittals.

1.2.1 SD-02, Manufacturer's Catalog Data

a. EPMD sheet

b. Adhesive

c. Fasteners

d. Water cutoff mastic water block

e. Lap cleaner, sealant, and edge treatment

f. Flashing

g. Flashing accessories

h. Roof insulation

Submit all date required by Section 07220, Roof Insulation, together with requirements of this section. Data shall include written acceptance by the roof membrane manufacturer of the insulation to be provided.

1.2.2 SD-04, Drawings

a. EPDM sheet

Submit membrane manufacturer's drawings indicating locations of perimeter half-sheets, spacing of perimeter and infield fasteners, and seaming data. The drawing shall reflect the project roof plan of each roof level and conditions indicated.

1.2.3 SD-06, Instructions

a. EPMD sheet

b. Adhesive

c. Water cutoff mastic water block

d. Lap cleaner, sealant, and edge treatment

e. Flashing

f. Flashing accessories

Include standard installation detail drawings where applicable.

1.2.4 SD-08, Statements

a. Qualification of applicator

Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Applicator," and include names and locations of 5 qualified installations and the roofing system manufacturer's written approval of the applicator.

1.2.5 SD-18, Records

a. Information card

b. Instructions to Government personnel

1.2.5.1 Information Card Contents

For each roofing installation, submit a typewritten card or photoengraved aluminum card containing the information listed on Form 1 located at the end of this section.

1.2.5.2 Written Instructions to Government Personnel

Submit instructions meeting the requirements of paragraph entitled "Instructions to Government Personnel" and include copies of Material Safety Data Sheets for maintenance/repair materials.

1.3 QUALITY ASSURANCE

1.3.1 Qualification of Applicator

Roofing system applicator shall be approved in writing by the EPDM sheet roofing system manufacturer and shall have a minimum of three years experience as an approved applicator with that manufacturer. Applicator shall have applied 5 installations of similar size and scope as this project, within the previous 3 years.

1.3.2 Fire Safety

Complete roof covering assembly shall:

a. Have ASTM E 108 Class 1A or UL 790 Class A classification; and

b. Be listed as part of Fire-Classified roof deck construction in the UL RMSD or Class I roof deck construction in the FM P7825.

UL approved components of the roof covering assembly shall bear the UL label.

1.3.3 Wind Uplift

Complete roof covering assembly shall be rated Class I 901 in accordance with FM P7825 capable of withstanding an uplift pressure of 901 pounds per square foot. Resistance to wind uplift for loose-laid ballasted application shall be in accordance with requirements in FM D/STAB1-29, or SPRI RP-4.

1.3.4 Preroofing Conference

After approval of submittals and before performing roofing [and insulation] work, including associated work, the Contracting Officer will hold a preroofing conference to review the following:

a. Drawings and specifications;

b. Procedure for onsite inspection and acceptance of roofing substrate and pertinent structural details relating to the roofing system;

c. Contractor's plan for coordination of work of the various trades involved in providing the roofing system and other components secured to the roofing; and

d. Safety requirements.

Preroofing conference shall be attended by the Contractor and personnel directly responsible for installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, and a representative of the roofing materials manufacturer. Before beginning roofing work, confirm in writing the resolution of conflicts among those attending the preroofing conference.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials in their original, unopened containers or wrappings with labels intact and legible. Where materials are covered by a referenced specification number, the labels shall bear the specification number, type, class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow continuity of work.

1.4.2 Storage

Store and protect materials from damage and weather in accordance with manufacturer's instructions, except as specified otherwise. Keep materials clean and dry. Use pallets to support and canvas tarpaulins to completely cover stored material. Do not use polyethylene as a covering. Locate materials temporarily stored on the roof in approved areas, and distribute the load to stay within the live load limits of the roof construction. Remove unused materials from the roof at the end of each days work.

1.4.3 Handling

When hazardous materials are involved, adhere to the special precautions of the manufacturer. Adhesives may contain petroleum distillates and may be extremely flammable; prevent personnel from breathing vapors, and do not use near sparks or open flame. Do not use materials contaminated by exposure to moisture. Remove contaminated materials from the site.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not install EPDM sheet roofing during high winds or inclement weather, or when there is ice, frost, moisture, or visible dampness on the substrate surface. Unless recommended otherwise by the EPDM sheet manufacturer, do not install EPDM sheet when air temperature is below 40 degrees F or within 5 degrees F of the dewpoint.

1.6 WARRANTY

Furnish the roofing manufacturer's premium warranty for the roofing system, including insulation, flashing, and accessories. The warranty shall run directly to the Government. In no event shall the warranty period be less than 10 years from the date of the Government's acceptance of the work, notwithstanding roofing applicator's or manufacturer's unpaid invoices for installation, supplies, or service. The warranty shall state that:

a. When within the warranty period the EPDM sheet roofing system becomes nonwatertight, splits, tears, or separates at the seams because of defective materials and workmanship, the repair or replacement of defective materials and correction of defective workmanship shall be the responsibility of the roofing manufacturer;

b. When the manufacturer or the manufacturer's approved applicator fail to perform repairs within 72 hours of notification, emergency repairs performed by others will not void the warranty; and

c. Damage to the EPDM roofing system caused by sustained winds having a velocity of 55 miles per hour or less is covered by the warranty.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 EPDM Sheet

ASTM D 4637. Ethylene Propylene Diene Terpolymer (EPDM), reinforced, 0.045 inch minimum thickness for loose-laid ballasted, mechanically fastened application. Width and length of sheet shall be as recommended by the manufacturer for the exact size of each building's roof.

2.1.2 Adhesive

As supplied and warranted by EPDM sheet manufacturer and recommended by EPDM manufacturer's printed data.

2.1.3 Lap Cleaner, Sealant, and Edge Treatment

As supplied by EPDM sheet manufacturer and recommended by EPDM sheet manufacturer's printed data.

2.1.4 Water Cutoff Mastic/Water Block

As supplied by EPDM sheet manufacturer and recommended by EPDM sheet manufacturer's printed data.

2.1.5 Flashing and Flashing Accessories

Flashing, including perimeter flashing, flashing around roof penetrations, and prefabricated pipe seals, shall be 0.06 inch minimum thick uncured EPDM sheet or 0.045 minimum thick cured EPDM, as recommended by the EPDM sheet manufacturer's printed data.

2.1.6 Fasteners

As supplied and warranted for the substrate type(s) by EPDM sheet manufacturer and recommended by EPDM sheet manufacturer's printed data.

2.1.7 Ballast Aggregate

Smooth, river-washed stone, except as recommended otherwise by the EPDM sheet manufacturer and graded in accordance with ASTM D 448, sizes 1, 2, 24, 3, and 4.

2.1.8 Ballast Pavers

Precast concrete not less than one-inch thick and no less than one foot in length and width and without sharp edges and projections.

2.1.9 Precast Concrete Paver Block Walkways

Provide either of the following:

2.1.9.2 Precast Concrete Paver Block

Precast concrete blocks, sized as indicated, without sharp edges and projections, and weighing no more than 80 pounds each.

2.1.10 Roof Insulation Below EPDM Sheet

Insulation shall be compatible with EPDM sheet as recommended in EPDM manufacturer's printed instructions. Facers of the insulation shall be a type permitting both fully adhered and mechanically fastened methods of membrane attachment.

PART 3 EXECUTION

3.1 PREPARATION

Coordinate work with that of other trades to ensure that components which are to be incorporated into the roofing system are available to prevent delays or interruptions as the work progresses. Examine substrates to which the roofing materials are to be applied to ensure that their condition is satisfactory for its application. Do not permit voids greater than 1/4 inch wide in the substrate. Concrete substrates shall be cured and free of laitance and curing compounds. Install wood blocking at perimeters, curbs, and penetrations. Substrates for roofing materials shall be dry and free of oil, dirt, grease, sharp edges, and debris. Inspect substrates, and correct defects before application of elastomeric sheets.

3.2 APPLICATION

Apply entire EPDM sheet utilizing loose-laid ballasted, mechanically fastened application method(s). Apply EPDM sheet roofing in accordance with the EPDM sheet manufacturer's application instructions.

3.2.1 Special Precautions

a. Do not dilute coatings or sealants unless specifically recommended by the materials manufacturer's printed application instructions. Do not thin liquid materials with cleaners used for cleaning EPDM sheet.

b. Keep liquids in airtight containers, and keep containers closed except when removing materials.

c. Use liquid components, including adhesives, within their shelf life period. Store adhesives at 60 to 80 degrees F prior to use. Avoid excessive adhesive application and adhesive spills, as they can be destructive to some elastomeric sheets and insulations; follow adhesive manufacturer's printed application instructions.

d. Require workmen and others who walk on the membrane to wear clean, soft-soled shoes to avoid damage to roofing materials.

e. Do not use equipment with sharp edges which could puncture the EPDM sheet.

3.2.2 Work Sequence

Arrange work to prevent use of newly constructed roofing for storage, walking surface, or equipment movement. Where access is necessary, provide temporary walkways, platforms, or runways to protect new roofing surfaces and flashings from mechanical damage.

3.2.3 EPDM Sheet Roofing

Unroll EPDM sheet roofing in position without stretching membrane. Inspect for holes. Remove sections of EPDM sheet roofing that are damaged. Allow sheets to relax at least 30 minutes before seaming. Lap sheets a minimum of 3 inches.

3.2.3.1 Loose-Laid Application

Lap adjoining sheets according to instructions of EPDM sheet manufacturer. Clean the membrane splice area using a recommended cleaner and lint-free applicator. Seal seams using adhesive in accordance with EPDM sheet manufacturer's printed instructions. Check seams to ensure continuous seal before proceeding with further work. Apply continuous lap edge treatment to seam edges to completely cover the lapped edges of all seams.

3.2.3.2 Perimeter Fastening

Mechanically secure EPDM sheet at roof perimeter and penetrations with specified fasteners. Space fasteners a maximum of 8 o.c., except as recommended otherwise by EPDM sheet manufacturer's printed data. Flash over fasteners with a fully adhered layer of material as recommended by EPDM sheet manufacturer's printed data.

3.2.3.3 Temporary Work

Install temporary cutoffs around incomplete edges of roofing assembly at the end of each day's work and when work must be postponed due to inclement weather. (Temporary cutoffs provide protection against moisture infiltration and absorption.) Straighten insulation line using pieces of insulation loosely laid, and seal EPDM sheet to deck. Seal metal deck ribs as part of the cutoff. Remove temporary seals completely when work resumes. Provide temporary ballast on roofing as necessary to prevent wind damage to EPDM sheet.

3.2.4 Flashing

Install flashing as roofing sheets are installed in accordance with printed instructions of EPDM sheet manufacturer. Extend base flashing not less than 8 inches above roofing surface. Completely adhere flashing sheets in place. Provide prefabricated pipe seals at pipe penetrations where possible, otherwise field-fabricate seals to conform to requirements specified in paragraph entitled "Flashing and Flashing Accessories".

3.2.5 Ballast

Apply ballast at the following coverage rates:

a. 30 pounds per square foot for perimeter and corner areas of roof.

b. 20 pounds per square foot for field of roof.

In no case apply ballast at a coverage rate less than 10 pounds per square foot or more," than 30 pounds per square foot.

3.3 FIELD QUALITY CONTROL

3.3.1 Roof Drain Test

After completing roofing but prior to Government acceptance, perform the following test for watertightness. Plug primary roof drains and fill with water to edge of drain sump for 24 hours. Do not plug secondary overflow drains. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the 24-hour period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect the installation; repair or replace roofing at drain. Repeat the test until there is no water leakage.

3.3.2 Instructions to Government Personnel

Furnish written and verbal instructions to designated Government personnel. Instructions shall be given by a competent representative of the EPDM manufacturer and shall include a minimum of 4 hours on maintenance and emergency repair of membrane. Include demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and repair operations.

3.4 INFORMATION CARD

For each roof, provide a typewritten card, laminated in plastic for interior display, or a photoengraved 0.032-inch-thick aluminum card for exterior display. Card shall be 8 1/2 by 11 inches minimum and contain the information listed on Form 1 located at end of this section. Provide card to Earle, NWS Environmental Department and to NORTHNAVFACENGCOM, Code 103A, 10 Industrial Highway, Mail Stop #82, Lester, PA 19113-2090.

-- End of Section --

FORM 1, ROOFING SYSTEM DESCRIPTION
(for Earle and Northern Divison)

1. Location_____ 2. Bldg. Name_____

3. Bldg. No._____ 4. Roof Area (SF) _____ 5. Contract No._____

6. New Construction: [ ] Yes [ ] No 7. Deck Slope:_____

8. Type of Deck:
   [ ] Metal
   [ ] Cast-In-Place Concrete
   [ ] Precast/Prestressed Concrete
   [ ] Wood Plank or Plywood
   [ ] Other _____

9. Type of Insulation Board:
   [ ] Polyisocyanurate/Composite
   [ ] Polystyrene/Composite
   [ ] Perlite
   [ ] Other _____
   [ ] Polyisocyanurate Foam
   [ ] Polystyrene
   [ ] Mineral Fiber

10. Insulation Manufacturer:_____

11. Insulation Thickness:_____

12. Vapor Treatment: Total coverage [ ] Yes [ ] No
   [ ] No Vapor Retarder
   [ ] One Way Roof Vents
   [ ] Other_____
   [ ] Bituminous Vapor Retarder
   [ ] Laminated Kraft Paper

13. Vapor Treatment Manufacturer(s): _____

14. Roofing Type:
   [ ] Built-Up (Asphalt)
   [ ] Built-Up (Coal-Tar)
   [ ] Metal
   [ ] Shingles
   [ ] PIB
   [ ] Modified Bitumen
   [ ] CSPE
   [ ] Other _____
   [ ] TPA
   [ ] EPDM
   [ ] PVC

15. Roofing Manufacturer:_____

16. Roofing Installer/Warrantor:_____

17. Roofing Application Method:
   [ ] Bitumen
   [ ] Mechanically Fastened
   [ ] Mechanically Fastened/Fully Adhered
   [ ] Fully Adhered
   [ ] Torched
   [ ] Loose-Laid Ballasted
   [ ] Other _____

18. Warranty Period: From_____ To_____

19. Warranty Serial Number:_____

20. Date Roofing Completed:_____ 21. Inspector:_____

22. Prime Contractor Name/Address:_____

Signature:_____ Date:_____

INSTRUCTIONS FOR FORM 1

1. Location: Name of activity as shown on contract.

2. Bldg. Name: As shown on contract or as provided by Contracting Officer.

3. Bldg. Number: As provided by Contracting Officer.

4. Roof Area: Area in square feet of roof for which deck insulation, membrane, etc. are the same. A separate form is required if any part of roof system is different over other areas of the roof.

5. Contract Number: As shown on the contract.

7. Show deck slope in inches per foot.

8. Deck: Check appropriate block.

9. Type of Insulation Board: Check appropriate block.

11. Show minimum thickness of installed insulation.

12. Vapor Treatment: Check appropriate block.

13. Show vapor treatment system manufacturer's name.

14. Roofing Type: Check appropriate block.

15. Show roofing manufacturer's name.

16. Roofing Installer's or Contractor's name.

17. Roofing Application Method: Check appropriate block.

18. Warranty Period: Insert start and end dates.

20. Show date roofing was accepted by the Contracting Officer. Warranty period begins on this date.

21. Show Government Inspector's name.

22. Prime Contractor Name/Address/Signature: Must be signed and dated by QC Manager an official of Contracting firm.

SECTION 13001

ENHANCED TANK MONITORING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

a. These specifications include furnishing and installing of enhanced capability monitoring systems for multiple underground liquid storage tanks and associated below-grade product piping and sumps. Complete working systems shall be provided in the quantity and locations below.

Schedule 13001-1

Building	Number of Tank Monitoring Systems	Number of Tanks
R-6	One (1)	Three (3)
C-17	Two (2)	Five (5)

b. Each system shall include all sensors, panels, remote communications equipment, IBM-PC compatible communications and reporting software. All data recorded and used to fulfill specification requirements shall be compatible using the software to ASCII format. Contractor shall be responsible to furnish, install and test each system.

c. The systems shall be a continuous underground monitoring and leak detection system that shall perform in accordance with Subpart D of 40 CFR 280.

d. These systems shall be furnished by same manufacturer as systems specified in Section 13002, Standard Tank Monitoring System.

1.2

The underground storage tank monitoring system shall meet all applicable standards and regulatory agency requirements including, but not limited to, the standards and requirements of the following:

(1) American National Standards Institute (ANSI)
(2) American Petroleum Institute (API)
(3) American Society for Testing and Materials (ASTM)
(4) Environmental Protection Agency (EPA)
(5) National Bureau of Standards (NBS)
(6) National Electrical Code (NEC)
(7) National Fire Protection Agency (NFPA)
(8) Underwriter Laboratories, Inc. (UL)
(9) Canadian Standards Association (CSA)
(10) Underground Storage Tanks: Subpart D, 40 CFR Part 280

(11) Federal Communications Commission (FCC)
(12) British Approval Service for Electrical Equipment in Flammable Atmospheres (BASEEFA)
(13) Factory Mutual (FM).

1.3 RELATED SECTIONS

The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers.

a. Section 13002 - Standard Tank Monitoring System
b. Section 13003 - Fuel Management System
c. Section 13004 - Data Processing Systems
d. Section 13005 - Soil Vapor Monitoring System
e. Section 13211 - Underground Storage Tank Retrofit
f. Section 16499 - Telephone Service and Communications

1.4 PERFORMANCE SPECIFICATION

1.4.1 In-Tank Leak Detection

a. The system shall utilize in-tank probes based on the magnetostrictive principle for liquid level measurement and in-tank leak detection.

b. The tank gauge shall be capable of performing a static tank tightness test to an accuracy of 0.1 GPH with a 99% probability of detection [P(D)] and a 1% probability of false alarm [P(FA)].

c. The system shall have a capability to automatically run a static leak test, by monitoring the activity of the submersible pump. Depending on the idle time between pumping cycles, the system will automatically run a 3.0 GPH test, a 0.2 GPH test or a 0.1 GPH test. Each successive test will start automatically upon completion of the previous test. If a dispensing transaction or a delivery takes place the system will automatically disable the test until the next appropriate idle period.

d. The system shall have a capability to be programmed to run a static 0.2 GPH quick leak test. The static leak test will take one hour and commence 30 minutes after the last dispensing cycle or five hours from the last delivery, whichever is greater.

e. The system shall have a capability to conduct automatic continuous statistical leak detection tests without the need to shut down tanks for scheduled test times.

f. The system shall continuously collect product height and temperature information from the tank and, without input from any other source, utilize dynamic pattern analysis to determine when idle periods in the tank begin and end. Idle time information thus collected shall be transferred to the systems database for qualification.

g. The system shall be capable of evaluating after each idle period the quality of information stored in the database. The idle period qualification shall consider noise factors affecting the idle time such as dispensing, deliveries, temperature changes, temperature stratification and evaporation.

h. The system shall be capable of dynamically qualifying the idle time data and selecting the best available data to perform a 0.2 GPH tank tightness evaluation.

i. The system shall employ the use of dynamic feedback variables in the algorithm to evaluate the noise factor patterns associated with a tank, thus tailoring the algorithms to each individual tank.

j. The system shall perform a new 0.2 GPH tank tightness evaluation as each new item of idle period data is added to the database.

k. The system, when operated in the continuous statistical leak detection mode, shall be third-party certified for statistical leak detection tanks up to 30,000 gallons. The test shall meet or exceed U.S. EPA standards with a 99% probability of detecting a 0.2 GPH leak and less than a 0.1% probability of false alarm. It shall meet federal, state and local compliance requirements for monthly monitoring.

l. In coordination with an ability to perform a statistical, continuous leak test, the monitoring system shall have the capability to perform a static leak test to an accuracy of 99% probability of detecting a leak and 1% probability of false alarm.

1.4.2 Containment Sump Monitoring

a. The system shall be able to perform automatic, continuous leak sensing in the containment piping sump.

b. The system shall have a capability to detect the presence of fluid (hydrocarbons and/or water) in the piping containment area and provide an alarm condition.

c. The system shall have a capability to differentiate between hydrocarbons and water and provide an alarm condition for the respective alarm. The system shall also have a capability to indicate when the sensing device has failed and is no longer providing environmental compliance.

d. The system shall have a capability to continuously monitor the integrity of he sensor for an open condition, alarm condition, or normal operating condition.

1.4.3 Environmental Compliance Reports

a. The system shall have a capability to provide a record of the last three occurrences of each type of alarm or warning condition detected by the system.

b. The system shall provide the following types of reports related to environmental compliance matters:

(1) System status messages
(2) In-tank warning and alarm messages
(3) In-tank tightness evaluation report
(4) Liquid sensor warning and alarm messages
(5) Normally-closed sensor warning and alarm conditions
(6) Hydrostatic sensor warning and alarm conditions/high or low liquid level conditions
(7) Discriminating dispenser pan and containment sump sensor warning and alarm messages
(8) Software module alarm message.

1.4.4 Product Inventory Control (Tank Gauging)

a. The tank management system shall collect product height and temperature data from up to eight magnetostrictive level sensors and compute gross and temperature-compensated net gallons. The operator may choose from inventory or delivery information to generate a complete set of inventory or delivery printed reports.

b. The system shall automatically generate a inventory increase report when a delivery of product to a tank has taken place. The report shall include the time and date of the delivery, the starting volume in the tank, the ending volume in the tank, the starting temperature of the fuel, the ending temperature of the fuel, and the inventory increase amount.

c. The system shall have a capability to store up to the ten most recent inventory increases in memory for business management purposes.

d. The system shall provide a capability to monitor aboveground storage tanks, as well as underground storage tanks, for inventory management.

1.4.5 Inventory Management Reports

a. The system shall monitor inventory in U.S. or Metric units for up to eight tanks and produce a combination of automatic and manual reports for each tank, which include the following information:

(1) Fuel volume
(2) Fuel height
(3) Water height
(4) Fuel temperature
(5) Ullage
(6) Temperature-compensated fuel volume
(7) Last inventory increase amount
(8) Last in-tank leak test results
(9) Time and date
(10) Tank identification
(11) Fuel type identification
(12) 90% ullage

b. A printout of the inventory status report shall be generated any time the operator presses the print button while the system is in the normal operating mode or generated automatically three times a day with the information stored in memory.

c. The system shall provide an automatic delivery report, programmed to print from 1 to 99 minutes after bulk delivery to a tank is complete. The information shall include station header, product label, date, starting and ending time,starting and ending volumes, temperature of the fuel as well as the net volume increase. The information shall be available in U.S. or Metric units.

d. The system shall be able to generate reports in a display/printer format as well as a computer format upon demand.

e. Communications

(1) The tank monitoring system shall provide a capability to communicate with locally attached electronic devices through an RS-232 port or remote locations via either an RS-232 port or internal modem. The system shall provide data in a display or packed computer data format.

(2) The communications protocol shall be standard serial communications protocol.

(3) The tank monitoring system shall provide all reports available on the integral printer through the communications port. These shall include all reports associated with inventory management, environmental compliance and diagnostics/troubleshooting,

(4) The system shall provide for setup and configuration through the communications port using the manufacturer's standard serial communications protocol.

f. Serial Communication

(1) The system shall provide an RS-232 communications interface for data transmission to a computer, point of sale terminal, printing device, or a modem for remote communications.

(2) The system shall provide an auxiliary RS-232 communications interface for data transmission to a computer, point of sale terminal, printing device, or a modem for remote communications, as well as linking to a second tank monitoring system.

g. Auto-Dial Site Fax Modem

(1) The tank monitoring system shall provide an internal auto-dial fax 2400/1200/300 baud, Hayes-compatible modem capable of transmitting information directly to a fax machine, PC or teletype.

(2) The auto-dial fax/modem shall include the following capabilities:

(a) Dial up to eight user-programmed phone numbers.

(b) Transmit up to 16 user-selected reports to each phone number. The reports can consist of:

- System status
- Inventory information
- Deliveries
- Tank and line leak test results
- Sensor status
- Alarm histories

(c) Programmable calling times and schedules for each of the eight phone numbers.

(d) Selectable automatic dialing to report any alarm condition immediately. The call shall be immediate on alarm occurrence, selectable by alarm type and assignable any or all of the eight user-programmed phone numbers.

(e) Selectable fax/computer/teletype compatibility.

(3) In addition to automatically dialing out at preprogrammed times or to report an alarm condition, the system shall have the ability to receive calls from a PC or terminal to query the tank monitoring system for information.

(a) The answer/receive mode shall be selectable with provisions for enabling or disabling the answer mode for telephone line sharing applications.

h. Wide Area Network Software

(1) The manufacturer shall provide one (1) IBM-PC compatible communications/database software package to poll remote tank monitoring sites from a central location. Software shall be compatible with system specified in specification Section 13002.

(2) The communications/database software shall provide the ability to communicate directly with the tank monitoring system, via a 25-pin RS-232 serial interface, or remotely via a dial-up network over the public telephone network.

(3) The software package shall provide a capability to remotely configure a system and download that information to the tank monitoring system. The software shall also provide the ability to call the tank monitoring system, upload information into the database and allow the user to make changes and transmit those changes to the system.

(4) The software shall provide a communications mode, in which it can automatically and continuously poll locations that have been designated for data retrieval.

(5) The software shall provide an immediate on-line mode to retrieve specific information from a tank monitoring system and to download setup and configuration information.

(6) The software shall be able to generate inventory and environmental compliance management reports on demand for all of the data stored or specific ranges of data.

(7) The software system shall provide the user the ability to retrieve all diagnostic data from the tank monitoring system. It shall also provide the ability to backup and recover data that has been stored.

(8) The software package shall permit the user to connect on-line with a location and enter serial communication protocol commands for information retrieval.

i. Remote Display

(1) No remote display shall be supplied, but system shall be capable of the following features.

(2) The tank monitoring system shall provide a capability to display inventory, delivery, environmental compliance and alarm data remote from the tank gauge console via a remote display.

(3) The remote display shall have a capability to be mounted up to 1000 feet away from the tank monitoring system and interface via a direct connection RS-485 interface.

(4) The remote display shall provide a audible and visual alarm indication when any leak inventory or system alarm condition is detected by the monitoring system.

(5) The remote display shall step the operator through an alarm verification procedure for 3.0 GPH line leak failures.

(6) The remote display shall allow the operator to view the following information for a single location.

(a) Inventory information
(b) Leak test data
(c) Sensor status
(d) Delivery data
(e) Alarm history
(f) System configuration
(g) Tank status

(7) The remote display shall provide detailed explanations of all menu choices, and instructions for starting and stopping in-tank and line leak tests.

(8) The remote display shall have a capability to emulate the tank monitor front panel and setup and configure important system and tank parameters.

(9) The operator shall have a capability to start and stop in-tank tests and the line leak tests from the remote display.

j. Reports

The system shall be capable to generate reports in a display/printer format as well as a computer format through the communication interface using a serial communications protocol. All reports including inventory, delivery, environmental compliance (leak detect), alarm history and status may be retrieved through remote or local communications.

1.4.6 Input/Output Devices

a. Output Relay Module

(1) The system shall provide a capability to enable the external audible/visual alarms or control external devices through a relay contact closure.

(2) The system shall provide 4 Form C contact relays per interface module.

(3) The system shall provide a capability to interface up to 8 relay output modules per system for a total of 32 relays.

(4) The system shall provide a capability to program the relay in either a Normally Open or Normally Closed orientation.

(5) The system shall provide a capability to assign in-tank, line leak, sensor, external input, or system alarm conditions to a select relay.

(6) The system shall provide a capability to designate a 20 character label to a device connected to the output relay through system programming.

b. Input/Output Combination Module

(1) The system shall provide a capability to accept an input from a external device and enable a relay to control an external device.

(2) The system shall provide 2 Form Type C contact relays per input/output module.

(3) The system shall have a capability to interface up to 8 input/output combination modules for a total of 16 inputs and 16 outputs.

(4) The system shall have a capability to define the type of input connected to the system, standard or generator.

(5) The system shall provide a capability to identify the input switch type from a stand-by generator (Normally Open or Normally Closed) to properly recognize a generator off condition.

(6) The system shall provide a capability to identify which tanks supply fuel to the generator to properly conduct continuous leak test on tanks when the generator is off.

c. Alarms

(1) The tank monitoring systems shall provide an audible and visual indication of all system, in-tank leak, product line leak and external sensor alarm conditions.

(2) The system alarm conditions shall include:

(a) Maximum product level
(b) High level limit
(c) Overfill alarm
(d) High water alarm
(e) Second high water alarm
(f) Delivery needed alarm
(g) Low limit
(h) Theft
(i) Periodic warning and alarm
(j) Annual warning and alarm

(3) The tank monitoring system shall provide an audible and visual alarm indication for in-tank leak failures (3.0 GPH, 0.1 GPH, and 0.2 GPH), line leak detect failures (3.0 GPH, 0.2 GPH and 0.1 GPH) and external sensor leak failures (fuel, water, sensor out).

(4) In conjunction with providing an audible and visual alarm, the system shall have a capability to print out all alarm conditions to the integral thermal printer.

(5) The system shall have a capability to send all alarm conditions to the RS-232 serial communications port for data transmission to a central computer. The system shall have a capability to transmit the alarm condition immediately or program a delay time before sending. The system shall also have a capability to enter a repeat function in the programming to repeat sending the alarm condition.

(6) The system shall have a capability to automatically dial out and transmit system, in-tank leak, line leak and external sensor alarm conditions to a fax machine.

(7) The system shall provide the operator with a capability to disable the audible portion of an alarm but the visual alarm shall not be disabled until the alarm condition has been corrected.

(8) The system shall provide a capability to transmit all system, in-tank leak, line leak and external sensor alarm conditions to a remote display. The remote display shall provide an audible and visual indication to the operator of an alarm condition and provide the operator a capability to acknowledge the alarm with acknowledgement switch. The external alarm box and acknowledgement switch shall be manufactured in a watertight gasketed enclosure for installation in an outdoor environment. The external alarm box and acknowledgement switch shall interface to the tank monitoring system via an internal relay.

(9) The system shall have a capability to store up to three alarm occurrences in memory. The operator shall have a capability to print the alarm history an alarm status on the integral printer as well as retrieve alarm history and alarm status through the communications interface (RS-232, or 2400/1200/300 baud auto-dial fax/modem).

In accordance with EPA guidelines a delivery truck fuel installer person is signalled when the UST is 90 percent filled.

1.4.7 Setup (Startup/Installation)

a. The system shall contain parameter-driven software to adapt the tank monitor to site specifications. The parameters must be enterable in assigned fields at the time of system startup. In addition, the parameters must be field updatable so that changes in tank diameter/dimensions as well as site specifications can be added.

b. The system shall provide the use of a security code to prohibit unauthorized entry to the systems set-up parameters. The system security code shall be a six-digit number entered through the front-panel keyboard or through the external communications interface. The security code shall have the capability of containing alpha or numeric characters.

c. A four-line, 24 character custom location header to identify the site must be user-programmable. The header must appear automatically on inventory status reports, leak detection reports and automatic delivery reports each time they are printed.

d. Set-up parameters shall include the following:

(1) System setup data
(2) Communications setup data
(3) In-tank setup data
(4) In-tank leak test setup data
(5) Pump sensor setup data
(6) Liquid sensor setup data

(7) Discriminating dispenser pan and containment sump sensor setup data
(8) External sensor setup data
(9) Output relay setup data
(10) Line disable setup data

1.4.8 Diagnostics/Troubleshooting

All diagnostic information shall be generated by the system itself. The system shall not allow the user to change or enter diagnostic information in any way. The following diagnostic information shall be included in the system:

a. Probe diagnostics

(1) Probe type
(2) Serial number
(3) Probe length
(4) Dry and wet calibration values

b. System diagnostics

(1) Software revision level
(2) Software part number
(3) Software creation date

c. In-tank diagnostics

d. In-tank leak results

e. Line leak diagnostic data

f. Liquid sensor diagnostics

g. Discriminating dispenser pan and containment sump sensor diagnostics

h. Alarm history report

1.4.9 Reports

All diagnostic information, listed in Part 1, Section 1.4.6, paragraph C, subsection (1) through (9), shall have a capability of being printed by the system's integral printer or remote PC and HS printer for hard-copy documentation and historical record keeping.

1.5 SUBMITTALS

a. Submit in accordance with Section 01330, "Submittals."

b. Shop drawings to be submitted shall describe compliance with these specifications.

c. Manufacturer's instruction manuals shall be supplied in permanent bound 3 ring binders.

d. Submit certificates detailed in paragraph 3.3, 3.4, 3.5, 3.6, and 3.7 of this specification section.

e. The manufacturer shall supply product documentation that addresses the following categories.

(1) Site preparation and installation instructions
(2) System setup instructions
(3) System operating instructions
(4) Individual sensor installation instructions
(5) Probe installation instructions
(6) Individual module installation instructions
(7) Product data sheets
(8) Troubleshooting and repair manuals
(9) Wiring diagrams which include the following:
  (a) Identification of all devices and equipment terminals, and all external connection terminal blocks.
  (b) All external wiring connection with approved wire colors and circuit designations.
(10) Serial communications manuals.

1.6 SPARE PARTS

Provide one (1) year's spare parts in accordance with manufacturer's recommendations.

1.7 ELECTRICAL REQUIREMENTS

Provide electrical components of mechanical equipment and systems such as motors, controllers, contractors, and disconnects under Division 16, as specified herein, and as necessary for complete and operable systems, except the controllers indicated as part of motor control centers shall be provided under Section 16402, "Wiring Systems"; these components shall meet the minimum requirements as specified in Section 16011, "Electrical General Requirements," and Section 16402, section covering the associated mechanical equipment. Extended voltage range motors will not be permitted.

Provide interconnecting wiring for components of packaged equipment as an integral part of the equipment. Interconnecting power wiring and conduit for field erected equipment and control wiring rated at 100 volts or higher and conduit shall be as specified in Section 16402. Control wiring rated at 100 volts or less and conduit shall be as specified in Division 16. Motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to mechanical equipment shall conform to Section 16402.

1.8 NAMEPLATES

FS L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches. Lettering shall be a minimum of 0.25-inch high normal block style.

PART 2 PRODUCTS

2.1 CONSOLE

a. The console shall be wall mounted using external mounting tabs.

b. The console shall be equipped with a two-line, 24-character liquid crystal display for on-site viewing of all inventory, leak detect and alarm information.

c. The console shall be equipped with a 24 button front-panel keyboard with control and alphanameric functions for programming, operating and reporting function.

d. The console shall be equipped with three front-panel indicators to provide a visual indication of power on, warning and alarm conditions.

e. The console shall be equipped with an integral, 24-character, thermal report printer with built-in take-up spool for hard-copy documentation of inventory, leak detect, alarm information, and facsimile transmission confirmation.

f. The console shall be equipped with a back-up battery to maintain all programming information as well as inventory, leak detect and alarm information in the event of a power outage.

g. The console shall be a modular design to accept additional business management, leak detection and communications features in the future. See Section 2.2 for definition of modular design.

h. The console shall be equipped with four 1-3/4" conduit knockouts on the top and the bottom of the monitor for rigid conduit entry into monitor. Two conduit entries (top and bottom) shall be designated for the intrinsically safe compartment, and two conduit entries (top and bottom) shall be designated for the high-power compartment.

i. The console shall be separated into three compartments for:

(1) intrinsically safe wiring and devices
(2) high-power wiring and devices, and
(3) communications wiring and devices.

j. The console shall have an internal quick-disconnect connector for 120 VAC wiring to the console for ease of installation, service and troubleshooting.

k. The console shall be equipped with the ability to communicate directly with an external POS terminal, printing device or PC. The system shall also have the ability to communicate with a remote device via the telephone lines.

l. The console shall be capable of selectively communicating in English, French, and Spanish.

m. The console shall be equipped with internal audible and visual warning and alarm indicators.

n. The console shall be intrinsically safe, with Underwriter Laboratories (UL) and Canadian Standards Association (CSA) approval.

o. The console shall comply with FCC testing, FCC Part 68, Subpart 15.

p. The console shall be mounted and wired according to the manufacturer-supplied installation manuals, with all underground intrinsically safe field wired enclosed in dedicated conduit and separate from all other wiring. The system's high-boltage wiring may share existing conduit with other high-boltage devices in accordance with the applicable guidelines published in the National Electrical Code (NEC).

q. The console shall continuously monitor all probes and sensors, reporting not only normal operating conditions but also system malfunctions or failures.

2.2 MODULES

a. The tank monitoring system shall incorporate a modular design to allow the factory installation of system features to meet specific application requirements as well as field installation/modification of features at a later date to meet changing business, environmental compliance or regulatory requirements.

b. The modular design shall consist of one console with the ability to accept plug-in modules. The console shall be divided into three compartments to separate and house plug-in modules for intrinsically safe devices, high power devices and communications devices, See Section 2.2.1 for compartment/module compatibility.

c. The interface of additional enclosures to the original console shall not be considered a modular design.

2.2.1 Module Compartments

a. The system shall have a capability to contain up to eight modules in the high-powered area of the console. The modules shall consist of:

(1) A Four-Relay Output Interface Module that can be programmed to actuate external alarm devices when assigned alarm limits are exceeded or alarm conditions are identified.

(2) A Two-Input/Two-Relay Output Interface Module that can be programmed to assign solid-state inputs from external devices to relay outputs on the module for the purpose of activating external alarm devices.

(3) A Four-Input Pump Sense Interface Module to monitor the activity of the submersible pump. The module will be used with the Automatic Start Leak Detect feature of the tank monitoring system.

b. The system shall have a capability to contain up to eight modules in the intrinsically safe area of the console. The modules shall consist of:

(1) A Four-Input Probe Interface Module compatible with Magnetostrictive probe.

(2) An Eight-Input Sensor Interface Module compatible with the sump and/or interstitial float switch sensors.

(3) A Six-Input Type B Sensor Interface Module compatible with discriminating dispenser pan and containment sump sensors.

c. The system shall have a capability to contain up to three modules in the communications compartment of the console. The modules shall consist of:

(1) An RS-232 Interface Module providing data transmission to a computer, point of sale terminal, or printing device.

(2) A SiteFax 2400/1200/300-baud Modem Interface Module for direct data transmission over the phone lines as well as the ability to automatically call a fax machine based on the occurrence of an alarm condition or a preprogrammed report transmission time.

(3) An Auxiliary RS-232 Interface Module providing data transmission to a computer, point of sale terminal, or printing device as well as linking two tank monitors together for communications with a central location.

2.3 PROBES

a. The probe shall be capable of utilizing standard non-shielded gas- and oil-resistant wire between 14 AWG and 18 AWG for field connections.

b. There shall be no more than two conductors between each probe and control console.

c. The probe shall be capable of performing a leak detect test to 0.1 GPH or higher.

d. Third-Party Certification is required in accordance with the U.S. EPA's "Standard Test Procedure for Evaluating Leak Detection Methods: Automatic Tank Gauging Systems" (0.2 GPH monthly monitoring).

e. Third-Party Certification is required in accordance with the U.S. EPA's "Volumetric Tank Tightness Testing Method" (0.1 GPH annual tank tightness test).

f. The probe shall be compatible for aboveground tank installations as well as underground tank installations.

g. A cap and ring kit, available from the manufacturer, shall be supplied with each probe for easy installation and removal.

h. The probe shall use digital communications protocol/format for maximum RF/EMF resistance immunity.

2.4 SENORS

The system shall provide a capability to monitor up to 64 interstitial areas and or containment areas utilizing a standard float style sensor.

2.4.1 Piping Sump Sensor

a. The piping sump sensor shall be a PVC Schedule 40 construction utilizing a float and reed switch technology to sense the presence of liquid. The sensor shall also be supplied with a PVC mounting sleeve for installation of the sensor in a containment area.

b. The piping sump sensor shall be 18.5" long to address monitoring in piping containment sumps as well as dispenser pan/sump areas.

c. The sump sensor shall be designed with a five-foot leader cable to connect the sensor to field wiring in the sensor junction box. The sensor shall be supplied with watertight cord grip assemblies to install in sensor junction box.

(1)	Power Requirements:	Intrinsically safe power supplied by tank monitor
(2)	Sensor Type:	Hermetically sealed magnetic reed switch
(3)	Contact Rating:	15 watts
(4)	Switch Travel:	7/8 inch to contact
(5)	Operating Temperature:	0°C to +60°C

2.4.2 Hydrostatic Sensor

a. The hydrostatic sensor shall be supplied by the manufacturer in a single-float or a dual-float configuration.

b. The dual-float hydrostatic sensor shall be 19" long with a clear lexan tubular housing for visible confirmation of sensor operation. The sensor shall be 2.5" in diameter to install in the riser pipe assembly of a double-wall tank brine reservoir.

c. The single-float hydrostatic sensor shall be 6.0" long with a clear lexan tubular housing for visible confirmation of sensor operation. The sensor shall be 2.5" in diameter to install in the riser pipe assembly of a double-wall tank brine reservoir.

d. The single- and dual-float hydrostatic sensor shall be supplied with a 12-foot leader cable to connect the sensor to field wiring in the sensor junction box.

e. The single- and dual-float hydrostatic sensor shall be supplied with a lockable, watertight riser cap to prevent accidental spills into the tank reservoir. The cap shall be equipped with a vent tube to vent air out of the reservoir area and prevent liquids from entering into the reservoir.

f. The single-float hydrostatic sensor shall indicate a low-liquid level only in the tank reservoir.

g. The single-float hydrostatic sensor shall utilize a float and reed switch assembly for sensing the presence and change in liquid level. The contact shall be a Normally Closed dry contact.

h. The dual-float hydrostatic sensor shall indicate a high liquid level and a low liquid level in the tank reservoir.

i. The dual-float hydrostatic sensor shall utilize a float and reed switch assembly for sensing the presence and change in liquid level. The contact shall be Normally Closed dry contact.

(1) Operating temperature: -25°C to +40°C
(2) Rests in brine solution of up to 30% calcium chloride
(3) Clear plastic housing for visual inspection
(4) Cable length: 12 Feet
(5) Available in both a single-float and a dual-float configuration.

2.4.3 Discriminating Dispenser Pan and Containment Sump Sensor

a. The discriminating dispenser pan and containment sump sensor shall utilize an ultrasonic technology to sense the presence of fluids and a conductive elastomer to differentiate between hydrocarbons and water.

b. The design of the sensor shall provide for a distributed sensing capability over the full length of the dispenser pan and containment sump sensor.

c. The dispenser pan and containment sump sensor shall be reusable after being exposed to hydrocarbon liquids.

d. The dispenser pan and containment sump sensor shall not put the system into an alarm condition due to high concentrations of hydrocarbon vapors.

e. The dispenser pan and containment sump sensor shall provide an indicator of fluid when liquid reaches 1" in height.

f. The dispenser pan shall provide a high-liquid-level indication when fluid reaches 8" high and the containment sump sensor shall indicate a high liquid level when fluid reaches 10" high.

g. The dispenser pan and containment sump sensors shall be supplied with a five-foot leader cable to connect the sensors to field wiring in the sensor junction box.

h. The dispenser pan sensor shall be 2.125" diameter and 13.175" high to address dispenser pan applications. The containment sump sensor shall be 2.125" diameter and 22.0" height to address containment sump applications.

(1) Operating temperature: -40°C to +70°C
(2) Three-wire connection to the monitor.
(3) Cable Length: 5 Feet
(4) Sensor alarms on fuel at any height on the sensor, even when floating on other liquids.
(5) Liquid warning is triggered when liquid reaches 1.0" high on the dispenser pan and the containment sump sensor.
(6) High liquid alarm is triggered when liquid reaches 8.0" on dispenser pan and 10" on containment sump sensor.
(7) Sensor is reusable and testable for regulatory purposes.

2.5 COMMUNICATIONS

2.5.1 Auto-Dial Site Fax Modem

a. The system shall have the capacity to install up to three SiteFax Auto-Dial fax/modem modules.

b. The Fax baud rate shall be 9600 baud with the communications baud rate selectable between 2400/1200/300.

c. The system shall have a capability to program in up to eight phone numbers assigned to a fax/modem module.

d. The system shall have a capability to enter in up to 20 characters maximum for the destination phone number.

e. The destination type shall be fax, teletype or computer, selectable by destination.

f. The system shall be capable of redialing a location from three to 99 times, selectable by destination.

g. The system shall be capable of redial intervals from one to 60 minutes, selectable by destination.

h. The system shall call immediately on an alarm occurrence, selectable by alarm type, assignable by destination.

i. The system shall allow for answer/receive disabling for line sharing applications.

2.5.2 RS-232 Serial Communications Interface

a. The system shall have a capability to communicate directly with a computer, teletype or printer.

b. The system shall provide direct interface via a 25-pin D connector using standard RS-232 serial communications hand-shaking signals.

c. The system shall have the capacity to install up to three RS-232 serial communications modules.

2.5.3 Auxiliary RS-232 Serial Communications Interface

a. The system shall have a capability to communicate directly with a computer, teletype or printer.

b. The system shall provide direct interface via a 25-pin D connector using standard RS-232 serial communications had shaking signals.

c. The system shall have a capability for two 25-pin D connectors to interface a second tank monitor as well as connect directly to a PC, Teletype, or remote communications device.

d. The system shall have a capability to install up to three RS-232 serial communications modules.

PART 3 EXECUTION

3.1 TECHNICAL SUPPORT

a. The manufacturer shall provide technical phone support available to customers from 8:00 a.m. to 7:00 p.m. EST.

b. The manufacturer shall provide phone support available to authorized distributors and service contractors for on-site troubleshooting of UST system problems. Phone support shall be available from 8:00 a.m. to 7:00 p.m. EST.

3.2 FIELD SERVICE, INITIAL OPERATION, AND TESTING

a. Written notice ten (10) days prior to any visit shall be given.

b. Software shall be installed by a competent representative of manufacturer at Computer System No. 1 and 2 (Ref. Spec. 13004, Data Processing Systems), and shall be set up to poll the various systems via modem and receive fax messages. These capabilities shall be demonstrated specifically to the Engineer.

c. After successful installation of system, a competent manufacturer's representative shall make a site visit for a minimum of eight (8) hours to provide training to Navy and another minimum eight (8) hour visit for startup service, troubleshooting, and integration with Computer System No. 1 and 2 (Ref. Spec. 13004, Data Processing Systems).

3.3 CERTIFICATION TRAINING

a. The certification program shall consist of three certification levels covering installation, setup/operation, and service/troubleshooting of the manufacturers UST monitoring systems.

b. The manufacturer shall provide certification information on contractor/installer to regulatory agencies that require certification documentation.

c. The manufacturer shall offer recertification training to keep contractors/installers current with updated information.

d. The manufacturer shall conduct regional training seminars throughout North America.

e. The manufacturer shall provide a home study certification program for installing contractors.

3.4 WARRANTY REGISTRATION AND CHECKOUT FORM

a. The manufacturer shall require that all UST monitoring systems be started up by an authorized distributor.

b. The startup shall consist of installation checkout, operation checkout and customer training on use of the equipment.

c. The manufacturer shall supply a Warranty Registration and Checkout Form to properly document the site information to include:

(1) Installation location
(2) Installer
(3) Equipment identification
(4) Tank information
(5) Leak detector information
(6) Start up distributor information
(7) Customer approval

d. The manufacturer shall compensate the authorized distributor for the start up procedure when a properly completed Warranty Registration and Checkout Form is submitted to the manufacturer.

e. Upon receipt of the Warranty Registration and Checkout Form, the manufacturer will initiate the system warranty and input the data into a site database.

3.5 THIRD-PARTY CERTIFICATION

The manufacturer shall supply third-party documentation for all products certifying that performance meets or exceeds EPA requirements. The third-party documentation is to be compiled in a separate binder for easy access to the information. For all third party certified products, the binder shall include data sheets describing operating specifications and product functions.

3.6 AUTHORIZED SERVICE PERSONNEL LISTING

The manufacturer shall supply a formal list of all Authorized Distributors and Service Contractors for sales, installation, training and support.

3.7 SYSTEM WARRANTY

a. The tank monitoring system shall be warranted for a period of one year of date from installation or 15 months from date of invoice.

b. The warranty is to include parts and labor with all warranty work performed on site by an authorized manufacturers representative.

c. Submit written contract of warranty.

-- End of Section --

SECTION 13002

STANDARD TANK MONITORING SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

a. These specifications include furnishing and installing of standard tank monitoring system for single underground liquid storage tanks and associated below-grade product piping and sumps. Complete working systems shall be provided in the quantity and locations below.

Schedule 13002-1

Building	Number of Tank Monitoring Systems	Number of Tanks
E-14	One (1)	One (1)
C-50	One (1)	One (1)

b. Each system shall include all seasons, panels, remote communications equipment, IBM-PC compatible communications and reporting software. All data recorded and used to fulfill specification requirements shall be convertible using the software to ASCII format. Contractor shall be responsible to furnish, install and test each system.

c. The systems shall be a continuous underground monitoring and leak detection system that shall perform in accordance with subpart D of 40 CFR 280.

1.2

The underground storage tank monitoring system shall meet all applicable standards and regulatory agency requirements including, but not limited to, the standards and requirements of the following.

a. American National Standards Institute (ANSI)
b. American Petroleum Institute (API)
c. American Society for Testing and Materials (ASTM)
d. Environmental Protection Agency (EPA)
e. National Bureau of Standards (NBS)
f. National Electrical Code (NEC)

g. National Fire Protection Agency (NFPA)
h. Underwriter Laboratories Inc. (UL)
i. Canadian Standards Association (CSA)
j. Underground Storage Tanks Subpart D, 40 CFR Part 280
k. Federal Communications Commission (FCC)
l. British Approved Service for Electrical Equipment in Flammable Atmospheres (BASEEFA)
m. Factory Mutual (FM)

1.3 RELATED SECTIONS

The specification sections listed below are an integral part of this equipment specification,and the contractor shall be responsible for providing these sections to the equipment supplier.

a. Section 13001 - Enhanced Tank Monitoring System
b. Section 13004 - Data Processing Systems
c. Section 13003 - Fuel Management System
d. Section 13005 - Soil Vapor Monitoring System
e. Section 13211 - Underground Storage Tank Retrofit
f. Section 16499 - Telephone Service and Communications

1.4 PERFORMANCE SPECIFICATION

a. A capability to monitor inventory in tanks and produce a combination of automatic and annual reports which include the following information.

   (1) Gallons of Fuel
   (2) Inches of Fuel
   (3) Inches of Water
   (4) Temperature
   (5) Ullage
   (6) Time and Date
   (7) Tank Identification
   (8) Fuel Identification

b. A capability to perform both automatic and manually activated leak detection tests, in compliance with federal EPA regulations 40 CFR Part 280, which includes a leak analysis report. This leak analysis report must indicate tanks failing a test, tanks passing a test and tanks invalidated from a test, as well as the reasons for the invalidation.

c. A capability to monitor up to 16 interstitial areas and/or piping sumps.

d. Computer formatted and printing terminal formatted reports.

e. Programmable automatic report times.

f. Programmable FTCE (Fuel Thermal Coefficient of Expansion)

g. Manifold tank capability.

h. Programmable alarm limits to warrant of:

(1) Leaks
(2) Overfills
(3) High water
(4) Low Inventory
(5) Thefts
(6) External input Alarm

i. System must be capable of the following performance specifications in a tank:

(1) Height of Fuel ±0.01"
(2) Volume of Fuel ± 15 Gallons
(3) Height of Water to 5" or greater
(4) Fuel Temperature ± 1.5 F
(5) Time ± Time ± min/week
(6) Leak Detection rate of 0.2 gph

j. Automatic inventory increase (Delivery) report consisting of:

(1) Delivery Start Time and Date
(2) Beginning Inventory
(3) Fuel temperature
(4) Delivery End Time and Date
(5) Ending Inventory
(6) Ending Fuel Temperature
(7) Net Increase

k. Store in memory at least ten delivery reports per tank.

l. Provide alarm history reports on demand, locally or remotely, using a build-in Hayes-compatible 1200 bps modem.

m. Containment Sump Monitoring.

(1) The system shall be able to perform automatic, continuous leak sensing in the containment piping sump.

(2) The system shall have a capability to detect the presence of fluid (hydrocarbons and/or water) in the piping containment area and provide an alarm condition.

(3) The system shall have a capability to differentiate between hydrocarbons and water and provide an alarm condition for the respective alarm. The system shall also have a capability to indicate when the sensing device has failed and is not longer providing environmental compliance.

(4) The system shall have a capability to continuously monitor the integrity of the sensor for an open condition, alarm condition, or normal operating conditions.

n. Alarms

(1) The system shall be equipped with an external audible and visual alarm with acknowledgement the external alarm box and acknowledgement switch shall be manufactured in a watertight gasketed enclosure for installation in an outdoor environment. The external alarm box and acknowledgement switch shall interface to the tank monitoring system via an internal relay.

(2) The system shall have a capability to store up to three alarm occurrences in memory. The operator shall have a capability to print the alarm history an alarm status on the integral printer as well as retrieve alarm history and alarm status through the communications interface (RS-232, 1200/300 baud modem.

o. Overfill Protection

In accordance EPA guidelines a delivery truck fuel installer person in signalled when the UST is 90 percent filled.

1.5 SUBMITTALS

a. Submit in accordance with Section 01300, "Submittals".

b. Shop drawings to be submitted shall describe compliance with these specifications.

c. Manufacture's instruction manuals shall be supplied in permanent-bound 3 ring binders.

d. Submit certificates detailed in paragraph 3.3, 3.4, 3.5, 3.6 and 3.7 of this specification.

The manufacturer shall supply product documentation that addresses the following categories.

(1) Site preparation and installation instructions.
(2) System setup instructions.
(3) System operating instruction.
(4) Line leak detector site preparation and installation instructions.
(5) Line leak detector checkouts procedures
(6) Probe installation instructions.
(7) Individual module installation instructions.
(8) Product data sheets
(9) Serial communications manuals
(10) Identification of all devices and equipment terminals, and all external connection terminal blocks.

1.6 SPARE PARTS

Provide one (1) year's spare parts in accordance with Manufacturer's recommendations.

1.7 ELECTRICAL REQUIREMENTS

Provide electrical components of mechanical equipment and systems such as motors, controllers, contractors, and disconnects under Division 16, as specified herein, and as necessary for complete and operable systems, except the controllers indicated as part of motor control centers shall be provided under Section 16402. "Wiring Systems"; these components shall meet the minimum requirements as specified in Section 16011. "Electrical General Requirements," and Section 16402, section covering the associated mechanical equipment.

Provide interconnecting wiring for components of packaged equipment as an integral part of the equipment. Interconnecting power wiring and conduit for field erected equipment and control wiring rated at 100 volts or higher and conduit shall be as specified in Section 16402. Control wiring rated at 100 volts or less and conduit shall be as specified in Division 16. Motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to mechanical equipment shall conform to Section 16402.

1.8 NAMEPLATES

FS L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall 1 by 2.5 inches. Lettering shall be a minimum of 0.25-inch high normal block style.

PART 2 PRODUCTS

2.1 A WALL-MOUNTED CONSOLE WITH THE FOLLOWING.

a. A liquid crystal display for on-site viewing of all inventory
b. An internal printer for system reports an alarm notification.
c. Standard built-in RS-232 communications interface with built-in 1200 bph modem.
d. Two internal alarm relays programmable to alarm limits and capable of activating external alarm devices.
e. Underwriters Laboratory (UL) listed
f. Intrinsically safe.

2.2 SINGLE-CABLE INTERSTITIAL SENSING ELEMENTS CAPABLE OF DETECTING FUEL AND/OR WATER.

a. Capable of utilizing standard gas-and oil-resistant stranded wire between 14 AWG and 18 AWG for field connections.

b. No more than two wires between each probe or sensor and the control console.

2.3 CAPACITANCE PROBES WITH BUILT-IN DIAGNOSTICS

a. Capable of utilizing standard gas- and oil-resistant stranded wire between 14 AWG and 18 AWG for field connection.

b. No more than two wires between each probe or sensor and the control console.

PART 3 EXECUTION

3.1 TECHNICAL SUPPORT

a. The manufacture shall provide technical phone support available to customer from 8:00 am to 7:00 pm. EST.

b. The manufacturer shall provide technical phone support available to authorized distributors and service contractors for on-site trouble shooting of UST system problems. Phone support shall be available from 8:00 am to 7:00 pm EST.

3.2 FIELD SERVICE, INITIAL OPERATION, AND TESTING

a. Written notice ten (10) days prior to any visit shall be given.

b. Software shall be installed by a competent representative of manufactures at Computer System No. 1 and 2 (Ref. Spec. 13004, Data Processing Systems), and shall be set up to poll the various systems via modem and these capabilities shall be demonstrated specifically to the Engineer.

c. After successful installation of system, a competent manufacturer's representative shall make a site visit for a minimum of eight (8) hours to provide training to Navy and another minimum eight (8) hour visit for start up service trouble shooting and integration with Computer System No. 1 and 2. (Ref. spec 13004, Data Processing Systems).

3.3 CERTIFICATION TRAINING

a. The certification program shall consist of three certification levels covering installation, setup/operation, and service/trouble shooting of the manufacturers UST monitoring systems.

b. The manufacturer shall provide certification information on contractor/installer to regulatory agencies that require certification documentation.

c. The manufacturer shall offer recertification training to keep contractor/installer current with updated information.

d. The manufacturer shall conduct regional training seminars throughout North America.

e. The manufacturer shall provide a home study certification program for installing contractors.

3.4 WARRANTY REGISTRATION AND CHECKOUT FORM

a. This manufacturer shall require that all UST monitoring systems be started up by an authorized distributor.

b. This startup shall consist of installation checkout, operation checkout and customer training on use of the equipment.

c. This manufacturer shall supply a Warranty Registration and Checkout Form to properly document the site information to include:

(1) Installation location
(2) Installer
(3) Equipment identification
(4) Tank information
(5) Lead detector information
(6) Start up distributor information
(7) Customer approval

d. The manufacturer shall compensate the authorized distributor for the start up procedure when a properly compliance warranty registration and checkout form is submitted to the manufacturer.

e. Upon receipt of the Warranty Registration and Checkout Form, the manufacturer will initiate the system warranty input the data into a site database.

3.5 THIRD-PARTY CERTIFICATION

a. The manufacturer shall supply third-party documentation for all products certifying that performance meets or exceeds EPA requirements. The third-party documentation is to be compiled in a separate binder for easy access to the information. For all third party certified products, the binder shall include data sheets describing operating specifications and product function.

3.6 AUTHORIZED SERVICE PERSONNEL LISTING

a. The manufacturer shall supply a formal list of all Authorized Distributors and Service Contractors for sales installation and support.

3.7 SYSTEM WARRANTY

a. The tank monitoring system shall be warranted for a period of one year of date from installation on 15 months from date of invoice.

b. The warranty is to include parts and labor with any warranty work performed on site by an authorized manufacturers representative.

c. Submit written contract of warranty

-- End of Section --

SECTION 13003

FUEL MANAGEMENT SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

This specification includes furnishing and installation of a fuel management system. Each system shall control the dispensing of fuel and shall record transaction information from each dispensing transaction through use of:

a. Card readers and pump control units located near fuel dispensers
b. indoor-mounted microprocessor-based site controllers, and
c. related appurtenances and wiring.

Each system shall be capable of communicating with a remotely located IBM-PC compatible computer through use of modems over standard telephone lines. Transaction data shall be stored at each site controller which can be downloaded to remote PC. This data shall be in ASCII format, or manufacturer's software shall convert data to ASCII format.

Three (3) complete working systems shall be supplied, installed completely, and tested. The systems shall be installed in the locations below (Schedule 13003-1) with the following general features.

Schedule 13003-1

Building	Number of Site Controllers	Number of Card Readers
C-50	One (1)	One (1)
C-17	One (1)	Three (3)
R-6	One (1)	Three (3)

Complete system shall be a fully integrated package including Island Card Readers, Site Controllers, pump control units, power conditioner, remote communication software and hardware and all appurtenances required to make a complete working system.

1.2 RELATED SECTIONS

The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers.

a. Section 13001 - Enhanced Tank Monitoring System
b. Section 13002 - Standard Tank Monitoring System
c. Section 13004 - Data Processing Systems
d. Section 13005 - Soil Vapor Monitoring Systems
e. Section 13112 - Underground Storage Tank Retrofit
f. Section 16499 - Telephone Service and Communications

1.3 REFERENCES

a. Underwriters Laboratories (UL) listed

b. Federal Communications Commission (FCC)

1.4 PERFORMANCE REQUIREMENTS

a. The system shall be designed to offer a wide variety of operational modes and to provide maximum versatility without special programming or engineering changes. Ease and economy of expansion shall also be a prerequisite of the proposed system.

b. The system shall provide self-test and diagnostic utilities for start-up and troubleshooting.

c. The purpose of the system shall be to control dispensing equipment and provide accurate accounting of all fuel and related products being dispensed.

The system shall record data for each transaction in non-volatile memory: This memory shall be battery-backed to retain memory in the event if power outage for up to 48 hours.

d. The system shall have the capability of user access by: magnetic stripe card, and manual entry of numbers via the keyboard.

e. Access to products shall be restricted to people holding valid cards and who perform a predetermined series of data entry operations.

f. An internal electronic file shall hold data for each card.

g. The authorized operator shall be able to check and/or change system operating parameters, as well as card and account data.

h. All system commands shall be menu-driven with on-screen "help" support for explanation of all functions. A single line command mode shall be available.

i. A supervisor card mode shall be provided for input of any card encoded data.

j. System shall allow manual entry for entering unmonitored of foreign fuel transaction.

k. Provide a fuel drop card for entering tank inventory additions.

l. System Memory

The system's memory shall be flexible to maximize the amount of card records and transaction records that can be stored, based on the data stored for each card record. The system shall allow the operator to determine what data is stored for each card record. Memory size shall be 2 Megabytes or greater. Typical range for card record and transaction record storage for the memory configuration shall be as follows.

Number of Transactions	Number of Cards Min. Data/Card	Number of Cards Max. Data/Card
100	140,000	39,000
10,000	75,000	21,000

The system shall be capable of storing the following data for each card record:

(1) Card Number (19 digits)
(2) Card Type - Single, Driver, Vehicle
(3) Status - Valid or Invalid
(4) Account Number (0 - 9999)
(5) Expiration Date - MM/DD/YY
(6) Monthly Allocation - $NNNNNN.NN
(7) Misc. Keyboard Entry - Off/On
(8) Personal Identification Number PIN (0 - 6 digits)
(9) Current Odometer (6 digits)
(10) Odometer Reasonability Code (up to 15 different levels)
(11) Pump Restriction (up to 15 different levels)
(12) Quantity Restriction (up to 15 different levels)
(13) Driver Name (9 characters)
(14) Language Code (1 digit)

m. Account File Memory

The system shall have, as standard, the capacity to store 10,000 account records. Each record shall contain:

(1) Account Number (0 - 9999)
(2) Status - Valid or Invalid
(3) Account Discount (0 - 99%)
(4) Expiration Date - MM/DD/YY
(5) Monthly Allocation - $NNNNN.NN

(6) Daily Allocation - $NNNNN.NN
(7) Quantity Restriction Level (up to 15 different levels)
(8) Pump Restriction (up to 15 different levels)
(9) Account Name (9 characters)

n. Transaction Memory

(1) Sequential Transaction Number
(2) Transaction Termination Code (i.e., Normal, Quantity Restriction, etc.)
(3) Account Name
(4) Driver Card Number
(5) Vehicle Card Number (omitted for single card transactions)
(6) Date and Time
(7) Fuel Type
(8) Pump Number
(9) Quantity Dispensed
(10) Unit Price
(11) Total Transaction Extended Monetary Amount
(12) Odometer Entry
(13) Misc. Keyboard Number
(14) Consumption Factor - Miles per Gallon or Litres/100km
(15) Receipt Status - Issued/Not Issued

o. Fuel Type (Product) Identification

The operator shall be able to specify and store the price and description of up to 16 products.

p. Miscellaneous Entry Field Capacity

The system shall be capable of recording a field of up to 10 digits entered at the keyboard by the user.

q. Clock/Calendar

The system shall keep an accurate accounting time and date, even in the event of a power failure. The date and time formats shall be user selectable (i.e., 12/24 hour, MMM/DD/YYYY or DD/MMM/YYYY). The system shall be able to automatically correct for daylight savings time.

r. Fuel Type Restriction

The operator shall be able create a table of up to 15 combinations, or levels, of authorized products. The operator shall then be able to assign a level number to each individual user or account group.

s. Quantity Restriction

The operator shall be able to create a table of 15 quantity restriction levels. The operator shall then be able to assign a level number to each individual user or account group to limit the amount of fuel dispensed for each transaction. By either quantity or monetary value.

t. Open/Close

The system shall have the capability of being placed in either an "Open" or "Closed" mode by authorized personnel. Fueling is not allowed in the "Closed" mode.

u. Single or Dual Card/Key Operation

The operator shall be able to program the system for cardless (manual entry via keyboard), single and/or dual card/key operation.

v. Personal Identification Numbers (PIN)

The system shall have a capability to recognize and verify up to a 6 digit Personal Identification Number (PIN) when entered at the Fuel Island Terminal. The operator shall have a choice of methods to select PIN's for each individual user:

(1) Individually program a PIN number for each user
(2) Automatically generate a random PIN number

The system shall be able to invalidate a card after 3 consecutive incorrect PIN entries.

w. Pump Configuration

The operator shall be able to program and store operating parameters for each hose position (up to 32). These parameters shall include:

(1) Pump Number

A pump number from 0 - 99 to be assigned to any available relay position.

(2) Fuel Type Number

The Fuel Type number (1 - 16) and operator-selectable description of the product being dispensed by the pump.

(3) Tank Number

The tank number (1 - 8) to be used by the inventory program.

(4) Quantity of Fuel per Transaction Limit.

(5) Total Transaction Time-Out

The system shall be able to monitor a total transaction time, programmable for each hose between 1 - 999 seconds (an entry of '0' shall allow unlimited time). The system shall turn off the pump if that time is exceeded.

(6) Pump Handle Time-Out

The system shall monitor the time between authorization and activation of the pump handle, programmable for each hose between 1 - 999 seconds (an entry of '0' shall allow unlimited time). If the device is selected but the pump handle not activated by the user before the end of this period, the transaction shall be terminated.

(7) First Pulse Time-Out

The system shall monitor the time between the activation of the pump handle and the receipt of the first pulse, programmable for each hose between 1 - 999 seconds (an entry of '0' shall allow unlimited time). The transaction shall be terminated if that time exceeds the programmed parameter.

(8) Missing Pulse Detector (MPD) Time-Out

A "Missing Pulse Detector" (MPD) shall be built into the circuit controlling each pump so that all power shall be removed from the pump if the pulses indicating fuel flow are not received at regular intervals. The length of the acceptable interval between pulses shall be programmable for each hose between 1 - 999 seconds (an entry of '0' shall allow unlimited time).

(9) Pulser Divide Rate

The operator shall be able to program the system to assign 1 - 9999 pulses per unit of fuel measure.

(10) Pump Deactivation Sentry

The operator shall be able to program the system to automatically place a pump "out of service" after 3 consecutive "zero quantity" fueling transactions occurring from that pump (zero quantity transactions may be an indication of a pump or pulser hardware failure). An "out of service", or other operator defined message, pump shall be indicated on the Fuel Island Terminal (FIT) display. This feature may be disabled for a particular pump.

(11) Messaging

The system shall have the capability of displaying up to 100 different, operator-defined messages at the Fuel Island Terminal (and/or printed on the receipt) for specific Card or Account numbers. The system shall have the capability to automatically clear messages after an operator - determined time period.

x. Card Status

The system shall have the capacity to allow driver and/or vehicle cards to be declared valid or invalid by authorized personnel.

y. Site Name

The system shall have the provision to program a 12 character site name into memory. This is used when the system is accessed by modem.

z. Pump and Product Totals

The system shall have the capacity to accumulate individual pump and product totals as well as track each pump totalizer. The operator shall be able to enter an initial pump totalizer number into the system for each pump. This number will be incremented by the system when product is dispensed and can be checked against the pump's totalizer to determine the accuracy and working status of the pulser.

aa. Inventory Control

The operator shall be able to program into system memory up to 8 tank inventory balances. The inventory balance for each product shall be reduced automatically as each fueling transaction occurs. The operator shall be able to change this number to accommodate fuel deliveries. The system shall be capable of displaying, on demand, the current inventory amount for each individual tank.

bb. Manual Operation

The operator shall have the ability to place pumps in a "manual" mode, allowing manual operation of the pumps (without entering a card). This can be done directly, through the programming terminal, or remotely by modem.

cc. Display Prompts

All Fuel Island Terminal display prompts shall be programmable by the operator. The system shall use a set of standard default prompts at start-up.

dd. Dual Language

The system shall have the capability of storing 2 sets of Fuel Island Terminal (FIT) display messages in 2 different languages or 2 separate sets of display prompts (i.e., Enter odom: as apposed to Enter Hubmeter). When a card is read, the system shall display all messages in the correct language for that user.

ee. Password

The operator shall be able to program a 6 character, alphanumeric password that must be entered correctly to gain access to the system either directly or via phone modem.

ff. Pump Handle Monitor

The system shall monitor the pump handle to insure that it was turned to the "OFF" (reset) position before the pump can be reactivated. The operator shall be able to disable this feature.

gg. Passthrough Communications Port

The system shall have the capability of passing modem communications through to another RS/232 device.

hh. Odometer Reasonability

The system shall have the capability of checking an odometer entry against the last odometer entry plus the authorized range allowed for that vehicle. The system shall be able to either record an error or deny access to fuel for an odometer entry that is not within the correct range.

ii. Account Group Discount

The system shall have the capability to assign a discount from 0 - 99% to each account. That discount will be reflected on the price of each transaction.

jj. Reports

(1) The system shall have the capability to generate reports. The operator shall be able to access these reports, on-demand, via the data terminal or via modem to a remote PC. The system shall be able to display or print report data at the user's direction.

(2) System Information Reports

- System Status Report
- Fuel Island Terminal (FIT) Status
- Pump Configuration Data

(3) Transaction Data Report

(4) Card/Key Information Report

(5) Account Information Report

(6) Pump Totals and Totalizers Report

(7) Inventory Report

(8) Product Totals Report

1.5 SUBMITTALS

a. Submit in accordance with Section 01300, "Submittals."

b. Shop drawings shall describe details to show conformance with these specifications.

c. Operation and Maintenance manuals shall be provided in permanent - bound 3-ring binders and shall include detailed descriptions on operation of all system components.

1.6 SPARE PARTS

Provide one (1) year's spare parts as recommended by manufacturer.

1.7 ELECTRICAL REQUIREMENTS

Provide electrical components of mechanical equipment and systems such as motors, controllers, contractors, and disconnects under Division 16, as specified herein, and as necessary for complete and operable systems, except the controllers indicated as part of motor control centers shall be provided under Section 16402, "Wiring Systems"; these components shall meet the minimum requirements as specified in Section 16011, "Electrical General Requirements," and Section 16402, section covering the associated mechanical equipment.

Provide interconnecting wiring for components of packaged equipment as an integral part of the equipment. Interconnecting power wiring and conduit for field erected equipment and control wiring rated at 100 volts or higher and conduit shall be as specified in Section 16402. Control wiring rated at 100 volts or less and conduit shall be as specified in Division 16. Motor control

equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to mechanical equipment shall conform to Section 16402. The system shall be capable of starting the submersible pumps using starters supplied by pump manufacturers.

1.8 NAMEPLATES

FS L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

PART 2 PRODUCTS

2.1 FUEL ISLAND TERMINAL

The Fuel Island Terminal (FIT) shall be contained in a weatherproof cabinet. A pedestal for mounting the FIT shall be standard equipment. The FIT shall include the following standard features:

a. An easy-to-read, back-lit, 32 character - 2 line, alphanumeric liquid crystal display (LCD).

   (1) This display shall be readable in bright sunlight.
   (2) The system shall be equipped with a 3 in. x 5 in. back-lit, graphic liquid crystal display (LCD).
   (3) An optional 1 line x 40 character display shall also be available.

b. A 12-key metal keyboard with audible (tone) and tactile (keys move when pressed) feedback.

c. An "emergency stop" button to facilitate immediate termination of fueling in case of an emergency.

d. Each Fuel Island Terminal (FIT) shall be able to house up to 8 relays (1 per hose). Each FIT shall be able to selectively access up to 32 hoses controlled by others FITs.

e. The Fuel Island Terminal (FIT) shall have the capability of being equipped with 2 different card/key reading devices to facilitate a combination of cards and/or keys. The following devices shall be supplied:

(1) Push/pull magnetic card reader

f. Each FIT shall have a heater and pocket weathershield

g. Output on FIT LCD display shall be programmable from Fuel Site Control or via modem from remote PC.

2.2 FUEL SITE CONTROLLER

a. The Fuel Site Controller (FSC) shall have the capacity to connect up to 4 FIT units. A fully expanded system shall be able to control 32 hoses simultaneously. Both mechanical and electronic pumps shall be controllable by the system.

b. Communication protocol between the FSC and the FIT's shall be RS485, or RS422. The maximum wiring distance between the FSC and any FIT shall be 5000 feet. All wiring related opportunities supplied by manufacturer.

c. The system shall have two RS/232 ports for communication. One shall be used to directly interface to an ASCII terminal, personal computer or mainframe computer which is capable of performing ASCII communication. One of these devices shall be required to configure the system and generate reports.

d. Built-in Modem

The indoor mounted site controller shall be supplied with a internal modem, 9600 bps communication speed minimum, Hayes-compatible. Modem shall have error checking and data compression capabilities.

e. PSC shall be indoor, wall mounted unit which integrates other system components and communicates with remote IBM-PC compatible computer.

f. Battery hookup shall be provided for FSC.

g. Supervisor Switch at FSC.

2.3 POWER CONDITIONERS

Each system shall be supplied with a power conditioner which shall allow complete system operation during operation under normal power or under emergency power. Refer to emergency generator specifications. Conditioner shall provide transient noise and filter protection.

2.4 SOFTWARE

Two copies of software shall be provided (for new Computer System at C-21 and existing system at C-14) to allow an IBM-PC compatible computer (supplied elsewhere in this contract) communicate via modem (Reference Spec. 13004, "Data Processing Systems") access to any of the three fuel management systems. This software shall allow remote programming of all variables and configurations for any of three (3) fuel management systems from remote location. The software shall allow command-line operation so that the program can automatically poll (via modem) each of the three (3) fuel management systems from the IBM-PC compatible computer (supplied elsewhere is in contract) and allow downloading of all transaction information and re-entry of user information (such as locking-out of user account numbers) without requiring computer user operation. This command-line instruction set shall be capable of being called up in a DOS-based computer software (.bat, .com, or .eve format).

2.5 PUMP CONTROL UNIT

a. Unit shall control operation mechanical fuel dispensers and submersible UST fuel pumps, supplied under Spec Section 13211, "Underground Storage Tank Retrofit", and shall be mounted in the FIT.

b. Unit shall contain four (4) sets of solid state relays for pump and dispenser control and shall be compatible with submersible pump starter relays located remotely inside each building.

c. Provision shall be made to bypass each pump and dispenser control.

d. Battery shall be provided to provide for receiving pump input for 30 minutes after power failure.

2.6 CARD MAGNETIZER AND INITIAL CARD SUPPLY

Provide 5,000 blank cards for magnetization and a unit which can magnetize and activate each card for use with system.

Provide up to 500 cards, with user accounts, complete and ready for operation. Navy will provide all user account information necessary with two (2) weeks of written notice from Contractor.

PART 3 EXECUTION

3.1 FIELD TESTING AND INITIAL OPERATION

Contractor, in presence of Engineer, and representative of system manufacturer shall demonstrate complete operation of all systems specified in this section. Contractor shall demonstrate each feature of the system including operation of fuel site controller, pump control units, fuel island terminals and operation of software and remote access to site controller.

Contractor shall also demonstrate that:

a. All panels and equipment has been installed properly.

b. There are no mechanical defects in any parts.

c. That the controls meet the performance specifications and requests stated herein.

5 days

3.2 SERVICES OF MANUFACTURER'S REPRESENTATIVE

Contractor shall arrange for the manufacturer to furnish the services of a qualified representative as necessary to check and to supervise equipment installation for not less than two (2) days; to supervise final testing and demonstration in accordance with paragraph 3.1 above for not less than two (2) days. Contractor to give written notice to Engineer and Navy of all visits by manufacturer representative seven (7) calendar days in advance.

3.3 TRAINING

Contractor to furnish services of a qualified manufacturer's representative to train Navy personnel on proper use of system for two (2) days of not less than eight (8) hours each.

-- End of Section --

INSTALL? TEST? SERVICE? TRAIN?

PROVIDE SERVICE for ONE YEAR? MAINTENANCE?

SECTION 13004

DATA PROCESSING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

Contractor shall furnish, install, integrate, and test computer hardware, computer software, and office equipment as specified herein. A summary of requirements is in Schedule 13004-1.

Schedule 13004-1

Building	Computer	Software[1]	Office Equipment
C-21	System No. 1 486-66 IBM-PC	a) Remote Control Software b) Communications Software c) Data Base Software d) Spreadsheet Software e) Fax Software	Desk, Chair

Note for Schedule 13004-1

[1]Software which is required to be furnished for other systems specified in Sections 13001, 13002, and 13005, is not listed here and is supplied by manufacturers supplying equipment for those systems.

1.2 RELATED SECTIONS

The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers.

a. Section 13001 - Enhanced Tank Monitoring System
b. Section 13002 - Standard Tank Monitoring System
c. Section 13003 - Fuel Management System
d. Section 13005 - Soil Vapor Monitoring System
e. Section 13211 - Underground Storage Tank Retrofit
f. Section 16499 - Telephone Service and Communications

1.3 PERFORMANCE SPECIFICATIONS

a. Automated Software

Contractor shall develop, or have developed, an automated MS-DOS based software routine through which settings can be modified by Navy personnel. Software which shall have the following features:

(1) At user-specified time intervals (default time shall be 10:00 pm each week-night) automated software routine shall execute, "call-up", or "run", in a user specified order and time, the software provided by system suppliers for equipment supplied under the following sections:

Section 13001 - Enhanced Tank Monitoring System
Section 13002 - Standard Tank Monitoring System
Section 13003 - Fuel Management System
Section 13005 - Soil Vapor Monitoring System

(2) Each manufacturer's software shall be called up in a user-definable order using this routine. When each routine is completed, the next shall execute.

(3) The software shall be menu-driven and shall allow up to 20 different programs to be executed at any time over a total period of 7 days or greater.

1.4 SUBMITTALS

a. Submit in accordance with Section 01300, "Submittals."

b. Shop drawings shall describe compliance with these specifications

c. Manufacturer's instruction manuals shall be supplied in permanent - bound 3-ring binders. Instructions shall describe operation of all hardware and all software.

PART 2 PRODUCTS

2.1 COMPUTER SYSTEM NO. 1

Complete working system, including all appurtance such as cables, shall have the following features, as a minimum:

a. Intel 486-66 processor, 8 meg RAM

b. Duplex operation, dual 1.0 gigabyte hard drives with less than 12 ms access time, IDE or SCSI interface

c. Tower case

d. 3 1/2" and 5 1/4" floppy drives

e. IBM PC-compatible, DOS based

f. Modem, V32bis, 14.4 kbps, external with 9600 or greater bps fax send/receive capability

g. SVGA color monitor and graphics adaptor with 1 megabyte memory minimum, VESA color local video

h. Latest availabe MS-DOS operators system

i. Adequate hardware expansion available to enable connection to a network environment

j. EISA or microchannel bus, with VESA bus to video adapter and hard drive controller

k. 600 dpi laser printer

l. Uniterruptible power supply (UPS) with 30-minute battery backup capability for complete system; software to warn user of electrical outage and to automatically power down

m. 2 serial, 2 parallel port, 1 bus-mouse port, all cables

n. Mouse with driver software

o. Keyboard with driver software

p. Keyboard, enhanced

q. Digital tape backup system with automatic scheduling backup software, SCSI interface, 1.0 gigabyte or greater storage capability per tape, 16 bit or greater card. Provide seven (7) storage tapes.

r. Multiple outlet strip, 5 plugs each.

2.2 NEW MODEM AT BUILDING C-14

Provide, install and test one new modem and new software to an existing IBM-compatible PC.

Modem shall be V32bis, 144 kbps, external, with 9600 or greater bps fax send/receive capability. Supply all cables.

Software shall include Remote Control Software, as specified in paragraph 2.3.A, and Fax Software, as specified in paragraph 2.3.F.

2.3 SOFTWARE

2.3.1 Remote Control Software

Asynchronous Remote Computer Control software shall be supplied, installed and tested and shall be compatible with computer system No. 1. Software shall allow any PC to access and control a host PC for remote computing and complete general communications via a serial or modem connection. Capabilities shall include:

a. Control a host PC from any PC, PS/2 compatible, or terminal via a modem or direct serial connection.

b. Control a host PC running Windows 3 in Real, Standard or 386 Enhanced Mode, including full Mouse support.

c. Bidirectional high speed file transfer in the foreground or background.

d. General communications capabilities:

(1) Terminal emulations include ANSI, VT100, VT102, VT52, VT220, (7 & 8 bit), DG 100 and DG 200, ADM 3A, IBM 3101, Televideo 912, 920, and 925, Adds Viewpoint, Hazeltine 1500, Wyse 50.

(2) File transfer protocols include ASCII, XMODEM, YMODEM, ZMODEM, and Kermit Families.

(3) Advanced Script Language.

(4) Character translation tables.

(5) Programmable function keys.

e. Serial communications rates up to 115,200 bps.

f. Full support for CGA, MDA, EGA, VGA with automatic graphics translation.

g. Built-in process control language for automating repetitive functions -- such as unattended file transfer to multiple sites after business hours.

h. Fully automated, menu driven installation, built-in hardware diagnostics, simultaneous printing at host and remote locations.

i. Program can be loaded into high memory and can be removed from memory.

j. Call logging and session record and playback functions.

k. Automated dial directory to store and dial telephone number of host PC to be accessed.

Drivers shall be supplied specifically for the modems supplied with Computer System No. 1. Software shall have script language capable of allowing automated scheduled downloading of information to remote PCs or terminals without computer operator assistance.

Software shall be the latest DOS-based Symantec PC-anywhere, or equal.

2.3.2 Communications Software

A remote communications software package shall be supplied, installed, and tested, and shall be compatible with Computer System No. 1. This software shall emulate terminals and shall have a script language capable of automated and scheduled routines. This software package shall be different than the Remote Control Software.

Software shall be the latest DOS-based Data Storm Procomm or equal.

2.3.3 Database Software

A single-user database program shall be supplied, installed and tested and shall be compatible with Computer System No. 1.

Software shall be the latest DOS-based Ashton-Tate dBase or equal.

2.3.4 Spreadsheet Software

A single-user spreadsheet program shall be supplied, installed and tested and shall be compatible with Computer System No. 1 Software shall be the latest DOS-based Lotus 123 or equal.

2.3.5 Fax Software

Compatible with fax/modem supplied. DOS-based send and receive capabilities. Program shall run as a terminate-and-stay (TSR) application.

2.4 OFFICE EQUIPMENT

2.4.1 Desk

Desk shall be fabricated of formica coated board of minimum thickness of desk top shall be 1"; all other components shall be minimum 1/2" thick. Legs and trim shall be chrome-coated steel. Minimum desk-top dimensions shall be 6'0" x 3'-0". The desk shall have drawers on one side only. Drawers shall have locks and two keys shall be supplied.

2.4.2 Chairs

Chairs shall be a swivel-base chair on rolling wheels and shall be cushioned with arm rests.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

a. Contractor shall install desk, chair and computer systems into each Building. Location of computer system No. 1 shall be as shown on Contract Drawings T5. Location of the existing computer system at Building C-14 shall be designated by Navy during construction. Contractor to make written request for new modem at Building C-14 location. Navy shall respond within fourteen (14) working days.

b. Contractor shall completely install computer systems complete with cables between equipment and to power outlet strip and existing nearby 120 VAC power outlet, and phone system. Components shall be assembled on desk as shown in drawings.

3.2 TESTING AND INITIAL OPERATION

a. Initial Operation

Contractor to operate each system to ensure that it operates to specified herein and that system works in conjunction with other systems specified in Sections 13001, 13002, 13003, and 13005.

b. Testing

Upon successful completion of Initial Operation, Contractor shall operate computer system #1 in the presence of Engineer to demonstrate proper operation of system. Perform the following testing as a minimum:

(1) Contractor shall operate the automated routine specified under paragraph 1.3.A of these specifications through its entirety to show that each manufacturer's software executes in order at a user-specified time with NO operation intervention. This test shall be run three (3) times between each test, the entire system (printer, computer, UPS, etc.) shall be shut off.

(2) Tests shall also demonstrate that UPS powers down on power-outage automatically.

(3) That printer and other peripherals are properly configured for use with all software and hardware supplied under this specification section.

(4) Operation of modems and communications between Computer System No. 1 and the new modem and software at Building C-14 shall be demonstrated using both the Remote Control Software and Fax Software.

(5) A successful demonstration of tape backup procedure shall be made, including scheduling of backup routines.

3.3 SERVICES OF CONTRACTOR'S PROGRAMMER

Contractor shall provide the services of a competent, professional computer programmer and integrator for at least five (5) working days of not less than eight (8) hours each day after successful completion of Initial Operation and Testing. This professional's visits shall be scheduled ten (10) days in advance in writing to both the Navy and Engineer. The Professional shall be available for training Navy personnel in proper use of System and in setting up systems including integrating and customizing the software supplied under Sections 13001, 13002, 13003, and 13005.

Qualifications of Contractor's Programmer shall be:

a. Five (5) years minimum full-time experience working with IBM-compatible DOS-based computers.

b. Bachelor of Science in Computer Science

c. Three (3) professional references to verify experience.

Contractor to provide proof of Programmer's qualifications one (1) month prior to his/her visit to site. Engineer or Navy may contact the references; therefore, name, title, company, address, phone number, and relationship shall be included.

-- End of Section --

EXPERIENCE IN FUEL DISPENSING OR RELATED FIELD

SECTION 13005

SOIL VAPOR MONITORING SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

Contractor shall furnish, install and test each soil vapor monitoring system. Each system shall be of aspirated-vapor type system designed to analyze the vapor concentration of Total Organic Hydrocarbons (TOH) found in the soil and backfill around motor fuel tanks. The system shall search for leaks by drawing air samples from up to 12 underground locations and electronically analyzing those samples for the vapor of leaking hydrocarbon materials (petroleum products). Complete working system includes system panel, vapor piping, vapor monitoring wells, electrical and telephone connections, and software installation.

One complete system shall be installed at Buildings C-50, E-14, R-6, and C-17. All shall have modems except for the system at E-14.

1.2 RELATED SECTIONS

The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers.

a. Section 13001 - Enhanced Tank Monitoring System
b. Section 13002 - Standard Tank Monitoring System
c. Section 13003 - Fuel Management System
d. Section 13004 - Data Processing System
e. Section 13211 - Underground Storage Tank Retrofit
f. Section 16499 - Telephone Service and Communications

1.3 SUBMITTALS

a. Submit in accordance with Section 01300, "Submittals."

b. Submit description of equipment and installation sufficient to describe location of wells, piping and equipment and to show equipment's conformance to the specifications.

c. Submit Operating and Maintenance Instructions in permanent-bound 3-ring binders.

1.4 REFERENCES

EPA Rules and Regulations, 40 CFR Part 280

1.5 PERFORMANCE SPECIFICATIONS

a. The monitoring wells used on this system shall allow vapor to be drawn from the vadose zone, the capillary area of the soil above the water table. High water tables (less than 25 feet deep) and fluctuating water levels (rising/falling cycles) shall not pose a problem for vapor monitoring with this system.

b. System shall properly operate if water table is normally 2 feet or deeper from surface. Periodic flooding of wells lasting up to three (3) days shall pose no problem in operation. Any well restrictions lasting more than 24 hours shall be noted with a system alarm message.

c. The system shall serve as a complete site monitoring and diagnostic tool. After an alarm has been activated, the system shall:

(1) Automatically call a remote personal computer - via a telephone line and modem to alert others of alarm conditions, with the optional communications interface.

(2) Confirm a vapor condition - frequently eliminating the need for expensive testing services or costly excavation work.

(3) Help identify the location of a problem.

(4) Establish a site profile.

(5) Track the migration of leaking materials.

(6) Confirm the dissipation of one-time releases or spills.

(7) Verify the effectiveness of site clean-up, repair work, or the integrity of new equipment installation.

(8) Store all monitoring events for later recall and provide historical documentation.

(9) Provide capability to receive vapors from 12 sampling points.

d. Suction of machine shall be 64" water column. Distance from system consite to any vapor sampling point, measured along transport tubing, shall be a maximum of 500 feet.

e. Operation and Configuration

(1) Automatic Operation - Three times each day, beginning at 8 am, 4 pm, and midnight, the system shall sequentially draw air samples from each active vapor sampling point. If a vapor level above the adjustable alarm is identified over three successive sampling cycles, or if a dangerously high vapor level is identified during any one cycle, the site alarm shall trigger, and a record shall be made of the day, cycle period (i.e., 08:00, 16:00, or 00:00), identification of the high vapor sampling point, and the measured vapor level. If any system problem or failure occurs, the system shall activate a system alarm and the cause shall be displayed and recorded. An "Auto-Call" feature signals a remote site of an alarm. User options to alarm immediately after one event of high vapor and subtract the background reference vapor reading shall be permitted.

(2) View Site Level - The last recorded vapor and pressure readings, for any port, can be viewed on the system's LCD display.

(3) Print Options - The system's Auto-Print function shall print the vapor level measured at each vapor sampling point over each scheduled sampling cycle during normal automatic operation. Other options that print the current, or historical, site vapor, pressure levels, or the major historical events, (alarms, set-up changes, etc.) shall be available.

(4) Operate/Setup Options - A menu shall control/initiate manual port samples, diagnostic self-tests, and external calibration. Other options controlled through this menu shall include: active sampling ports, alarm threshold levels, alarm delay option, date and time, access code option, and background subtraction option. All setup/operation options shall be accessible using modem to a remote PC.

f. The console shall also have the capability to access all data stored in the system memory. Console shall be programmable to call a remote data point automatically to obtain details of an alarm situation. The well identification and its parts per million (ppm) hydrocarbon level shall be accessible through the Liquid Crystal Display (LCD) panel on the front of the system console. For site management, information displayed shall differentiate between leaks, spills, and overfills from a range of 50 to 25,000 ppm total organic vapors.

g. Site monitoring information shall be available from internal Read Only Memory (ROM) non-volatile memory for up to five (5) years. Automatic sampling mode shall be 20 minute vapor cycle from each point per eight (8) hours. Such data shall be accessible from a remote intelligent terminal, or printed on demand from the console. Entire system shall have diagnostic messages which are complete and easy to understand for Navy personnel.

h. Front panel LCD shall detail system status, system failures, and vapor alarms. All sampling, alarm and event data shall be stored in non-volatile memory for access at any time by user personnel. Software options shall encompass: current site status and configuration, historical site vapor levels, or historical alarm events and configuration changes, and be transferrable to a disk if required.

1.6 ELECTRICAL REQUIREMENTS

Provide electrical components of mechanical equipment and systems such as motors, controllers, contractors, and disconnects under Division 16, as specified herein, and as necessary for complete and operable systems, except the controllers indicated as part of motor control centers shall be provided under Section 16402, "Wiring System"; these components shall meet the minimum requirements as specified in Section 16011, "Electrical General Requirements," and Section 16402, section covering the associated mechanical equipment.

Provide interconnecting wiring for components of packaged equipment as an integral part of the equipment. Interconnecting power wiring and conduit for field erected equipment and control wiring rated at 100 volts or higher and conduit shall be as specified in Section 16402. Control wiring rated at 100 volts or less and conduit shall be as specified in Division 16. Motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to mechanical equipment shall conform to Section 16402.

1.7 NAMEPLATES

FS L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches. Lettering shall be a minimum of 0.25-inch high normal block style.

PART 2 PRODUCTS

2.1 SYSTEM COMPONENTS

a. The system console shall contain an aspirator pump, a self-cleaning metal Oxide Semi-Conductor (MOS) vapor sensor, system microprocessor, communications and printer interface ports, and other operating components. The system console shall be located inside using 115 VAC power, mounted on an outside wall.

b. Fresh Air intake, exhaust, and fresh air wash-down lines shall be routed from the system console to a point outside the building. Fresh-air intake and wash-down lines shall be filtered.

c. A background reference sampling point shall be located at a point on the site that would not normally be exposed to vapors from leaking or spilled materials.

d. From 1 to 12 vapor sampling points, slotted 2-inch ID pipe or 0.03 +/- 0.01-in. well-screen shall be inserted into pea-gravel backfill for single-wall tanks and product piping.

e. Transport tubing of 1/4-inch ID x 0.062-inch wall high-density polyethylene with a diffusing filter/restrictor assembly clamped at the sampling end shall link each sampling point to the system console.

f. PVC conduit shall serve as carriers and protection for the transport tubes.

g. A water-tight well-head enclosure shall be used at each vapor sampling point.

h. A dedicated telephone line installed as indicated in Section 16499, "Telephone Service and Communications", shall all automatic calling in case of alarm and shall allow remote monitoring of the site by calling from a remote PC. Software shall be supplied and installed on a computer system No. 1 and 2 for these purposes (Reference Specification Section 13004, "Data Processing Systems") 1200 bps internal modem shall be integral with system.

i. System console shall not exceed 17" wide x 20" high x 5" depth.

j. The UST at E-14 shall have an on site alarm mounted on outside of the building rather than a remote modem connection to C-21.

k. Vapor sensor to be installed in a 4" diameter schedule 40 PVC slotted well casing. The bore hole diameter must be a minimum of 4 inches greater than the casing diameter clean sand/gravel pack of appropriate size for formation must be placed in bore hole for length of screening. At the top of the boring, a water proof casing seal should be installed. The top of the well should be sealed with a waterproof cap.

PART 3 EXECUTION

3.1 INSTALLATION

a. Contractor shall follow manufacturer's recommended installation instructions.

b. Contractor shall supply and have software installed on Computer System No. 1.

c. A system console shall be mounted on the wall of the operations building at each site at not less than 72" above the highest soil gas collection well top.

d. Contractor shall install gas tramsport tubes without kinks, pinches or bends that may constrict soil gas flow.

3.2 INITIAL OPERATION AND TESTING

Contractor shall operate the system in the presence of Engineer to demonstrate proper operation. Contractor shall notify Engineer ten (10) days in writing in advance of such demonstration.

3.3 SERVICES OF MANUFACTURER'S REPRESENTATIVE

Contractor shall provide the services of a qualified, competent manufacturer's representative's time on-site to train Navy personnel in operation and maintenance of systems and to install, demonstrate and integrate software to Computer System No. 1 and 2, for two (2) days of not less than eight (8) hours each day.

A return visit two (2) weeks after successful operation of all systems has occurred and shall be made by a manufacturer's representative to examine systems data readings, to adjust system settings to account for background levels of chemicals, and to interpret results of data. Written report shall be made and submitted to Engineer and Navy within seven (7) days of this visit.

3.4 SOIL INFORMATION AND PERMITTING

Contractor may request boring logs and on-site soil information from Navy during construction to present to NJDEPE. Contractor shall obtain permits from NJDEPE prior to installing each system.

-- End of Section --

SECTION 13006

CANOPIES

PART 1 GENERAL

1.1 SECTION INCLUDES

Metallic-construction, overhead canopies shall be provided at the following locations, with overall dimensions as indicated on contract drawings. Locations are: Building R-6, Vehicle Fueling Station; Building R-6, Bulk Fueling Island; Building C-17, Vehicle Fueling Station; Building C-17, Bulk Fueling Island.

For each canopy, the following shall be supplied:

a. canopy system including structural members, fascia and decorative details

b. concrete footings and associated work

c. lighting

d. fire suppression system

e. all drainage piping and related fixtures

1.2 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S335	1989 Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.3	1985 Malleable Iron Threaded Fittings Classes (ANSI/ASME B16.3)
ANSI B16.11	1980 Forged Steel Fittings, Socket-Welding and Threaded

ANSI B18.2.1	1981 Square and Hex Bolts and Screws Inch
ANSI C136.10	1988 Roadway Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS2	1985 Structural Supports for Highway Signs, Luminaries and Traffic Signals

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	1989 Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.9	1986 Factory-Made Wrought Steel Buttwelding Fittings (ASME/ANSI B16.9)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	1985 Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 526/A 526M	1990 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 580	1990 (Rev. A) Stainless and Heat-Resisting Steel Wire
ASTM A 853	1990 Steel Wire, Carbon, for General Use
ASTM B 633	1985 Electrodeposited Coatings of Zinc on Iron and Steel
ASTM D 226	1989 Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 371	1989 Asphalt Roll Roofing (Organic Felt) Surface with Mineral Granules; Wide Selvage

ASTM D 4586	1986 Asphalt Roof Cement, Asbestos Free
ASTM E 108	1991 (Rev. A) Fire Tests of Roof Coverings
ASTM A 90	1981 (R 1991) Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
ASTM A 153	1982 (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615	1990 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM B 370	1988 Copper Sheet and Strip for Building Construction
ASTM A 27/A 27M	1991 Steel Castings, Carbon, for General Application
ASTM A 36/A 36M	1991 Structural Steel
ASTM A 123	1989 (Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	1982 (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	1991 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 563	1991 (Rev. C) Carbon and Alloy Steel Nuts
ASTM A 615	1990 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	1990 Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM A 708	1990 Repair of Damage Hot-Dip Galvanized Coatings

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4	1979 Structural Welding Code Reinforcing Steel

FEDERAL SPECIFICATIONS (FS)

FS L-P-387	(Rev. A) (Int Am. 2) Plastic Sheet, Laminated, Thermosetting (for Design Plates)
FS QQ-N-281	(Rev. D) (Am. 2) Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC	Uniform Building Code (UBC)

1.3 SUBMITTALS

1.3.1 Manufacturer's Catalog Data

Contractor shall submit detailed canopy catalog information and components source documents for approval. Included shall be details of canopy structure, column foundations; roof and structural decking, on top and underneath canopy internal structure; fascia and closure materials; electrical components; lighting components and mountings; fire suppression system; plus related items.

1.3.2 Drawings

Contractor shall submit a set of drawings that fully details all aspects for each canopy size and location. Drawings shall each carry a Professional Engineer's (PE) seal and review signature.

The canopy manufacturer shall furnish the anchor bolt pattern, foundation dimensions, and all shop drawings necessary, upon notification of bid acceptance by the Contractor. The canopy manufacturer shall then provide a set of drawings with a NJ Professional Engineer's seal, together with calculations for each canopy design, to the Engineer of Record.

1.3.3 Design Calculations

Contractor shall submit a set of design calculations and assumptions for each canopy configuration and location. Calculations shall encompass design spans, wind uplift from hurricane force loads; snow and ice loading; internal structure, facades, and finishes; lighting fixtures and fire suppression equipment; and related.

1.3.4 Instructions and Manuals

Canopy manufacturer or Contractor shall provide sets of instructions for proper installation of basic canopy components; lighting installation and operations, standard and emergency sub-systems; electrical components and systems; fire suppression installation, operation and recharging procedures for each canopy. Operation and Maintenance Manuals (O&MM) shall be provided for each item noted above.

1.3.5 Certificates

Contractor shall provide Certificates of Warranty for each canopy in terms of structural integrity and resistance to loadings from above the below; all electrical components and lighting fixtures; facade and decking durability; and related canopy aspects, for not less than 5 years after installation and U.S. Navy acceptances.

1.4 QUALITY ASSURANCE

1.4.1 Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for not less than two (2) years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The produce shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

1.4.2 Service Support

The equipment items shall be supported by service organization which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.4.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.5 DELIVERY, STORAGE, AND HANDLING

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 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for the use of the operation and maintenance personnel. The operation instructions shall include the following:

a. System Descriptive Information: Wiring diagrams, control diagrams, rain piping diagrams, control sequence and operating points for each principal system and item of equipment. Post instructions where directed.

b. Equipment Instructions: Attach to or post adjacent to each principal item of equipment and include directions.

   (1) Start up, proper adjustment, operating, maintenance, and shutdown procedures.

   (2) Safety precautions, procedure in the event of equipment failure.

   (3) Other areas as recommended by the manufacturer of each system or item of equipment.

Print or engrave, and frame under glass or in approved laminated plastic. Operating instructions exposed to the weather shall be made of weatherproof materials or enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.7 RELATED SECTIONS

The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers:

03302	Cast-In-Place Concrete (minor construction)
05358	AFFF Fire Extinguishing System for Haz/Flam Material Facility
16011	Electrical General Requirements
16375	Underground Electrical Requirements
16402	Interior Wiring Systems
16530	Exterior Lighting

1.8 PERFORMANCE SPECIFICATIONS

1.8.1 Canopy Footings

Canopy manufacturer shall design concrete footings for each canopy system integral with manufacturer's structural designs. The canopy manufacturer shall design column footings for each canopy, and shall consider variations in location, wind loading, soil conditions and other conditions necessary to ensure a safe and functional footing system. Footings shall be designed not to interfere with surrounding structures such as dispenser islands, buildings, building footings, conduit, pipes, bulk fuel station footings and columns, and other structures. Canopy manufacturer shall consider unique designs for each canopy system.

Contractor shall install canopy footings after Engineer's review of Canopy manufacturer's footing design. Concrete shall be placed in conformance with Specification Section 03302, Cast-In-Place Concrete (Minor Construction).

1.8.2 Canopies

Canopy manufacturer shall design and provide complete working canopies which meet the requirements of these specifications and drawings. The designs shall include canopy structure; fascia; decorative materials, layout and design; decking; roof; lighting fixture mountings; coordination with fire protection system components; electrical systems (conduit, conductors, connectors and boxes layout and sizing); drainage and piping; any canopy related appurtenances; and any other components necessary to make a complete working system. Canopy manufacturer shall provide complete canopy system including structural components, connectors, decking, roof fascia, decorative lettering, paint and coatings; as well as lights and all light mounting fixtures, and coordinated fixtures, openings or spaces for fire protection system components.

Contractor shall install the canopies and all related systems including electrical systems, fire protection system, and drainage piping in accordance with these specifications and drawings and in accordance with Canopy manufacturer's installations and recommendations.

1.8.3 Compatibility With Other Systems

Each canopy design shall be compatible with, and allow for coordination with related systems. Included are fire suppression, lighting under normal and emergency conditions, placement of columns and footings around dispenser islands, the dispenser island services buildings, below ground piping and electrical systems.

1.9 CANOPY CLEARANCE HEIGHTS AND SPANS

Canopy clearance heights and spans shall be obtained from Contract Drawings.

PART 2 PRODUCTS

2.1 STRUCTURAL FRAME

Structural steel for each canopy frame shall be not less than AISC A-36 structural strength. Columns, beams and girders shall be wide-flange, hot rolled sections, shop primed with red oxide primer.

2.2 DECKING MEMBERS

The decking members and deck pans shall be galvanized steel, not less than 3 inches deep by 16 inches wide in a gauge thickness not less than 19 gauge, G-90 material. Deck pans shall be provided with flat bottoms, finished with a white acrylic #80 gloss finish. Stucco embossed finish shall not be permitted.

2.3 DECKING ATTACHMENTS

Canopy decking shall be attached with bolt-type panel clips. Decking members or materials shall not be pierced by bolts, and clips shall not require welding attachment procedures.

2.4 FASCIA

Each canopy fascia shall be pre-finished galvanized steel, thickness not less than 24 gauge. Fascia shall be laminated to a foam core center, not less than one inch thick, with a 22 gauge galvanized steel backer plate, attached to a steel channel not less than 2 inches by one inch, with galvanized surface coating.

2.5 FINISHES

Each canopy member or material shall be provided by the canopy manufacturer as follows:

2.5.1 Columns

Shop primed with red oxide plus epoxy-polyurethane coating system with the following coats: intermediate epoxy coat of 4.0 total min dry mil thickness, finish coat of semi-gloss polyurethane top coat of 2.5 total min dry mil thickness.

2.5.2 Girders and Beams

Shop primed with red oxide plus epoxy-polyurethane coating system with the following coats: intermediate epoxy coat of 4.0 total min dry mil thickness, finish coat of semi-gloss polyurethane top coat of 2.5 total min dry mil thickness.

2.5.3 Deck Pans

Roll coated polyester-based white paint, as a prefinish coating.

2.5.4 Fascia

Baked enamel paint, as a prefinished coating.

2.6 ELECTRICAL SYSTEM

2.6.1

Canopy lighting fixtures and signage shall be provided by the Canopy Manufacturer in accordance with the quantity and layouts as indicated on drawings, and as specified in Specification Section 16530.

2.6.2

Electrical systems for canopy lighting, except lights and light mounting fixtures, and as necessary to actuate fire suppression equipment, shall be provided by the Contractor.

2.7 CONCRETE FOUNDATIONS

Concrete foundations shall be 4,000 psi reinforced concrete and shall account for anchor bolts and columns.

2.8 STORMWATER DRAINAGE

The Canopy manufacturer shall provide rain water gutters and leaders for each canopy. Drainage for rain and stormwater shall be of a perimeter type, directed to leaders or downspouts attached to the interior of appropriate canopy columns.

Canopy manufacturer shall supply, and Contractor shall install, not less than two (2) downspouts per canopy (only one typical downspout is shown on each drawing for typical placement); for rapid and full removal of stormwater, and to provide alternate rain disposal in cases one downspout clogs.

PART 3 EXECUTION

3.1 PERMITS

Contractor shall obtain all necessary NJ state and local permits for concrete work and for erection of canopies as required by regulations.

3.2 INSPECTION

Prior to preparation and assembly, the Contractor shall inspect the canopy components and materials for physical damage and effect repairs in accordance with the manufacturer's written instructions. Overwrapping the damage of a facility area with any type of patch will not be permitted.

Aside from touchups, damaged materials shall be replaced at the expense of the Contractor, unless the canopy manufacturer supplied defective parts or materials.

-- End of Section --

SECTION 13211

UNDERGROUND STORAGE TANK RETROFIT/INSTRUMENTATION SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

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

MILITARY SPECIFICATIONS (MIL SPEC)

MIL-V-18435	1987 Valves, Checks, Bronze Cast Iron and Steel Body
MIL-P-29206	1988 Pipe and Pipe Fittings, Glass Fiber Reinforced Plastic for Liquid Petroleum Line
MIL-C-18480	1987 Coating Compounds Bituminous Solvent Coal Tar Base

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147	1989 Sources of Standards for Subpart J General Environmental Controls

FEDERAL SPECIFICATIONS (FED SPEC)

L-P-387	1971 Plastic Sheets Laminated Thermal Setting (for Designation Plate)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	1990 Flammable and Combustible Liquids Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	1990 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

1.2 SUBMITTALS

1.2.1 SD-02, Manufacturer's Catalog Data

a. Dispenser System Upgrades G
b. Dispenser Replacement - Gas Station G
c. Stage II Vapor Recovery System G
d. Valves, Check & Float Type G
e. Valves - 2 Inch and Smaller G
f. Flexible Connectors G
g. Containment Sump/Dispenser Sump and UST Manway Sump G
h. Double Wall Piping G

1.2.2 SD-04, Drawings

a. Dispenser System Upgrades G
b. Dispenser Replacement - NEX Gas Station G
c. Stage II Vapor Recover System G
d. Containment Sump/Dispenser Sump and UST Manway Sump G
e. Double Wall Piping G

1.2.3 SD-06, Instructions

a. Piping Leak Detection System G
b. Dispenser Replacement G
c. Stage II Vapor Recovery G
d. Double Wall Piping G

1.2.4 SD-13, Certificates

a. Dispenser System Upgrades G
b. Dispenser Replacement - NEX Gas Station G
c. Valves, Check & Float Type G
d. Valves - 2 Inch and Smaller G
e. Flexible Connectors G
f. Containment Sump/Dispenser Sump and UST Manway Sump G
g. Double Wall Piping G

1.2.4.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), Military Specifications (MIL SPEC), and National Fire Protection Association (NFPA), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.2.4.2 Independent Testing Organization Certificate

In lieu of the label of listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.2.5 SD-19, Operation and Maintenance Manuals

1.2.5.1 Operating Instructions

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

1.3 QUALITY ASSURANCE

1.3.1 Equipment and Instrumentation Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for two (2) years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

1.3.2 Service Support

The equipment items shall be supported by service organization which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.4 DELIVERY, STORAGE, AND HANDLING

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.

1.5 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for the use of the operation and maintenance personnel. The operation instructions shall include the following:

a. System Descriptive Information: Wiring diagrams, control diagrams, piping diagrams, control sequence and operating points for each principal system and item of equipment. Post instructions where directed.

b. Equipment Instructions: Attach to or post adjacent to each principal item of equipment and include directions.

   1. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

   2. Safety precautions, procedure in the event of equipment failure.

   3. Other areas as recommended by the manufacturer of each system or item of equipment.

Print or engrave, and frame under glass or in approved laminated plastic. Operating instructions exposed to the weather shall be made of weatherproof materials or enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.5.1 Lockout of Energy Sources

Provide appropriate lockout devices for energy isolating valves and for machines or other equipment to prevent unexpected start-up or release of stored electrical, mechanical, thermal or chemical energy in accordance with 29 CFR 1910.147. Lockout devices for valves shall provide a means of attachment to which, or through which, a lock can be affixed or shall have a locking mechanism built into it so than the valve cannot be moved from the lockout position until the lock is removed. Electrical isolation of machines or other equipment shall be accordance with requirements of Section 16375.

1.6 ELECTRICAL REQUIREMENTS

Provide electrical components of mechanical equipment and systems such as motors, controllers, contractors, and disconnects under Division 16, as specified herein, and as necessary for complete and operable systems, except the controllers indicated as part of motor control centers shall be provided under Section 16402, "Interior Wiring Systems"; these components shall meet the minimum requirements as specified in Section 16011, "Electrical General Requirements," and Section 16402, section covering the associated mechanical equipment. Extended voltage range motors will not be permitted.

Provide interconnecting wiring for components of packaged equipment as an integral part of the equipment. Interconnecting power wiring and conduit for field erected equipment and control wiring rated at 100 volts or higher and conduit shall be as specified in Section 16402. Control wiring rated at 100 volts or less and conduit shall be as specified in Division 16. Motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to mechanical equipment shall conform to Section 16402.

Electric work shall conform to NEC Article 514, "Gasoline Dispensing and Service Stations" as defined by the NEC and as indicated on Contract Drawings.

1.7 NAMEPLATES

FS L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches. Lettering shall be a minimum of 0.25-inch high normal block style.

1.8 RELATED SECTIONS

The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers.

a. Section 13001 - Enhanced Tank Monitoring System
b. Section 13002 - Standard Tank Monitoring System
c. Section 13003 - Fuel Management System
d. Section 13004 - Data Processing Systems
e. Section 13005 - Soil Vapor Monitoring System
f. Section 16499 - Telephone Service and Communications

PART 2 PRODUCTS

2.1 DISPENSERS MOUNTED ON GRADE

a. Contractor shall provide new stand-alone remote mechanical fuel dispensers, single product 1 1/4" minimum by 12 foot side-mounted hoses and fittings/locking devices for nozzles and overhead hose retractor devices. Each shall be compatible for use with submersible pumps.

b. Each unit shall measure 52 5/8" x 25 13/16" x 18 3/8" (H x W x D) at the base with stainless steel side housings and trim. Each unit shall be rated at up to 60 gpm at up to 50 psi.

c. Contractor shall provide all hook up/connections to this system. Entire dispenser system shall have a three (3) par limited warranty.

d. Each system shall be equipped with super high-flow 1 1/4" minimum automatic nozzles. For all gasoline dispensers, a vapor-recovery system shall be furnished. All systems shall include at a minimum the following: high hose retractor, special nozzle and hanger, 1 1/4" x 12'-0" coaxial hose, vapor valve, and connection hose with swivel. Each hose system shall have break-away connectors.

e. Each system shall be remote dispenser equipped with a positive displacement, six-step rotary motion meter accurate to ± 0, 5% four-wheel, non-computing register with electric reset, a 40 mesh strainer, and 1 1/2" minimum solenoid valve in the discharge line between the hose and meter. System shall be UL Listed for hazardous locations Class 1, Group D. A dual-faced register shall be furnished to permit viewing if indicator wheels from either side of dispenser. Unit shall have interlock mechanism incorporated into computer to permit dispenser to be approved for sealing by "Weights and Measures".

f. Frame shall be 12 gauge minimum steel weldment consisting of 14 gauge minimum steel channel shaped pieces with diagonal braces. Removable front and rear door panels and slide out top panels shall be 20 gauge minimum stainless steel panels.

g. The Dial Enclosure Assembly primary item shall consist of a cast aluminum bezel. The opening shall be filled with a plastic lens retained with brackets and screws. A painted steel dial face shall be 0.045 in thick shall be retained with screws.

h. Unit shall have a 1-1/2 inch inlet ground joint union. System shall be fully equipped with vapor recovery equipment and have coaxial safety brakes and dispenser mounted coaxial valve splitter. In addition, an island-mounted retractor pole assembly shall be provided.

i. A 100:1 ratio pulser for each dispenser shall be supplied compatible with Fuel Management System, Specification 13003.

j. 10 micron filter kits for each shall be supplied for high flow (60 gpm) use with each dispenser.

k. 2" shear valves shall be supplied and installed integral with each dispenser. Provide appropriate reducers.

l. Each dispenser shall have a switched, lighted panel.

2.2 OVERHEAD DISPENSERS

Contractor shall provide overhead loading-arm pantograph dispensers at are bulk loading terminals. Loading arm reach shall be a minimum of 12 ft. System shall provide approximately 150 gpm using a 2HP submersible UST pump.

All above-ground piping at the bulk loading terminals shall be steel with 200 threads, welded connections.

Dispenser system, beginning at ground level towards the dispenser arm shall consist of the following:

(1) flanged, carbon steel, full-port ball valve, 2"

(2) flanged, carbon steel strainer, basket-type, 2"

(3) flanged, 2" solenoid control valve, electrically interconnected to fuel management system

(4) flanged, fuel-port ball valve, carbon steel, 2"

(5) vertical, flanged, 2" carbon steel meter with resettable register with 1871 pulser

(6) flanged, full-port carbon steel ball valve, 2"

a. For diesel or fuel oil:

2" flanged, carbon steel, aluminum pantograph-type loading arm with remote control lever and deadman valve, or

b. For gasoline:

2", flanged, carbon steel, aluminum, top loading, vapor return arm, with deadman control and remote lever and high level control with visual indicator

(7) Mechanical flowmeter/totalizer shall be resettable and capable of registering 200 gpm flow. Mount meter in a location accessible during loading procedures.

The loading arm shall be supported securely by brackets and supports supplied by loading arm distributor.

Thermal reliefs of 1/2" diameter shall be installed around all ball valves at each bulk dispenser.

2.3 STAGE II VAPOR RETURN SYSTEM

A complete Stage II vapor recovery system shall be installed to all gasoline systems and shall consist of the following components:

a. Splitter valve for each hose - Installed into concrete island adjacent to dispenser hoses, on each side of dispenser.

b. Containment sump - Installed under dispenser to contain fluid seepage.

c. Flexible boot assembly - from vapor recovery pipe to containment sump. Flexible metallic connector for supply pipe to sump.

d. Vapor recovery pipe seals and fuel supply entry seals at entry to sump.

e. Flexible hose assembly-from pan to "T" fitting.

f. A "T"-fitting inside each dispenser for connection to galvanized pipes.

g. Galvanized steel pipes for connection from T-fittings to splitter valves.

h. Union check valve-in lines from sump to dispenser.

i. Suction line offset adaptor for misalignments.

j. U-clamp anchor.

k. Safety or Impact valve-double poppet.

l. Hose extension pole - mounted against dispenser.

m. Hose retractor.

n. Coaxial hose clamp.

o. Coaxial vapor recovery hose, width positioned multi-port evacuation venturi.

p. Coaxial vapor recovery nozzle.

q. Hose breakaway vapor valve.

r. Commensurate couplings and fittings for all the proceeding components.

s. Restrictor vent on vent pipe flange, at UST connection.

t. Vapor check valve-on vent pipe.

u. Adaptor with vapor check valve on fill pipe at top, just below grade.

v. Toggle lever cap or latch cap-on top of vapor check valve adaptor.

w. Any other components or fittings required for Contractor to satisfactorily and completely modify dispenser and tank, piping for Stage II vapor recovery. Included are rubber test reducers and flexible boots.

2.4 SUBMERSIBLE UST FUEL PUMPS

Submersible UST fuel pumps shall be installed in existing USTs in accordance with manufacturers recommendations. Each pump shall have single phase, 60 cycle, 208-230 volt U.L. listed motors. Pump features shall include the following:

a. One small assembly shall contain all functional elements of the pump; check valve, air eliminator, expansion relief valve, syphon nozzle and venturo, syphon check valve, and pressure test screw. Entire assembly shall be removable as a unit by removing two machine screws. The two machine screws, the capacitor, and electric disconnect shall easily be accessible - a must be within reach from manhole cover.

b. Pump shall be equipped with leak detector which fits between pump and dispensers and operates automatically. Detector shall fit on top of pump.

c. 1-1/2 HP pumps shall fit standard 4" NPT tank opening; 2 HP shall fit 6".

d. Bayonet-type electrical connector shall provide a safe explosion-proof electric disconnect without separating wires.

e. To assist in line pressure-testing, pressure relief valve and check valve shall be able to be isolated.

f. Tank test and line test ports shall be located on top of discharge manifold.

g. Manifold assembly leakage shall be directed into storage tank if leakage occurs.

h. Motor shall be equipped with on-winding thermal overcurrent protector.

i. Pump shall be capable of direct wiring on wired using a control box by using a permanent split-phase capacitor motor.

j. Impellers shall be hydraulically balanced. 16 spline shaft shall be supplied.

k. For existing USTs which are connected to any bulk loading arm dispenser, 2 HP pumps shall be provided. For existing USTs which are not connected to any bulk loading arm dispensers, 1-1/2 HP pumps shall be provided.

l. Manufacturer shall supply pump curve and operating literature.

m. Contractor shall install and furnish a pump starter relay for all motors 1-1/2 HP and larger, compatible with Fuel Management System, Section 13005.

2.5 VALVES, CHECK AND FLOAT TYPES

Valves shall be placed on pipes in the UST piping manway or "wet sump", at the fuel dispensers, and on fill and vent pipes to prevent backflow and overfill conditions. They shall be provided as indicated.

Valves in noncorrosive aviation fuel systems shall have aluminum (Alloys 3003 or 6061) or stainless steel (Type 304 or 316) bodies and not contain zinc, zinc-coated, copper, or copper-bearing materials in contact with the fuel. Other valves shall have carbon bodies and bonnets. Cast-iron or bronze-bodied valves shall not be furnished or installed in liquid petroleum service.

Must conform to MIL-V-18436, Type IV, Class 150, nonslamming type, except as specified otherwise.

Pressure relief type valve shall be mounted in the fuel line where there is a submersible (pressure) pump to hold the prime. These valves relieve thermal expansion between the pump head and dispenser, usually set at 25 psi, in a 15-35 psi range. Angle check valves shall be used in suction systems as added protection for holding fluid in both lines, if activated. Valves shall have cadmium-plated cast iron body and precision-machined bronze seat for positive vent.

Safety valve or "shear valve" must have double flapper poppets for positive shut off of supply pipe as well as for the line up into dispenser, to hold fuel already in the dispenser but not yet pumped out the nozzle, in case of shear-off from impact or fire. Impact valve must provide 100 percent liquid-tight seal. Shall be cadmium-plated for corrosion resistance, with stainless steel shaft and spring construction.

Vent valve assembly must be used to restrict the vent system, when fuel level in a UST reaches 90 percent of capacity, alerting fuel delivery person to stop tank filling. Valve must be mounted on UST flange with vent pipe assembly on opposite side. Float vent valve and must be mounted inside the UST at the vent port. Float vent valve must have a polymeric-coated steel body, with galvanized steel cage and stainless steel float ball.

2.6 VALVES - 2 INCH AND SMALLER SIZES

Valves for stage I vapor return from fill back to delivery truck at vents for smaller tanks, and for use at dispensers shall follow specification 2.5 regarding valve materials and construction.

Valve assemblies of 2 inch diameter and smaller shall include splitter valves at dispenser hose connections, inside dispenser containment sump, at vent pipe for USTs of 6,000 gallons and less, and in UST manway sumps for vapor return pipe. Also included are union check valves, safety or impact valves below dispenser in containment and pressure relief valves for submersible pumps.

Splitter valve shall be used at the base of a dispenser to separate vapor return and liquid return from dispensing nozzle. Splitter valve must be 5/8 inch or 3/4 inch diameter, with cast iron or galvanized steel body. Minimum Class 150, full bore, non-lubricated double-seat type.

Safety valve or impact valve shall be designed and so as to separate and instantly snap shut if dispenser is sheared off or consumed in a fire. One valve poppet shall instantly seal off fuel supply, the other valve poppet shall seal and hold fluid from dispensing hose and nozzle above the suction pump.

Union mounted check valve shall seal off loss of prime caused by damage to foot valve, angle check valve, or vertical check valve. Shall contain a screen to prevent contaminants from entering the fuel supply pump. One model shall be mounted in fuel lines directly below the dispenser in a suction system, another model is configured for use is a suction line until a damaged valve is repaired or replaced. A double-actuating valve shall be installed into coaxial delivery hose to seal supply when hose is broken off.

2.7 FLEXIBLE CONNECTORS

Shall be used to connect vapor recovery pipe to UST manway sump, from vapor recovery pipe to dispenser containment sump, and within the sump up to the T-fitting which gathers vapors form splitter valves on either side of a dispenser.

Construction of four (4) foot long tubing must be 40 mil (or greater) cross-linked polyolefin, for interconnection between vapor recovery pipe and sump/manway or sump/pan. Interior wall material shall be heat-activated thermoplastic sealant, which softens and bonds when heated to fill voids and must provide a barrier against water, moisture, dirt and contaminants.

Vapor recovery hose shall be co-axial in design with a nominal 5/8 inch diameter inner hose, constructed of PVC or HDPE thermoplastic with one textile braid and nominal 1-1/2 inch diameter outer hose constructed of encapsulated wire helix over black urethane plastic. Inner hose shall incorporate a pre-positioned multi-port evacuative venture system to ensure full-flow vapor passage. Maximum pressure inside hose shall not exceed 150 psi. Fittings shall consist or molded-on vapor recovery couplings and cuffs, as 1 7/8 inch -12 UN-2A threads, or equal.

Rubber test reducers, with mold-in nipple, shall be installed inside the containment sump to provide a means of testing the secondary containment piping system. Flexible entry boots with clamps shall be installed on pipe and conduit entries into the containment sump to seal entry through the sump from any side or bottom.

2.8 FITTINGS

Shall be incorporated into each coupling, hose, pipe, conduit, reducer, boot and related material items to ensure liquid-tight and vapor-tight connections. Fittings must be constructed of cast iron, galvanealed steel, or malleable iron. Clamps for positive seals and connections must composed of Type 304 stainless steel or galvanealed spring type steel.

Fittings must have National pipe thread (NPT) male or female threading, diameter and length to be consistent with each application. Included are T-fittings, union connectors, hose extender, and related types.

2.9 CONTAINMENT SUMPS/DISPENSER SUMPS AND UST MANWAY SUMPS

Dispenser sumps and UST containment sumps shall be provided below each fuel dispenser, at each refueling station for overfills and on each tank system as specified, respectively. The tank containment sump must have a liquid tight connection between the tank and sump as well as between the sump and ground surface. The dispenser sumps must be liquid tight between the sump and the dispensers. Both gasoline and diesel fuel dispenser must receive a containment sump, but only a gasoline dispenser requires Stage II vapor recovery system components.

2.9.1 Dispenser Sump Components

The fuel dispenser containment sumps must consist of the following 10 components:

a. Mounting frame - one per dispenser sump model, frame must be composed of cast iron, ductile iron, galvanealed steel, HDPE, or equal.

b. Containment Sump - must be composed of HDPE, galvanealed steel, or equal. Size must be consistent with dispenser model configuration.

c. Pipe Entry Boots - one per pipe entry.

d. Shear (or Safety) Valve Brackets - one per pipe entry.

e. Shear (or Safety) Valve Bolts - total of 3 per shear valve bracket.

f. Eye Hooks, with nuts - one per pipe entry.

g. Stabilizer Bar - one per dispenser sump model.

h. Stabilizer Bar Bolts - total 4 per dispenser sump model.

i. Mini-Struts- Total of 2 per dispenser sump model.

j. Anchor Bolt, 6 inch lg, with Nuts - total of 4 per dispenser sump model.

2.9.2 UST Manway/Containment Sump

Manway riser, manhole extension and containment sumps, shall be constructed of virgin HDPE, or galvanealed steel with not less than 125 mil FRP permanently adhered to all external surfaces, with a 5 pound sacrificial anode attached to an external surface. Size of riser base must be 42 inch internal diameter, by not less than 33 inch height commensurate with tank depth, for attachment to existing UST manhole plate circular bolt arrangement. Collar at top of riser must be a nominal 36 inch diameter for fit inside a rain tight circular manway access frame and cover. Contractor shall verify manway dimensions, and tank burial depth.

Manway riser, or watertight sump, must have knockouts for piping and conduits. Design must be of sufficient strengths to withstand maximum burial loads of anticipated vehicle loads at grade. Construction must be corrosion-resistant, dielectric, non-degradable, and resistant to attack from microbial corrosion factors. Materials of construction must be compatible will all fuel products dispensed.

2.9.3 Manway Access Frame and Cover

A weather-tight manway access, frame and cover must be installed at grade level, supported all around for not less than 2 feet from edge of frame by a reinforced concrete slab whose top surface is level with manway cover.

For application at a product fill pipe containment sump, a cover within cover shall be provided, watertight with not less than 12 inch diameter or 12 inch by 13 inch standard cover each with pull handle.

Material of construction shall be having cast iron frame or outer ring, with not less than 14 gauge galvanealed steel skirt extending below surface 8 inch to 10 inch, depending upon size of manway riser. Cover must be not less than 3/8 inch thick steel deck plate, with inner 12 inch x 13 inch fill pipe access cover or 12 inch diameter cover. Entire cover/frame/unit must be reinforced to with stand a possible external load of not less than 24,000 pounds.

Sealer gasket must be of tube flange designed, composed of low swelling nitrile rubber, with stainless steel worn clamp. Gasket shall be viton, if required.

Alternate manway frame and cover construction of a composite composition material cannot be used.

2.10 DOUBLE - WALL PIPING

Existing single wall piping shall be removed. Double-wall piping shall be used for all replacement and new applications except for vent and vapor lines. This shall include piping from UST/AST to product dispenser. Inner or primary pipe shall be fabricated from fiberglass reinforced plastic (FRP) for petroleum tanks. Primary pipe continues through manway riser sump by means of a flexible connector hose, through angle check valve into manhole plate bung connection. Piping to the waste storage tank shall be connected to an external bung near the top of that tank.

Piping to a fuel dispenser shall be connected through a flexible connector base to a fuel-tight containment sump fitting, through the shear or safety valve, then to the dispenser pump. All fittings shall be liquid-tight and vapor-tight and compatible with the product it is being used with.

Outer wall pipe or secondary containment of a double-wall piping combination, shall be not less than 2 inches larger in diameter than primary or inner pipe. Inner and outer pipes shall be separated and held apart by plastic rings which fit around inner pipe, and placed not more than 24 inches apart. Outer pipe shall be composed of HDPE, equally dielectric, non-corrosive and non-degradable plastic material and shall have interstitial monitoring. Secondary containment pipe shall be designed to withstand maximum vehicle imposed burial loads, as loading from anticipated vehicles passing over not less than 2 feet of soil of backfill covering.

Double-wall piping shall be pitched a nominal 1/8 inch per linear foot of length back toward UST containment sump where possible. No installation of double-wall piping shall be permitted without a slope toward a containment sump. Connection from outer or secondary pipe to sump, or dispenser pan, shall be effected through a reinforced flexible hose, which is design to receive outer pipe and pass inner or primary pipe through a liquid-tight fitting. Inside sump, or dispenser pan, a flexible boot shall be attached with a mold-in nipple to permit extraction and removal of potential liquids that may collect between inner and outer pipes.

Where double-wall piping changes direction, fittings shall be used which are completely compatible with inner FRP pipe and outer HDPE, or polyethylene pipe. Inner or primary pipe shall be tested, after each connection and after not more than 40 feet of piping, to withstand an internal air pressure equal to 5 psi gage pressure. Outer pipe hydrostatic test shall be equal to 5 psi.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be executed in accordance with each manufacturer's specific written instructions and installation procedures, as approved by the Contracting Officer.

3.1.1 Instrumentation

Fluid detection sensors, alarms panels and rectifiers, shall be installed in accordance with manufacturer's requirements and in accordance with related specification sections. Electrical wiring and conduits shall be installed as per Section 16375 - Underground Electrical Work. Equipment shall be field checked prior to installation to verify it is not damaged and is in operable condition.

3.1.2 Equipment, Fittings and Valves

Devices, mechanisms, valves, containment sumps fittings and connectors shall be installed as per their manufacturer's instructions, together with specifications in this Section 13211, plus Section 16375.

Concrete slabs required shall be provided around manway access frames and above conduit change of direction.

3.1.3 FRP and HDPE Piping Field Assembly

Shall be in accordance with the manufacturer's written instructions and installation procedures as approved by the Contracting Officer.

3.1.4 Inspection

Prior to preparation and assembly, the contractor shall inspect pipe for physical damage and make repairs in accordance with the manufacturer's written instructions, except over wrapping the damaged of faulty area with any type patch or other material will not be permitted.

3.1.5 Preparation

Sand or prepare surfaces to be bonded, including those formed or shaved at the factory, not more than 2 hours prior to assembly and as by the manufactures instructions. Clean and remove sanding dust to obtain surfaces suitable for bonding. Sanded surfaces which come in contact with hands, equipment, or dirt must be re-sanded. Dry and re-sand damp or wet bonding surfaces as required by the manufacturer. During rain or cold weather, prepare joint and assemble under a protective cover with heat applied. Pipe cut to length in the field shall have ends square within 1/16 inch for all diameters through 12 inch pipe. Form spigot ends using tools recommended by the manufacturer. Align and fit prepared joints prior to application of adhesive.

3.1.6 Adhesive\Mixing and Application

MIL-P-29206, adhesive materials, mixing and application shall be in accordance with manufacturer's instructions including limitations on adhesive shelf life and pot life.

3.1.7 Assembly and Alignment

Assemble FRP pipe and fittings according to manufacturer's instructions. Proper alignment shall be maintained during assembly so that twisting or straightening is not required after joining. Misalignment shall not exceed 1/16 inch or one degree prior to application of adhesive.

3.1.8 Curing

Cure FRP pipe joints and fittings joints according to the manufacturer's instructions. Heating devices shall be as recommended by the FRP pipe manufacturer. Do not move, vibrate, or otherwise disturb joints during curing of adhesive.

3.1.9 Connections to Metal Pipe

Use flanged connections between FRP pipe and metal pipe with the metal pipe anchored within 5 feet of the connection. Do not transmit expansion and load forces of metal piping to the FRP pipe. Do not bury metal to FRP connections. Install washers under bolt heads and nuts on flanges and torque bolts in accordance with manufacturer's requirements.

3.1.10 Air Vents and Low Point Drains

Install hand operated air vents valves at all high points in the piping. Install hand operated low point drain valves at low points in the piping.

3.1.11 Pitch

Pitch horizontal buried fuel piping, and the aboveground hazardous waste piping unless otherwise indicated, with a downward grade of not less than one inch in 50 feet in the direction of low point drains.

3.2 FRP PIPE INSTALLATION

3.2.1 FRP Pipe Assembly

Visually inspect the inside of each length of pipe to ensure that it is clear and clean prior to installation. Not more than 40 foot lengths of FRP pipe can be assembled over or beside the trench. Assemble greater lengths in the trench. Assemble outside the trench on timbers with the pipe blocked to hold alignment. Lower pipe into the trench in accordance with the manufacturer's recommendations. Lowering operations shall not move or disturb FRP pipe where joints are being assembled and cured. Block and support FRP pipe assembled in the trench with bedding to hold alignment.

3.2.2 Thrust Blocks

Cast thrust blocks after successful completion of hydrostatic testing. Encase each elbow, tee, and change in size of direction of the FRP pipe in a concrete thrust block with dimensions size to handle thrusts from design temperatures and pressures in accordance with FRP pipe manufacturer's recommendations and local soil conditions. In any case, thrust block shall provide a minimum of 3 square feet of thrust bearing surface against undisturbed soil, able to withstand both tensile and compressive loads, and with a minimum pipe to bearing surface single dimension of 10 inches, and 9 cubic foot minimum volume.

Provide in-line thrust or anchor blocks as indicated on straight runs and outside of manholes and wall penetrations. Size in accordance with FRP pipe manufacturer's recommendations to handle thrusts from design temperatures and pressures. In any case, provide 4.5 square foot minimum bearing surface in each FRP pipe direction cast against undisturbed soil, 13-cubic foot minimum volume. Concrete shall conform to Section 03302.

3.2.3 Bending of Fiberglass Reinforced Plastic Pipe

Limit bending of pipe to follow ditch contours to long trench curvatures and do not permit abrupt changes in pipeline direction. Bending radii shall not be less than shown in the manufacturer's installation instructions. Do not make bends until all joints in the section of pipe to be bent are cured.

3.2.4 Open Ends of the Pipe System

Close the open ends of the pipe system at the end of each day's work or when work is not in progress and keep closed until work is resumed.

3.3 MANHOLES AND WALL PENETRATIONS

Where an FRP pipe penetrates manhole, concrete, masonry, or metal walls, provide a Schedule 40 steel pipe sleeve 2 inches larger than the pipe in accordance with ASTM A 53. Each steel pipe sleeve shall be given a coat of bituminous paint conforming to MIL-C--18480. Calk opening between sleeve and pipe with sealing compounds outside of manhole or wall penetration in accordance with paragraph entitled, "Thrust Blocks".

3.4 LINE VALVES

Provide line valves with stems positioned vertically up. Provide individual supports and anchors for line valves. Sealed valve box or pit shall prevent soil and moisture contact with valve.

3.5 FLUSHING

Prior to hydrostatic testing, flush the FRP pipe system with water until piping is free of dirt and foreign matter.

3.6 FIELD INSPECTION, TESTS AND QUALITY CONTROL

Furnish everything required for performing inspections and tests. Correct defects and repeat the respective inspections and tests.

3.6.1 Test Gauges

Use pressure test gauges certified as being accurate to within one percent of their full scale. Use gauges with maximum scale between 1-1/2 and 2 times the test pressure.

3.6.2 Field Inspections

Prior to initial operation, inspect piping system for conformance to drawings, specification, and manufacturer's submittals; submit daily written reports, as specified under "Contractor's Responsibility".

3.6.3 Field Tests

3.6.3.1 Initial Pneumatic Tests

Pneumatically test every FRP pipe and fittings and every FRP pipe to metal fittings at a pressure of 15 psig for at least 4 hours, during which Contractor shall time brush each joint with a soap solution and examine for leaks. Maintain 15 psig pressure throughout test period. The piping may be tested in sections, but test the entire installation at 15 psig prior to the hydrostatic test. Contractor shall furnish any necessary air compressors, gauges, and other equipment necessary for carrying out the tests. No taps in the line are permitted. Isolate equipment such as pumps and filter-separators from the FRP piping system during the test. Prior to starting any pneumatic testing of buried FRP pipe, portions of the pipe. Similar tests shall be conducted on outer HDPE piping except at pressures specified in Section 2.10.

3.6.3.2 Hydrostatic Test

Hydrostatically pressure test all FRP pipe and fittings and all FRP pipe to metal fittings using potable water to 1-1/2 times the maximum operations pressure or 25 psig, whichever is greater, for a period of 4 hours prior to placement of sand bedding and backfill, except as required by paragraph entitled, "Initial Pneumatic Test." The operating pressure shall be the sum of the static head pressure, pressure required to overcome friction losses, and any requiring back pressure. Provide controls and protective equipment so that the level of pressure rise above operating pressure due to surges and other variations from normal operation shall not exceed the test pressure at any point in the piping system.

Limit pressure rise to 5 psi per minute at beginning of test and pressure drop to 5 psi per minute at conclusion of test. Air or vapor at all high points in the system must be replaced by the test fluid before testing. Pressure must hold for a minimum of 4 hours with a 4 psi maximum drop. After 4 hours at test pressure and with pressure still applied, visually inspect all pipe, fittings, and joints for indications of weeping or leaking. Repair any weeping or leaking condition discovered in accordance with paragraph entitled, "Field Repairs of Pipe and Joints." During 4-hour pressure holding period, valve off system and disconnect method of pressurization. Similar tests shall be conducted on outer HDPE piping except at pressures specified in Section 2.10.

3.6.4 Field Repairs of Pipe and Joints

The contractor shall be responsible for the repair of all leaks or other deficiencies caused by faulty workmanship or materials. Make repairs to leaking pipe or joints, whatever the cause, by removing and replacing the faulty section or a short length containing the fault. Over wrapping the fault with any type of patch or other material will not be permitted. If a joint is damaged during the laying operation, it can be cut off and a coupling bonded to the cutoff end and laid in the line as a normal pipe. If damage occurs to a pipe after it has been laid, the damaged section shall be cut out and replaced with a new pipe section in accordance with the manufacturer's instruction.

-- End of Section --

SECTION 13219

CLEANING PETROLEUM/HAZARDOUS WASTE STORAGE TANKS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z88.2	1980 Practices for Respiratory Protection

AMERICAN PETROLEUM INSTITUTE (API)

API RP 500C	1984 Locations for Electrical Installations at Pipeline Transportation Facilities
API RP 2003	1982 Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents
API PUBL 2015	1985 Cleaning Petroleum Storage Tanks
API PUBL 2015A	1982 Guide for Controlling the Lead Hazard Associated with Tank Entry and Cleaning

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.134	1988 Respiratory Protection
29 CFR 1910.146	Sources of Standards
29 CFR 1910.1200	1988 Hazard Communication
40 CFR 260	Hazardous Waste Management Systems: General
40 CFR 261	Identification and Listing of Hazardous
40 CFR 262	Generators of Hazardous Waste

40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Owners and Operators of Hazardous Waste
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities

FEDERAL SPECIFICATIONS (FS)

FS TT-T-291	(Rev. F) (Int Am. 1) Thinner, Paint, Mineral Spirits, Regular and Odorless
FS O-D-1276	(Rev. B) Disinfectant-Detergent, General Purpose (Pine Oil)

MILITARY SPECIFICATIONS (MIL)

MIL-A-22262	(Rev. A) (Am. 2) Abrasive Blasting Media Ship Hull Blast Cleaning

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1990 National Electrical Code

NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 85-101	NIOSH Certified Personnel Protective Equipment List, Current Issue

UNDERWRITERS LABORATORIES INC. (UL)

UL 844	1984 (Bul. 1989) (R 1989) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations, Ninth Edition

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Cleaning agents G

b. Gasoline-oil-resisting rubber gloves and boots and personal protective equipment (PPE). G

c. Cotton coveralls and hard hat G

d. Respiratory protective equipment G

e. Disinfectant G

f. Abrasive for blasting G

Submit identification for the items by designated name, specification number, project contracting number, and intended use.

1.2.2 SD-06, Instructions

a. Tank cleaning agents G

Submit material safety data sheets for materials to be used at the job site, in accordance with 29 CFR 1910.1200.

1.2.3 SD-08, Statements

a. Safety plan G

b. Work plan G

c. Hazardous waste disposal plan G

d. Tank certification of safety G

e. Name, location and permit number of approved disposal facility. G

1.2.3.1 Safety Plan

Submit a safety plan within 45 calendar days after contract award and 30 days prior to commencing work. The safety program shall be reviewed and approved by the safety/health officer of the facility. The safety plan shall meet OSHA requirements and address the following:

a. Identification and evaluation of the hazards and risks associated with each site being studied, including precautionary measures to be followed by workers.

b. Names and qualifications of each Contractor's representative in charge of the work and present at the job site when tank cleaning and repair work will be performed.

c. Identification of supervisory personnel and alternates responsible for site safety/response operations.

d. Determination of levels of personnel protection to be worn for various site operations.

e. List of equipment with adequate nomenclature by item, that will be used at the job site and the date and location where this equipment can be inspected by the Contracting Officer.

f. Establishment of work zones (exclusion area, contamination area, and support area).

g. Establishment of decontamination methods and procedures.

h. Determination of the number of people required to enter the contamination zones during the initial entries and subsequent operations.

i. Establishment of emergency procedures, such as: escape routes, fire protection, signals for withdrawing work parties from site, emergency communications, wind indicators, including Navy notification.

j. Identification and arrangements with nearest medical facility for emergency medical care for both routine-type injuries and toxicological problems. Submit name, location, and telephone number of this medical facility.

k. Establishment of continual air and personnel monitoring procedures.

l. Establishment of procedures for obtaining and handling potentially contaminated samples.

m. Identification of medical monitoring program, including respirator medical qualification examination for each individual at the work site.

n. Identification of training plan to be instituted, including contents of 29 CFR 1910.1200 and 29 CFR 1910.134; its training contents; and instructor with appropriate qualifications.

o. Establishment of a respiratory protection program conforming to 29 CFR 1910.134 and ANSI Z88.2.

p. Establishment of a hazard communication program (29 CFR 1910.1200).

q. Contractor shall be responsible to dispose of all hazardous waste from the concrete tanks according to State and Federal Regulations.

1.2.3.2 Work Plan

The shut down or interruption to normal operations or traffic shall be listed on the progress schedule and submitted to the Contracting Officer.

1.2.3.3 Hazardous Waste Disposal Plan

The Contractor shall be responsible to dispose of all Hazardous Waste from the concrete tanks according to State and Federal Regulations. Prepare a Hazardous Waste Disposal Plan and submit within 45 calendar days after contract award for approval by the Contracting Officer, or if there are no hazardous wastes indicated by Government tests, submit the plan 21 days after the Contractor's tests indicate hazardous wastes. The Hazardous Waste Disposal Plan shall comply with applicable requirements of federal, state, and local hazardous waste regulations and shall address the following:

a. Identification of hazardous wastes associated with the work, including a sampling and testing plan for each waste stream, the purpose of each test, and the rationale for evaluating the test results. Indicate the representative sampling and specific testing methods, number of samples, and the name and qualifications of the testing laboratory.

b. Estimated quantities of wastes to be disposed in the cleaning of each tank and a description of arrangements made for storage and disposal.

c. Names and qualifications of each Contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact. Furnish two copies of EPA state and local hazardous waste permits and EPA Identification numbers.

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, treatment, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures to be implemented.

g. Work plan and schedule for waste removal and disposal.

h. Cost for hazardous waste disposal according to this plan.

1.2.3.4 Tank Certification of Safety

Submit certification, from an NFPA certified "Marine Chemist" or "Gas Free Engineer" stating that tank is safe for hot work and that special precautionary measures have been taken for workers to enter the tank to perform the work,

1.2.4 SD-10, Test Reports

a. Blasting abrasive test G

b. Tank contents tests G

1.2.4.1 Required Test Reports

Submit test results required by MIL-A-22262, for blasting abrasive. Submit contractor's independent tests of tank contents (water, sediment, and sludge).

1.2.5 SD-13, Certificates

a. Respiratory protective equipment G

b. Breathing-air supply source G

c. Combustible gas indicator G

d. Lead-in-air analyzer G

e. Hydrogen-sulfide (H_2S) indicator G

f. Oxygen meter G

g. Velometers G

h. Lighting G

i. First aid kit G

j. Tank exhaust blower G

k. Appropriate instrumentation for hazardous environment where work is to occur. G

Submit certificates for the items listed. Where equipment or materials are specified to conform with the standards of organizations, such as National Institute for Occupational Safety and Health (NIOSH), Underwriters Laboratories (UL), and American Petroleum Institute (API), include a label or listing indicating compliance. In lieu of the label or listing, the Contractor may submit a test report from an approved testing organization stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms with the organization's standard or code.

1.2.6 SD-18, Records

a. Safety permits G

Submit copies of permits required to comply with local, state, and federal regulations.

1.2.6.1 Hazardous Waste Permits

Submit copies of EPA, state and local hazardous waste permits and EPA Identification numbers of the transporter, treatment, storage and disposal facility that will be accepting hazardous waste. Include the facility location and a 24-hour point of contact.

1.2.6.2 Non-Hazardous Waste Permits

Submit EPA, state and local permits for disposal site for non-hazardous residues and wastes.

1.3 QUALITY ASSURANCE

1.3.1 Modification of References

Except as modified herein, the work shall conform with the recommendations of APT RP 500C and API RP 2003, API PUBL 2015 and API PUBL 2015A Where the word "should" appears in these publications, substitute "shall."

1.3.2 Copies of Standards

Furnish four copies of API RP 500C AND API RP 2003, API PUBL 2015 and, API PUBL 2015A.

1.3.3 Safety Permits and Equipment

Acquire safety permits (specified by the facility safety authorities) and necessary safety equipment.

1.3.4 Regulatory Requirements

a. Obtain permits required to comply with local state, and federal regulations.

b. Hazardous wastes, such as water, sediment, and sludge, shall be packaged, labeled, stored, transported, treated and disposed of in accordance with 40 CFR 260 through 40 CFR 266 and state and local regulations. Transporters, sorters, treaters and disposers must be certified and have EPA ID numbers. Payment for disposal of hazardous waste will not be made until a completed hazardous waste manifest from the treatment or disposal facility is returned, and a copy furnished to the Government.

1.4 DELIVERY AND STORAGE

Deliver equipment and materials to the site in an undamaged condition bearing the manufacturer's name and brand designation. Store equipment and materials off the ground to provide proper ventilation, drainage, and protection against dampness. Replace defective and damaged equipment and materials.

1.5 JOB CONDITIONS

1.5.1 Safety

Ensure that employees are trained in the requirements of 29 CFR 1910.1200 and understand the information contained in the MSDS for protection against toxic and hazardous chemical effects.

1.5.2 Ventilation

Maintain a vapor-free condition throughout the course of the work inside the tank. The air movers shall be non-sparking, explosion-proof, electrically operated or air-driven exhaust type. A rate of one air change per hour shall be the lowest acceptable rate, for tanks under 30,000 BBL. For tanks greater than 30,000 BBL, use 10,000 cfm. Air movers shall be kept in operation whenever workers are in the tanks; except the air movers shall be shut down 15 minutes before taking tests.

1.6 SCHEDULING AND SEQUENCING

1.6.1 Sequence of Primary Phases of the Cleaning Procedure

a. Planning the operations

b. Preparation for cleaning

c. Vapor-freeing of the tank

d. Cleaning the tank

e. Clean-up, residue disposal, inspection, and acceptance.

1.6.2 General Scheduling

Complete the work specified in this section before any other work in the tank is started. The work includes the complete interior cleaning of the storage tanks.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cleaning Agents

a. Detergent: FS O-D-1276.

b. Solvent: FS TT-T-291, Type II, minimum flashpoint of 60 degrees C.

c. Approved commercial cleaning agent.

2.1.2 Abrasive

2.1.2.1 Abrasive for Blasting

Provide sharp, washed, salt-free, angular abrasive material, free from feldspar and other constituents that tend to break down and remain on the surface. Abrasive shall not contain magnetic materials and shall conform to MIL-A-22262, except that Mohs' hardness shall be 7 to 9.

2.1.2.2 Recycled Abrasive

Screen and air wash abrasive that is recycled at the job site, to remove dirt and fines, Add new abrasive so that the combined new and recycled abrasive mixture meets specified abrasive requirements for chemical composition, moisture, friability, silica, anchor pattern and oil content. Do not recycle abrasive which has picked up toxic or hazardous material. Do not recycle nickel slag.

2.2 EQUIPMENT

Furnish necessary clothing and equipment for the work and protection of people entering the tank. Electrical equipment and wiring shall be in accordance with NFPA 70, Class 1, Group D, Division 1. Provide any item or items for the protection of these people including but not limited to the following:

a. Gasoline-Oil, Resisting Rubber Gloves and Boots: Gauntlet type and conductive type respectively (acid proof rubber is an acceptable material) furnished for each person entering or working inside the tank or handling sludge materials on the exterior of the tank, plus one extra pair each for emergency use.

b. Cotton Coveralls and Hard Hat: Light colored; one change per person per day, and an adequate supply of chemical-resistant disposable coveralls to be worn over cotton coveralls. As determined by site conditions and the on-site Health & Safety Officer, the contractor shall upgrade their personal protection as needed Appropriate equipment should be available on-site.

c. Respiratory Protection: Provide one of the following types of NIOSH-approved respiratory protective equipment for each person working inside the tank, plus one extra for emergency use. NIOSH 85-101 listing constitutes NIOSH approval.

   (1) Self-contained breathing apparatus with a full facepiece operated in a positive pressure mode.

   (2) A combination respirator which includes a Type C supplied-air respirator which a full facepiece operated in a positive pressure mode and an auxiliary positive pressure self-contained breathing apparatus.

d. Safety Harness: For each person working inside tank, plus one extra for outside the tank.

e. One-half-Inch Diameter Life Rope of Required Length: For each person working inside the tank.

f. Oil-Resistant Air Hose of Required Length for Each Hose Mask: NIOSH approved; low-pressure type; part of manufacturer's mask and hose assembly. NIOSH 85-101 listing constitutes NIOSH approval.

g. Breathing-Air Supply Source: 29 CFR 1910.134.

h. Combustible Gas Indicator, Lead-in-Air Analyzer Hydrogen-Sulfide (H_2S) Indicator, Benzene Indicator and Oxygen Meter.

i. Shovels, Buckets, Brooms, Wrenches, Scrapers, Squeegees, Wire Brushes, Scrub-Brushes, Ladders, Staging, and Other Tools: Do not use brooms or brushes that have plastic or synthetic bristles.

j. Lighting: UL 844, explosion-proof, minimum 50 foot candle, floodlight type, or Mining Enforcement and Safety Administration (MESA) approved, explosion-proof, portable battery-powered light.

k. Air Movers for Tank Ventilation: Explosion proof electrically operated or air driven. Nonferrous fan blades. Use velometers for measuring velocity.

l. Disinfectant for Cleaning Face Masks: Cleaner-sanitizer for cleaning and disinfecting respirator facepieces as specified in ANSI Z88.2.

m. Soap for Personnel Washing: Non-phosphate type.

n. A.B.C. Fire Extinguishers: UL listed 2A: 40B: C, 2A: 20B: C, or 4A: 30B: C; minimum 15 pound capacity.

o. First Aid Kit: One 16-unit kit for each 25 persons.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

3.1.1 Permission For Each Entry Into A Tank

Obtain written permission from the Contracting Officer prior to each entry into a tank. Permission will be granted only under the following conditions:

a. The Contractor's qualified supervisor and Health & Safety Officer is present.

b. The Contractor's personnel have been briefed by the supervisor on the procedure and role of each employee in the event of an emergency.

c. Required equipment is approved and properly located.

d. Personnel are properly trained and equipped with properly fitted protective equipment for the particular hazards at each tank location and have received adequate training from a qualified instructor.

e. The entire area adjacent to the tank is secured.

f. A minimum of two persons outside and two or more persons inside of each tank are provided at all times during cleaning operations.

g. Tank air is monitored and corrective action is taken to ensure that the vapor concentration is less than 10 percent of the lower flammable limit (LFL), lead-in-air is less than 0.075 milligrams per cubic meter , hydrogen sulfide is less than 10 ppm permissible exposure level (PEL), benzene is less than 10 ppm PEL and oxygen content is a minimum of 19.5 percent.

h. An NFPA certified "Marine Chemist" or "Gas Free Engineer" has certified that the tank is safe for hot work, and that the required special precautionary measures have been taken due to the potential health hazard to the worker that still exists, even when the vapor concentration is well below the LFL. The Contractor shall be responsible for reviewing the record drawing(s) of the tank to be cleaned.

i. People entering the area leave smoking materials such as cigarettes and flame-producing devices at a previously determined location.

j. When work involves handling and disposal of hazardous waste, the Contractor has a copy of 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, and 40 CFR 266 in his possession.

k. Permit only personnel authorized in the safety plan within 100 feet of the tank perimeter.

3.1.2 Traffic Control

Direct traffic minimum 200 feet away from the tank cleaning area. Set up road blocks and warning signs. Do not operate vehicles in hazardous areas.

3.1.3 Lavatory Facilities

Arrange for lavatory and toilet facilities and, in the case of tanks for leaded fuel, provide showers for bathing.

3.1.4 Miscellaneous

Ensure that the manufacturers have labelled containers holding products involving hazards in use or storage, in accordance with 29 CFR 1910.1200. Label containers used to store, transport, or dispose of hazardous waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, and 40 CFR 266 and State Regulations. Remove small objects of ferrous metal within the working areas to prevent the accidental striking of a spark. Place equipment upwind of tank openings at highest elevation possible; do not place in a spot lower than the surrounding terrain. Review drawings of the tank to be cleaned and brief workers on the location of pits, sumps, piping, or other tank appurtenances which could be hazardous to personnel. Provide floodlights to illuminate the work area without the need for battery operated handlights. Provide scaffolding, platforms, and ladders for secure, safe accessibility to tank surfaces. Install electrical equipment in accordance with API RP 500C. Provide floodlights to illuminate the work area without the need for battery operated handlights. Do not use,artificial lights inside tank until the tank is vapor-free. Unless otherwise approved by the Contracting Officer, do not heat tanks during winter to provide personnel comfort or melt ice.

3.1.4.1 Grounding and Bonding for Equipment

Provide grounding and bonding for equipment which may generate static electricity including air hose to sandblast nozzle. Do not pass the air hose through an area where flammable vapors may exist.

3.1.4.2 Fire Extinguishers

Furnish 4 carbon-dioxide fire extinguishers of minimum 15 pounds capacity each, in the immediate vicinity of the work. Provide a continuous fire watch. CAUTION: Do not discharge high pressure carbon dioxide extinguishers where explosive vapors exist since the discharge can cause a spark which will ignite the vapors.

3.1.4.3 Disconnection of Pipelines

After the product and other associated lines have been drained of liquid, they shall be cleaned and flushed prior to being excavated from the ground. In instances where they are below a structure and cannot be removed, they shall be cleaned, sealed and capped. At locations where piping to be removed

connects to active piping which is to remain, the active line shall be sealed off/shut down and separated from the inactive lines. Insert a solid-plate blind flange between two flanges near this point, or remove a valve or piece of pipe and install a blind flange to prevent flammable material from entering the tank or the piping to be removed. Blind flanges shall be of sufficient strength to withstand pressure which might be exerted by the material being blanked off and shall be gasketed on both sides if blind flange is inserted between two flanges. CAUTION: Do not disconnect piping or valves until it is certain the line has been emptied of fuel/liquid.

3.1.4.4 Removal of Ignition Sources

Remove sources of ignition from the cleaning area. Do not permit ignition producing devices, including matches, lighters or cigarettes, within 100 feet upwind and 200 feet downwind of a tank, or inside the tank farm, or within the tank firewall, whichever is farther.

3.1.4.5 Survey of Hazardous Areas

Carefully survey the entire area around the tank to be cleaned to ensure that there are no vapors present in the pit, low places, or hazardous areas and that all unauthorized personnel are cleared from the area. Ensure that there is no possibility of anyone smoking in the immediate vicinity. Hazardous areas are defined as follows:

a. Interior of tanks.

b. Areas within 100 feet from points having flammable vapor emissions which, for example, are from the exhaust manholes of tanks under repair, open vents or pressure vacuum vents (breather valves) of active tanks in the vicinity of tanks under repairs or cleaning. CAUTION: Allowance shall be made for 4 or more miles-per-hour winds by increasing the size of the hazardous area to a minimum of 200 feet on the downward side.

3.1.4.6 Exit from A Tank During Emergencies

To permit quick, free exit from a tank during emergencies, keep the area around the tank openings and emergency routes clear of obstructions.

3.2 INSPECTION

3.2.1 Inspection of Equipment

3.2.1.1 Respirators

Respirator users shall inspect their respirators in strict accordance with the instructions provided by the manufacturer.

3.2.1.2 Air Hose From Breathing-Air Supply

If air line respirators are used, ensure that:

a. There are no breaks in outside covering;

b. Condition of gaskets is good;

c. Connections are tight; and

d. There are no restrictions in the hose.

3.2.1.3 Safety Harness and Life Line

Ensure that:

a. There is no frayed or weak material; and

b. Condition of harness is good.

3.2.1.4 Breathing-Air Supply Source

Ensure:

a. Good working condition; and

b. Location in vapor-free area.

c. Compliance with 29 CFR 1910.134 for breathing air quality, frequency of air analysis, and presence of safety devices.

d. Backup air supply source.

3.2.1.5 Monitoring Equipment

Calibrate each day before use:

(1) Combustible gas indicator

(2) Oxygen meter

(3) H2S Indicator

(4) Lead-in-Air Analyzer

3.2.1.6 Other Equipment

Ensure:

a. Proper grounding and bonding;

b. Explosion-proof motors; and

c. Explosion-proof lighting.

3.2.2 Personnel Inspection

3.2.2.1 Clothing

Personnel for Proper Attire Commensurate with Hazards Involved: Check for:

a. Clean clothing in good condition (wear freshly laundered clothing at the beginning of the job and at the start of each workday thereafter).

b. Boots, gloves and other personal protective equipment for the specific waste type, of approved type and in good condition.

3.2.2.2 Breathing-Air Supply

If air line respirators are used, ensure that air is supplied to the facepiece at a rate of 4 to 15 cfm. If self-contained breathing apparatus are used, ensure sufficient number of full replacement cylinders are available to last the duration of the job.

3.2.2.3 Harness and Lifeline

Harness and lifeline shall be in good condition and properly attached.

3.2.2.4 Gum or Tobacco Chewing

Ensure that gum or tobacco chewing is prohibited.

3.2.2.5 Physical Defects or Injuries

Ensure that people have no physical defects or injuries which may prevent their wearing respirators or which may cause rescue to be difficult. No beards, sideburns, or large mustaches shall be allowed on people who must wear respirators.

3.2.2.6 Alcoholic Beverages and Drugs

Ensure that people entering the tank are not under influence of alcoholic beverages and drugs.

3.2.2.7 Females With Child-Bearing-Capability

Females with child-bearing capability shall not be allowed to work in contaminated areas or in leaded gasoline or chemically contaminated tanks since they may be seriously affected by organic lead compound or other chemical contaminants.

3.2.2.8 Hazardous Areas

Check hazardous areas as defined in paragraph entitled "Survey of Hazardous Areas."

3.3 TABLE OF TANK HISTORY

The following table lists some of the tanks to be removed by the Contractor.

Tank Number	Tank Location	Tank Capacity	Date Constructed	Type of Const.	Type of Fuel	Remarks
C20	Bldg. C-20	26,000 g	UK	Conc	G, D, F.O.	Empty
C20	Bldg. C-20	26,000 g	UK	Conc	G, D, F.O.	Empty

Notes:

UK -	Unknown
g -	Gallons
Conc -	Concrete
G -	Gasoline
D -	Diesel
F.O. -	Fuel Oil

The Contractor shall remove the four existing concrete tanks at R-7. The Hazardous Waste in the tank shall be disposed of by the Contractor in accordance with all State and Federal Requirements.

3.4 FUEL REMOVAL

The Contractor shall remove all product from the UST's and dispose of all product and residues from the UST's in accordance with 40 CFR 263, 264. All possible fuel will be pumped or otherwise removed from the tank by the Government. Consider remaining fuel contaminated or waste fuel; pump into 55 gallon drums or other suitable containers for disposal in accordance with approved procedures meeting local, state, and federal regulations. Dispose of remaining fuel emulsions in accordance with applicable local, state, and federal regulations. Drums or tanks used for containerizing waste fuel will be furnished by the Contractor.

Contractor shall remove all product from the UST's and dispose of all product and residues from the USTs in accordance with 40 CFR 263, 264.

3.5 TANK CLEANING

For the interior of the tanks, the shell, bottom, columns, roof, roof beams, and interior accessory equipment such as pumps, heating coils, compartment walls piping, and ladders shall be cleaned free of rust, dirt, scale, loose materials, fuel, oil, grease, sludge, and other deleterious materials. Remove unsound or loose lining or coating and clean the surfaces exposed thereby to bare metal or concrete as applicable. All material from the tank cleaning shall be disposed of by the Contractor in accordance with all State and Federal Requirements.

3.5.1 Lead Hazard Personnel Safety

Due to the lead hazard (inorganic and organic (TEL)) associated with the gasoline tank(s) comply with API PUBL 2015, API PUBL 2015A, and the applicable rules and regulations of the Federal Occupational Safety and Health Standards. If there is conflict among the API Publications, state, and federal regulations; the most stringent criteria shall apply. Ensure that the requirements for protective clothing and equipment, monitoring to determine exposure levels, and all other relevant controls are complied with.

3.5.2 Precautions for Airborne Lead

Since some of the tanks are a known lead hazard, the Contractor shall, in accordance with API PUBL 2015A, ensure that the workers inside the tank wear the appropriate protective clothing and respiratory equipment as prescribed by API PUBL 2015 for the duration of the tank cleaning. Use only the types of respirators specified for "Respiratory Protection" under paragraph titled "Equipment." After completion of the cleaning operation, the Contractor has the option of allowing people to enter the tank without respiratory protective equipment, only after in lead-in-air analysis has been obtained in accordance with API PUBL 2015A.

3.5.3 Water, Sediment, and Sludge Analysis

The water, sediment, and sludge remaining in the tank contain the following quantities of leachable metals as analyzed by the Government in accordance with 40 CFR 261.

a. Water: Unknown

b. Sediment: Unknown

c. Sludge: Unknown

No sampling/analysis has been performed of the material within the tank systems. The Contractor shall be responsible for independently testing the water, sediment, and sludge in accordance with 40 CFR 261 to ascertain the materials waste classification. Submit laboratory reports to the Contracting Officer describing sampling and testing procedures used, test results, and findings. If the Contractor's tests determine that the water, sediment, and sludge are hazardous, then the hazardous wastes shall be packaged, labeled, stored, transported, treated and disposed of in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, and 40 CFR 266. Transporters, storers, treaters and disposers must be certified and have EPA ID numbers. Payment for disposal of hazardous waste will not be made until a completed hazardous waste manifest from the treatment or disposal facility is returned, and a copy furnished to the Government. Nonhazardous or hazardous wastes shall be handled and disposed of as described below.

3.5.4 Water Removal and Disposal

Pump or otherwise remove water from the tank. Ensure that the sludge and sediment are not pumped out or mixed with the water. The liquid shall be packaged, labeled, stored, transported, treated, and disposed of in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, and 40 CFR 266. The estimated volume of liquid is listed in Section 3.3 No determination has been made as to its waste classification. For the purpose of this specification the water/liquid is presumed to be classified as a hazardous waste.

3.5.5 Sludge and Sediment Removal and Disposal

Squeegee or brush any sludge, sediment, or other loose material into piles, shovel into buckets or other suitable containers, and remove from the tank.

3.5.5.1 Sludge Disposal

At the time of inspection, the tanks did not contain any sediment or sludge. No sampling or analysis has been performed. For the purpose of this specification, any sediment or sludge which may exist at the time of field activities will presumed to be classified as a hazardous waste. The material shall be disposed of as per Federal, State and local regulations.

3.5.5.2 Removal of Sludge

Any sludge, tank bottoms and unusable tank contents shall be disposed of by the Contractor. Package, label, store, transport, treat, and dispose of hazardous sludge and sediment in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, and 40 CFR 266. The sludge shall be presumed to be a hazardous waste.

3.5.6 Washing

After water, fuel, and sludge have been removed, thoroughly wash the tank interior. Minimize the use of water; substitute brush blasting when practical. Start washing at the top of the walls and columns and work down to the floor. Wash the floor last starting from the sides and working towards the sump. Wash to remove oil, sludge, wax, tar, and other fuel residue adhering to the surface. Wash by any one or a combination of the following methods: (It is imperative that the Contractors on-site Health and Safety Officer ascertain that the cleaning method/cleaning solution being used is compatible with the tank contents/residue/sludge before proceeding.)

a. Apply a detergent cleaning solution or type appropriate to the tank environment by spray or brush and allow to soak approximately 30 minutes. The cleaning solution shall be either a one-to-one ratio of detergent conforming to FS O-D-1276 and solvent conforming to FS TT-T-291 or an equivalent commercial cleaning agent as approved by the Contracting Officer.

b. Hand-scrub the surfaces vigorously with long-handled stiff-bristle brushes. Wet the brushes intermittently with fresh [cleaning agent] during scrubbing process. For heavily oil-soaked areas which still appear to retain some residue after first scrubbing.

c. Rinse the surfaces thoroughly with fresh water.

d. Brush-off blast clean.

3.5.7 Wash Water, Detergent Solution, and Sediment Removal

During the washing process, operate a portable pump continuously with suction hose extended to the tank bottom to remove water, detergent, dirt, oil, or other loose materials washed off. Following the final rinse, pump, squeegee, and mop the tank dry.

a. Prior to discharge or disposal, test the wash water, sediment,and sludge in accordance with paragraph titled "Water, Sediment, and Sludge Analysis."

b. The wash water is presumed to be hazardous and shall be handled in accordance with paragraph titled "Water, Sediment, and Sludge Analysis."

c. For bidding purposes, assume that the sediment is hazardous and must be handled in accordance with paragraph entitled "Sludge and Sediment Removal and Disposal.".

3.5.8 Removal of Scale and Other Tenaciously Adhering Materials

Perform sandblast cleaning or power wire brushing. The brush shall be made of spark resistant bronze wire. After sandblasting or power wire brushing, clean the entire tank interior surfaces by brushing, blowing with dry compressed air, and vacuuming. Remove loose materials from the tank interior.

3.5.9 Disposal of Used Blasting Abrasive

Test used abrasive in accordance with 40 CFR 261 to determine if it is a hazardous waste using the Toxicity Characteristic Leaching Procedure (TCLP). Handle and dispose of abrasive determined to be hazardous waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, and 40 CFR 266. Dispose of abrasive which is not hazardous waste at a landfill off Government property in accordance with applicable regulations. The contract price will be adjusted if the used abrasive is determined to be hazardous waste. [However, payment for disposal of hazardous waste will not be made until a completed manifest from the treatment or disposal facility is returned, and a copy furnished to the Government.

3.5.10 Special Precautions

Special Precautions for Tanks with Pipe Columns and Braces, Pontoons, and Leaking Bottoms:

a. Pipes used for columns and braces, pontoons and leaking bottoms are a potential source of explosive vapors even after the tank is cleaned. The tank may be determined to be vapor free below 4 percent of lower explosive limit; but after one or two hours, explosive readings must again be obtained from these sources. The Contractor shall take readings at least every half hour when working in tanks after they have been cleaned and each floating roof or pan pontoon shall be checked individually with a combustible gas indicator.

3.5.11 Lead-Hazard-Free Tests

In accordance with API PUBL 2015A, tank lead-in-air tests to make sure that the tank is lead-hazard-free (CAUTION: Never take lead-hazard-free tests before or during cleaning, only after).

3.6 FINAL CLEAN-UP

After the Contracting Officer has inspected and accepted the tank cleaning and before final inspection, accomplish the following work:

3.6.1 Stenciling Tank

Stencil on the tank in 3/4-inch letters adjacent to the manhole openings the following data:

Date Cleaned - _____

Contractor Name - _____

Address - _____

3.6.2 Restoration of Site to Original Condition

Do not reconnect pipelines until application of interior and exterior coatings specified in other sections of this specification, have been completed. Replace valves, piping, manhole covers, and similar items which were removed at the start of the job with new gasket material resistant to fuel. Pressure check valves and piping. Remove, from the site, debris and equipment and materials used for the cleaning operations. Restore the site to its original condition.

-- End of Section --

SECTION 15358

AFFF FIRE EXTINGUISHING SYSTEM FOR HAZ/FLAM MATERIAL FACILITY

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825	1992 Approval Guide

FEDERAL SPECIFICATIONS (FS)

FS TT-E-489	(Rev. H) Enamel, Alkyd, Gloss, Low VOC Content
FS TT-P-664	(Rev. D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant
FS WW-S-2739	Strainers, Sediment: Pipeline, Water, Air, Gas, Oil or Steam

MILITARY SPECIFICATIONS (MIL)

MIL-F-24385	(Rev. F) Fire Extinguishing Agent, Aqueous Film Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater
MIL-P-24441	(Rev. B) (Supp. 1) Paint, Epoxy-Polyamide
MIL-T-27730	(Rev. A) Tape, Antiseize, Polytetrafluoroethylene, with Dispenser

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 11	1988 Low Expansion Foam and Combined Agent Systems
NFPA 13	1991 Installation of Sprinkler Systems
NFPA 16	1991 Deluge Foam-Water Sprinkler and Foam-Water Spray System
NFPA 24	1992 Installation Private Fire Service Mains and Their Appurtenances
NFPA 30	1990 Flammable and Combustible Liquids Code
NFPA 70	1993 National Electrical Code
NFPA 72	1990 Installation, Maintenance and Use of Protective Signaling Systems
NFPA 72E	1990 Automatic Fire Detectors
NFPA 231C	1991 Rack Storage of Materials

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 3	1989 Power Tool Cleaning
SSPC SP 6	1991 Commercial Blast Cleaning
SSPC SP 11	1991 Power Tool Cleaning to Bare Metal
SSPC Paint 22	1991 Epoxy-Polyamide Paints (Primer, Intermediate, and Topcoat)
SSPC Paint 25	1991 Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

UNDERWRITERS IABORATORIES INC. (UL)

UL FPED	1992 Fire Protection Equipment Directory
UL 789	1987 (R 1990) Indicator Posts for Fire-Protection Service

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section, with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

Design and provide a new automatic aqueous film forming foam (AFFF) for deluge sprinkler system(s) for Fuel Dispenser Islands. System shall provide uniform distribution of AFFF solution to provide complete coverage throughout the canopy areas indicated. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 11, NFPA 13, NFPA 16, NFPA 24, NFPA 30, NFPA 70, NFPA 72, NFPA 72E, NFPA 231C, except as modified herein. Each system [shall be designed for earthquakes and] shall include all materials, accessories and equipment necessary to provide each system complete and ready for use. Design and install each system to give full consideration to blind spaces, piping, electrical conduits and equipment, and all other construction and equipment to provide complete coverage in accordance with the drawings to be submitted for approval.

Devices and equipment for fire protection service shall be of a make and type listed by the Underwriter's Laboratories Inc. in the UL FPED, or approved by the Factory Mutual System and listed in FM P7825. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Northern Division, Naval Facilities Engineering Command, Fire Protection Engineer Corps of Engineers, Contracting Officer. Begin work at the point indicated.

1.3.2 System Operation

Flow of water and AFFF shall be controlled by deluge valves. Foam proportioning equipment shall activate automatically upon tripping of the deluge valve(s) for the corresponding foam system(s). Deluge valves shall be tripped by independent detection systems.] No valve will be operated by the building fire evacuation alarm system. Use of motor-operated valves is prohibited. Once activated, system(s) shall operate until shut down manually. Provide separate circuits from the control panel to each zone of initiating devices. Transmission of signals from more than one zone over a common circuit is prohibited.

1.3.2.1 Overhead and In-Rack Systems

Overhead and in-rack systems shall be controlled by deluge valves operated by automatic detection systems and by remote manual release stations.

1.3.2.2 Monitor System

Monitor nozzles shall be controlled by deluge valves operated by automatic ultraviolet-infrared (UV-IR) optical detection systems and manual release stations.

1.3.2.3 Hose System

Hose reels for remotely parked vehicles shall be controlled by deluge valves operated by remote manual release stations, separate from those used for overhead systems and monitor nozzles.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals." The fire protection engineer, Northern Division, Naval Facilities Engineering Command will review any approve all submittals in this section requiring Government approval.

Submit the following in accordance with Section 01300, "Submittals." The Northern Division, Naval Facilities Engineering Command, Fire Protection Engineer delegates the authority to the Quality Control (QC) Representative's U.S. Registered Fire Protection Engineer for review and approval of submittals required by this section. Submit to the Northern Division, Naval Facilities Engineering Command, Fire Protection Engineer one set of all approved submittals and drawings immediately after approval but no more later than 15 working days prior to final inspection.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Pipe, fittings, and mechanical couplings G

b. Pre-action Deluge valves G

c. Dry-pipe valves G

d. Valves, including gate, check, and globe G

e. Water motor alarm G

f. Sprinkler heads G

g. Monitor nozzles G

h. Hose and nozzle G

i. Pipe hangers and supports G

j. Pressure switch G

k. Fire department inlet connection G

l. Tank mounted air compressor G

m. Air pressure regulating device G

n. Air compressor (pneumatic detection system) G

o. Low air pressure *trouble alarm G

p. Electric detection system G

q. Battery charger G

r. Storage batteries G

s. Alarm bells G

t. Alarm horns G

u. Annunciator panel G

v. Foam hydrants G

w. AFFF concentrate storage tanks G

x. Proportioning equipment G

y. AFFF concentrate G

z. Strainers G

aa. Manual release stations G

bb. Backflow preventers G

cc. Control panel G

Data which describe more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Submit only originals. Photocopies will not be accepted. Partial submittals will not be accepted.

1.4.2 SD-04, Drawings

a. Fire extinguishing system G

1.4.2.1 Fire Extinguishing System

Prepare shop drawings for the system in accordance with the requirements for "Plans" as specified in NFPA 11 and "Working Plans" as specified in NFPA 13. Each drawing shall be 34 inches by 22 inches. Do not commence work until the design of each system and the various components have been approved. Show:

a. Canopy and or area layout and include data essential to the proper installation of each system.

b. Sprinkler heads, discharge nozzles and system piping layout annotated with reference points for design calculations.

c. Field wiring diagrams showing locations of devices and points of connection and terminals used for all electrical field connections in the system, with wiring color code scheme.

d. UV-IR detector manufacturer's recommended detector layout (plan view) including horizontal and vertical angles for correct aiming.

1.4.3 SD-05, Design Data

a. Hydraulic calculations G

b. Pressure discharge graphs or tables G

c. Battery standby power requirements calculations G

d. System surge analysis G

1.4.3.1 Calculations

a. Hydraulic calculations showing basis for design in accordance with NFPA 11 and NFPA 13.

b. Pressure discharge graphs or tables showing relationship for sprinkler heads and discharge nozzles.

c. Substantiating battery standby power requirements calculations showing battery capacity, supervisory and alarm power requirements. If 2-wire smoke detectors are proposed for use show comparison of the detector power requirements per zone versus the control panel smoke detector power output per zone in both the standby and alarm modes.

1.4.4 SD-08, Statements

a. Qualifications of installer G

b. AFFF containment and disposal plans G

Submit installers qualifications as required under paragraph entitled "Qualifications of Installer."

1.4.4.1 AFFF Containment and Disposal Plans

Submit AFFF containment and disposal plans as required under paragraph entitled "Environmental Protection."

1.4.5 SD-10, Test Reports

a. Open-area (Spot Type) 2-wire smoke detectors G

Submit copies of UL listing or FM approval data showing compatibility of the smoke detector model being provided with the control panel being provided, if 2-wire smoke detectors are proposed for use.

1.4.6 SD-11, Factory Test Reports

a. Hydrostatic testing of the *diaphragm pressure proportioning tanks G

1.4.7 SD-12, Field Test Reports

a. Preliminary tests G

b. Acceptance tests G

Submit for all inspections and tests specified under paragraph entitled "Field Quality Control."

1.4.8 SD-13, Certificates

a. Backflow preventers G

1.4.9 SD-18, Records

a. As-built drawings for the fire extinguishing system G

1.4.9.1 As-Built Drawings for the Fire Extinguishing System

Upon completion, and before final acceptance of the work, submit a complete set of as-built drawings, including complete as-built circuit diagrams, of each system. Submit 34 by 22 inch reproducible as-built drawings on mylar film with 8 by 4 inch title block similar to contract drawings. Submit as-built drawings in addition to the record drawings required by Division 1.

1.4.10 SD-19, Operation and Maintenance Manuals

a. Deluge valves, Data Package 3 G

b. Tank mounted air compressor, Data Package 3 G

c. Proportioning equipment, Data Package 3 G

d. Control panel, Data Package 3 G

e. AFFF concentrate storage tanks, Data Package 3 G

f. Monitor nozzles, Data Package 3 G

g. Instructions for operating the fire extinguishing system, Data Package 4 G

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data". Furnish one complete set of data prior to the time that final acceptance tests are performed, and furnish the remaining sets before the contract is completed.

1.5 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.5.1 SD-02, Manufacturer's Catalog Data

Submit data for pipe, fittings, and mechanical couplings; deluge valves for pressurized foam tanks; sprinkler heads; monitor nozzles; hose and nozzles; pipe hangers and supports; pressure switch; fire department connection; tank mounted air compressor; air pressure regulating device; air compressor (pneumatic detection system); low air pressure trouble alarm; detection devices and control panel; batteries and charger; alarm bells; alarm horns; annunciator panel; foam hydrants; foam tanks; proportioning equipment; foam concentrate; strainers; manual release stations; and backflow preventers. Data which describe more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Submit only originals. Photocopies will not be accepted. Partial submittals will not be accepted.

1.5.2 SD-04, Drawings

Prepare shop drawings for the system in accordance with the requirements for "Plans" as specified in NFPA 11 and "Working Plans" as specified in NFPA 13. Each drawing shall be 34 inches by 22 inches. Do not commence work until the design of each system and the various components have been approved. Show room, space or area layout and include data essential to the proper installation of each system Show sprinkler heads, discharge nozzles and system piping layout annotated with reference points for design calculations. Show field wiring diagrams showing locations of devices and points of connection

and terminals used for all electrical field connections in the system, with wiring color code scheme. Show UV-IR detector manufacturer's recommended detector layout (plan view) including horizontal and vertical angles for correct aiming.

1.5.3 SD-05, Design Data

Submit design calculations for the system. Include hydraulic calculations showing basis for design in accordance with NFPA 11 and NFPA 13. Include graphs or tables showing pressure discharge relationship for sprinkler heads and discharge nozzles. Include substantiating calculations showing battery capacity, supervisory and alarm power requirements. If 2-wire smoke detectors are proposed for use show comparison of the detector power requirements per zone versus the control panel smoke detector power output per zone in both the standby and alarm modes. Include system surge analysis showing surge pressure occurring throughout the system at both design flow and nonflow conditions.

1.5.4 SD-08, Statements

Submit installers qualifications as required under paragraph entitled "Qualifications of Installer." Submit plan for AFFF containment and disposal as required under paragraph entitled "Environmental Protection."

1.5.5 SD-10, Test Reports

For open-Area (Spot Type) 2-wire smoke detectors submit copies of UL listing or FM approval data showing compatibility of the smoke detector model being provided with the control panel being provided, if 2-wire detectors are proposed for use. Submit for the hydrostatic testing of the diaphragm pressure proportioning tanks. Submit for all inspections and tests specified under paragraph entitled "Field Quality Control."

1.5.6 SD-13, Certificates

Submit Contractor's material and test certificate for backflow preventers.

1.5.7 SD-18, Records

Upon completion, and before final acceptance of the work, submit a complete set of as-built drawings, including complete as-built circuit diagrams, of each system. Submit 34 by 22 inch reproducible as-built drawings on mylar film with 8 by 4 inch title block similar to contract drawings. Submit as-built drawings in addition to the record drawings required by Division 1.

1.5.8 SD-19, Operation and Maintenance Manuals

Submit operation and maintenance manuals for pressurized foam tank deluge valves, tank mounted air compressor, foam proportioning package, control panel, foam tanks, (monitor nozzles) and system operation. Furnish one complete manual prior to the time that final acceptance tests are performed, and furnish the remaining manuals before the contract is completed. Inscribe

the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the location of the building, the name of the Contractor, system manufacturer and the contract number. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: schematic drawings showing AFFF concentrate and solution piping; circuit drawings; wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shutdown instructions; installation instructions; maintenance instructions; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list.

1.6 QUALITY ASSURANCE

1.6.1 Qualifications of Installer

Prior to commencing work, submit data showing that the Contractor has successfully installed automatic foam fire extinguishing sprinkler systems of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having the required experience. Include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system, and certify that the system has performed satisfactorily for a period of at least 18 months.

Qualifications of System Technician: Installation drawings, shop drawing and as-built drawings shall be prepared, by or under the supervision of, an individual who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level-III certification in the Fire Protection, Automatic Sprinkler System, Fire Alarm System, Special Hazards Systems] programs. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

1.7 SPARE PARTS

Furnish the following spare parts:

a. 2 of each type of detector installed.

b. 1 of each type of audible and/or visual alarm device installed.

c. 2 of each type of fuse required by the system.

d. 5 complete sets of system keys.

PART 2 PRODUCTS

2.1 DESIGN OF FOAM SYSTEMS

Design of deluge fire extinguishing foam systems shall be by hydraulic calculations for uniform distribution of AFFF solution over the protected area and shall conform to the NFPA standards listed above and to the requirements as specified herein.

2.1.1 Sprinkler Heads

Heads shall have 17/32-inch orifice. For deluge systems, provide open heads. For deluge and bulk stations the release elements of the in-rack sprinklers shall be of the "ordinary" (165 degrees F) temperature rating. Provide chromium plated canopy deck plates and pendent sprinklers below canopy deck. Provide corrosion resistant sprinkler heads and sprinkler head guards as required by NFPA 13. Provide water shields and head guards for all in-canopy sprinklers.

2.1.2 Cabinet

Provide extra sprinkler heads and sprinkler head wrench in a metal cabinet adjacent to the pre-action valve within each canopy. The number and types of extra sprinkler heads shall be as specified in NFPA 13.

2.1.3 Deluge Valves

Valves shall be operated by a detection system listed for releasing service and independent of the building fire alarm system. Deluge valve clappers shall incorporate a latching mechanism that will not be affected by changes of pressure in the pressurized tank system. If 6-inch valves are used in 8-inch risers, provide smoothly tapered connections. In addition to automatic operation, arrange each valve for manual release at the valve. Provide pressure gages and other appurtenances at the deluge valves as required by NFPA 13. Provide a detection device at the end of each actuation circuit to test the circuit and mount the device adjacent to the valve between 6 feet and 8 feet above the dispenser island, mounted to canopy column(s). Label each testing device to indicate the valve it activates. Provide remote manual releases at each fuel dispenser.

2.1.4 Dry-Pipe Valves

Provide valves complete with accessories and appurtenances for the proper operation of each system. Provision shall be made to prevent excessive water columning. Provide an approved quick-opening device for each drypipe valve controlling a system having a capacity greater than 500 gallons. Provide gages and other appurtenances as required by NFPA 13.

2.1.5 AFFF Solution Distribution

Distribution shall be essentially uniform throughout the canopy area. Variation in discharge from individual heads shall be between 100 and 120 percent of the specified density.

2.1.6 AFFF Solution Application Density

Size system to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the canopy sprinklers shall be 5 cubic feet of foam per minute (cfm) per square foot with simultaneous operation of 3 in-canopy sprinklers on each level of the hydraulically most remote rack at a minimum discharge pressure of 30 psi, and 18 operating foam monitor nozzles for bulk dispensers canopies, but minimum 30 nozzles for dispenser island canopies, from 6 cylinders, and 2 operating foam hose lines for bulk canopies or minimum 3 cylinders, minimum 3 lines for dispenser island canopies.

2.1.7 Sprinkler Discharge Area

Area shall be the hydraulically most remote 2200 square feet area as defined by NFPA 13 and NFPA 231C.

2.1.8 Friction Losses

Calculate losses in pipe in accordance with the Hazen-Williams Formula with 'C' value of 120 for steel pipe used in deluge systems, or 150 for copper tube.

2.1.9 Location of Sprinkler Heads

Location of heads in relation to the canopy and spacing of sprinkler heads shall conform to NFPA 13 for ordinary hazard occupancy; except for discharge density of more than 0.5 cubic feet per minute per square foot, the spacing of the sprinkler heads shall conform to NFPA 13 for extra hazard occupancy. The spacing of sprinklers on the branch lines shall be essentially uniform. Location of in-rack sprinklers shall conform to NFPA 231C. Minimum 18 nozzles for 3 cylinders in bulk dispenser canopies and minimum 30 nozzles for 6 cylinders dispenser island canopies.

2.1.10 Duration of Discharge

System shall apply pressurized foam solution over the deluge discharge area for a minimum of 2 minutes while simultaneously discharging pressurized foam solution through monitors for a minimum of 2 minutes. Hose station discharge time shall be a minimum of 3 minutes. Reduction of the discharge duration based on a discharge rate higher than the specified minimum is not permitted.

2.2 ELECTRIC DETECTION SYSTEM

Provide electric heat detectors, and smoke detectors, and combination ultraviolet-infrared detectors. All wiring shall be supervised and installed in protective metal conduit or tubing.

2.2.1 Control Panel

Modular type panel installed in a surface mounted steel cabinet with hinged door and cylinder lock. Switches and other controls shall not be accessible without the use of a key. The control panel shall be a neat, compact, factory-wired assembly containing all parts and equipment required to provide specified operating and supervisory functions of the system. Panel cabinet shall be finished on the inside and outside with factory-applied enamel finish. Provide main annunciator located on the exterior of the cabinet door or visible through the cabinet door. Provide audible trouble signal.

Provide prominent engraved rigid plastic or metal identification plates, or silk-screened labels attached to the rear face of the panel viewing window, for all lamps and switches. System power shall be 120 volts AC service, transformed through a two winding isolation transformer and rectified to 24 volts DC for operation of all system initiating, actuating, signal sounding, trouble signal and fire alarm tripping circuits.

System shall be electrically supervised on all circuits. A ground fault condition or a single break in any circuit which prevents the required operation of the system shall result in the operation of the system trouble signal. A single open or ground fault condition in any detection (initiating) or signaling circuit shall not result in any loss of system function, but shall cause the actuation of system trouble signals. A ground fault condition or single break in any other circuit shall result in the activation of the system trouble signals. Loss of AC power, a break in the standby battery power circuits, or abnormal AC power or low battery voltage shall result in the operation of the system trouble signals.

The abnormal position of any system switch in the control panel shall result in the operation of the system trouble signals. Trouble signals shall operate continuously until the system has been restored to normal at the control panel. System trouble shall also be annunciated on the appropriate zone of the building fire alarm panel. Provide a 4 inch remote system trouble bell or buzzer, installed in aconstantly attended area, arranged to operate in conjunction with the integral trouble signals of the panel.

Provide remote bell or buzzer with a rigid plastic or metal identification sign which reads "Foam System Trouble." Lettering on identification sign shall be a minimum of one inch high. Control panel, batteries, and battery charger shall be weatherproof type or located in an area not subject to water damage. System control panel shall be UL listed or FM approved for extinguishing system control (releasing device service). Permanently label all switches. Provide panel with the following switches:

a. Trouble silencing switch which transfers audible trouble signals (including remote trouble devices into Building C-21) to an indicating lamp. Upon correction of the trouble condition, audible signals will again sound until the switch is returned to its normal position, or the trouble signal circuit shall be automatically restored to normal upon correction of the trouble condition. The silencing switch may be a momentary action, self-resetting type.

b. Alarm silencing switch which when activated will silence all associated alarm devices without resetting the panel, and cause operation of system trouble signals.

c. Individual zone disconnect switches which when operated will disable only their respective initiating circuit and cause operation of the system and zone trouble signals.

d. Reset switch which when activated will restore the system to normal standby status after the cause of the alarm has been corrected, and all activated initiating devices reset. Operation of reset switch shall restore activated smoke detectors to normal standby status.

e. Lamp test switch.

f. City disconnect switch which when activated will disconnect the coded device and cause operation of the system trouble signal.

2.2.1.1 Main Annunciator

Provide integral with the main control panel. Provide separate alarm and trouble lamps for each zone alarm initiating circuit as indicated below, located on the exterior of the cabinet door or visible through the cabinet door. Lamps shall be LED (Light Emitting Diode) type. Supervision will not be required provided a fault in the annunciator circuits results only in loss of annunciation and will not affect the normal functional operation of the remainder of the system. Each lamp shall provide specific identification of the area and dispenser by means of a permanent label. In no case shall zone identification consist of the words "Zone 1,." "Zone 2," etc., but shall consist of the description of the area and device.

2.2.1.2 Initiating Zones

Shall be arranged as follows:

Zone 1: Canopy at Fuel Station Building C-17

Zone 2: Canopy over Bulk Dispenser at Building C-17

Zone 3: Canopy at Fuel Station Building R-6

Zone x: Canopy over Bulk Dispenser at Building R-6

2.2.1.3 Remote Annunciator Panel

Locate as shown. Panel shall duplicate all requirements specified for the main control panel annunciator, except that in lieu of individual zone trouble lamps a single common system trouble lamp may be provided. Lamps shall be LED (Light Emitting Diode) type, except lamps used in backlit panels shall be LED or neon type. Panel shall have a lamp test switch. Zone identification shall be by means of permanently attached rigid plastic or metal plate(s). Panel shall be of the interior weatherproof type, surface mounted.

2.2.2 Auxiliary Power Supply

2.2.2.1 Storage Batteries

Provide vented wet cell nickel cadmium, batteries and charger. Drycell batteries are not acceptable. House batteries in the control panel or in a well constructed vented steel cabinet with cylinder lock, non-corrosive base, and louvered vents. Provide batteries of adequate ampere-hour rating to operate the system under supervisory conditions for 60 hours, at the end of which time batteries shall be capable of operating the entire system in a full alarm condition for not less than 15 minutes.

Provide calculations substantiating the battery capacity. Provide reliable separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts. Provide batteries with post-and-nut, "L"-blade, or similar terminals. Slip-on tab type terminals are not acceptable. When a separate battery cabinet is used, provide a fuse block for battery leads within the cabinets. Finish the cabinet on the inside and outside with enamel paint. Locate the top of the battery cabinet not more than 4 feet above floor level.

2.2.2.2 Battery Charger

Provide completely automatic high/low charging rate type charger capable of recovery of the batteries from full discharge to full charge in 24 hours or less. Provide an ammeter for recording rate of charge and a voltmeter to indicate the state of battery charge under load. Meters shall be factory installed, or factory-supplied plug-in modules. Field installation of meters other than the panel manufacturer's plug-in modules is prohibited. Provide a trouble light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided. House charger in the control panel or battery cabinet.

2.3 MANUAL RELEASE STATIONS

Provide overhead system, and monitor nozzle release stations where determined by system supplier and separate hose station release stations at each hose station. Stations shall be of a type not subject to operation by jarring or vibration. Stations shall have a dual action release configuration to prevent accidental system discharge. Break-glass-front stations are not permitted;

however a pull lever break-glass-rod type is acceptable. Station color shall be red. Station shall provide positive visible indication of operation. Restoration shall require use of a key or special tool.

Place warning signs at each station indicating that operation of the station will cause immediate AFFF discharge. Where a building fire alarm pull station is also mounted in the vicinity of a foam release station, separate the stations by at least 3 feet horizontally. Provided permanent engraved rigid plastic or metal labels to clearly distinguish foam release stations from building fire alarm stations, and to indicate the function of each foam release station. Stations shall be weatherproof type.

2.4 HEAT DETECTORS

Designed for detection of fire by combination fixed temperature rate-of-rise principle. Locate detectors in accordance with their listing by UL or FM and the requirements of NFPA 72E, except provide at least two detectors in all canopies of 600 square feet or larger in area. Temperature rating of detectors shall be in accordance with NFPA 72E. Reduce heat detector spacing in areas with ceiling heights exceeding 10 feet, in accordance with NFPA 72E.

No detector shall be located closer than 12 inches to any part of any lighting fixture. Detectors, located in hazardous locations as defined by NFPA 70, shall be types approved for such locations. Provide with terminal screw type connections. Removal of detector head from its base shall cause activation of system trouble signal. Detectors shall be weatherproof type.

2.4.1 Combination Fixed Temperature Rate-of-Rise Detectors

Designed for surface outlet box mounting and supported independently of conduit, tubing or wiring connections. Contacts shall be self-resetting after response to rate-of-rise actuation. Operation under fixed temperature actuation shall result in an external indication. Detector units located in areas subject to abnormal temperature changes shall operate on fixed temperature principle only.

2.4.2 Rate Compensating Detector

Designed for surface outlet box mounting and supported independently of conduit, tubing or wiring connections. Detectors shall be hermetically sealed and automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise. Detector operation shall not be subject to thermal time lag.

2.5 OPEN-AREA (SPOT-TYPE) SMOKE DETECTORS

Designed for detection of abnormal smoke densities by the photoelectric principle. Provide necessary control and power modules required for operation integral with the main control panel. Provide detectors and associated modules which are compatible with the main control panel and suitable for use in a supervised circuit. Detector circuits shall be of the 4-wire type whereby the detector operating power is transmitted over conductors separate from the initiating circuit. Provide a separate, fused, power circuit for each smoke detection initiating circuit (zone).

Failure of the power circuit shall be indicated as a trouble condition on the corresponding initiating circuit. As an alternate, detector circuits of the 2-wire type whereby the detector operating power is transmitted over the initiating circuit are permitted, provided the detectors used are approved by the control panel manufacturer for use with the control panel provided and are UL listed or FM approved as being compatible with the control panel (copies of the UL or FM listings showing compatibility shall be submitted). When 2-wire smoke detectors are used, the total number of detectors on any detection circuit shall not exceed 80 percent of the maximum number of detectors allowed by the control panel manufacturer for that circuit and the standby current draw of the entire system shall not exceed 80 percent of the rated output of the system power supply module(s).

Provide additional zones above those specified in the paragraph entitled "Initiating Zones" if required to meet the above requirements. Calculations showing compliance with the power consumption limitation requirements specified above shall be submitted with the calculations required by the paragraph entitled "Design Data." The data submitted under the paragraph entitled "Test Reports" shall clearly indicate the compatibility of the detectors with the control panel provided and the maximum number of detectors permitted per zone. Malfunction of the electrical circuits to the detector or its control or power units shall result in the operation of the system trouble signals.

Equip each detector with a visible indicator lamp that flashes when the detector is in the normal standby mode and glows continuously when the detector is activated. Provide remote indicator lamps for each detector that is concealed from view. Provide plug-in type detectors with tab-lock or twist-lock, quick disconnect head and separate base in which the detector base contains screw terminals for making all wiring connections. Detector head shall be removable from its base without disconnecting any wires. Removal of detector head from its base shall cause activation of system trouble signals. Provide each detector with an integral screen to prevent entrance of insects into the detection chamber(s).

2.5.1 Photoelectric Detectors

Operate on a multiple cell concept using an infra-red light-emitting diode (LED) light source.

2.5.2 Detector Spacing and Location

NFPA 72E, the manufacturer's recommendations and the requirements stated herein, however, in no case shall spacing exceed 30 by 30 feet per detector, and 30 lineal feet per detector along periphery of any canopy. Detectors shall not be placed closer than 12 inches to any part of any lighting fixture.

2.6 COMBINATION ULTRAVIOLET-INFRARED FIAME DETECTORS

Flame detectors shall operate on the dual spectrum ultraviolet-infrared (UV-IR) principle. Detector shall employ a solar-blind UV sensor with a high signal-to-noise ratio, and a narrow band IR sensor. Detector logic shall require UV and IR signals to be present, in the proper ratio or signature as emitted by a hydrocarbon fire, before the detector initiates an alarm. Detectors shall respond within 3 seconds to a gasoline or JP-4 fire 10 feet square, 150 feet from the detector. Detector shall not be activated by non-fire sources such as continuous or intermittent direct or reflected solar radiation, arc-welding, lightning, radiant heat, x-rays, artificial lighting, radio transmissions, and normal jet engine functions. Detector shall have an automatic through-the-lens self-testing feature.

Malfunction of the detector circuitry, or degradation of the sensors' lens cleanliness to the point where the detector will not detect the design fire signature, shall cause operation of the system trouble signals. Logic circuits necessary for operation of the detector shall be integral to the detector or located in separate flame detector control panel(s) located adjacent to the foam system control panel(s). Each detector in alarm shall be individually annunciated by an LED on the detector or at the detector control panel.

Primary and auxiliary power supply shall be taken from the foam system control panel(s). Detectors, and associated control panels if required, shall be compatible with the foam system control panel(s). Detectors and associated control panels shall be weatherproof, or housed in weatherproof enclosures) when in an area subject to system discharge and shall also be explosion-proof when located in hazardous areas as defined by NFPA 70. Detector spacing and location shall be in accordance with NFPA 72E, their UL listing or FM approval, and the manufacturer's recommendations.

The detector manufacturer shall determine or approve the detector layout. Detector layout drawings shall include horizontal and vertical angles for correct aiming. Locate detectors so that every portion of the protected area is within the field of view of at least two three detectors, taking into account fixed obstructions. Provide detectors with manufacturer's swivel mounting bracket. Provide a permanent engraved rigid plastic or metal label at each detector location with detector aiming information (degrees horizontal and vertical) for the corresponding detector.

2.7 ELECTRICAL WORK

Electrical work is specified in Section 16402, "Interior Wiring Systems" 16415, "Electrical Work, Interior", except for control and fire alarm wiring. Fire alarm system is specified in Section 16722, "Interior Fire Alarm System" "Fire Alarm and Fire Detecting Systems (Local)" 16721, "Fire Detection and Alarm System".

2.7.1 Wiring

Provide control wiring and connections to fire alarm systems, under this section and conforming to NFPA 70, NFPA 72 and NFPA 72E. Wire for 120 volt circuits shall be No. 12 AWG minimum solid conductor. Wire for low voltage DC circuits shall be No. 16 AWG minimum solid conductor, except wire to remote annunciators, if provided, may be 18 AWG minimum solid conductor. All wiring shall be color coded. Wiring, conduit and devices exposed to water or foam discharge shall be weatherproof. Wiring, conduit and devices located in hazardous atmospheres, as defined by NFPA 70, shall be explosion-proof. All conduit shall be minimum 3/4 inch size.

2.7.2 Operating Power

Power shall be 120 volts AC service, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all signal initiating, signal sounding, trouble signal, and actuating (releasing) circuits. Provide secondary DC power supply for operation of system in the event of failure of the AC supply. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm.

Obtain AC operating power for control panel, and battery charger, from the line side of the incoming building power source ahead of all building services. Provide independent properly fused safety switch, with provisions for locking the cover and operating handle in the "POWER ON" position for these connections and locate adjacent to the main distribution panel. Paint switch box red and suitably identify by a lettered designation.

2.7.3 Conductor Identification

Identify circuit conductors within each enclosure where a tap, splice or termination is made. Identify conductors by plastic coated self sticking printed markers or by heat-shrink type sleeves. Attach the markers in a manner that will not permit accidental detachment. Properly identify control circuit terminations.

2.8 SYSTEMS ACTIVATION

2.8.1 Overhead System Activation

Upon activation of detection system or overhead system manual release station(s), the corresponding combination overhead and in-rack system protecting that area shall activate.

2.8.2 Monitor System Activation

Upon activation of two UV-IR detectors for more than 3 seconds or activation of a manual release station, all monitors in that zone shall be activated. Activation of a single UV/IR detector shall cause activation of the fire alarms but shall not cause activation of the monitor nozzle(s).

2.9 ALARMS

2.9.1 Foam Motor Alarm

Provide weatherproof and guarded type alarm for each group of pressurized foam tank deluge valve(s). Alarms shall sound locally on the flow of foam solution in each system to which it is connected. Mount alarms on the outside of the outer walls of each building, at locations indicated. When more than one alarm gong is provided, provide permanent engraved rigid plastic or metal signs indicating to which system each gong is connected.

2.9.2 Local Alarm

Provide electric alarm horns to sound locally on operation of any system, regardless of whether foam flows or not. When more than one alarm is provided, provide permanent engraved rigid plastic or metal signs indicating to which system each alarm is connected.

2.9.3 Fire Alarm

Provide equipment for the automatic transmittal of an alarm over the canopy fire alarm system. Arrange so that the detection system and the flow of solution in each system will actuate the alarm. Activation of a single UV-IR detector shall not cause activation of the foam system but shall cause activation of the fire alarm system.

2.9.3.1 Pressure Switch

Provide switch with SPDT contacts to automatically transmit alarms upon flow of pre-pressurized AFFF. Alarm actuating device shall have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and shall] instantly recycle.

2.9.4 Trouble Alarm

Provide local 4-inch electric alarm horn to indicate trouble or failure of the detection system or pre-action sprinkler piping system. Alarm shall operate when air pressure in the dry-pipe system drops halfway from the normal pressure to the tripping point. Also connect trouble alarm into the building fire alarm control panel to indicate "trouble" on a separate zone labelled "Foam System Trouble".

2.10 AFFF CONCENTRATE

MIL-F-24385, 6 percent UL listed alcohol/polar solvent resistant type.

2.10.1 Concentrate Fill Pump

Provide one pump to fill foam system tank. Pump shall have a minimum flow rate of 15 gpm. Pump shall be complete with 115 VAC motor, fused switch, power cord with plug and 10 foot minimum suction and clear discharge hoses.

2.11 DIAPHRAGM PRESSURE PROPORTIONING EQUIPMENT

Foam solution shall be produced by introducing new pre-pressurized tanks of AFFF concentrate into the system, as necessary after a given usage.

2.11.1 Diaphragm Pressure Proportioning Tanks

Tanks shall be cylindrical steel ASME pressure vessels with a full Buna-N impregnated nylon inner tank or bladder designed to contain AFFF pre-pressurized foam. Tanks shall be designed for working pressure of minimum 115 psig and hydrostatically tested at 1.5 times the working pressure in accordance with ASME standards at the factory. Tanks shall have UL or FM label and ASME stamp affixed to the vessel. Size tank to provide sufficient AFFF foam for the time specified when the system is discharging foam solution at total maximum system flow. Also provide connected reserve tanks(s) of equal capacity. Permanently label each tank with its capacity, type and percentage of pressurized foam, which system(s) it serves, and whether it is a main or reserve tank.

Conspicuously post tank replacement instructions near each group of tanks. Provide a gage or unbreakable sight glass to permit visual determination of level of tank contents. Prior to shop painting, abrasive blast clean tank exterior surface in accordance with SSPC SP 6 to a surface profile not to exceed 2.0 mils and provide a MIL-P-24441 or SSPC coating system to the tank exterior. Prime tank exterior with one coat of MIL-P-24441/1, Formula 150 or SSPC Paint 22 primer applied to a dry film thickness of 3 mils and topcoat with one coat of MIL-P-24441/7 Formula 156 (red) or SSPC Paint 22 topcoat (red) applied to a dry film thickness of 3 mils.

2.12 FOAM MONITOR NOZZLES

Fixed, water motor operated, with override to allow manual aiming. Oscillation arc shall be adjustable from at least 0-165 degrees. Oscillation speed shall be adjustable from 0-30 degrees per second. Nozzle shall be adjustable while in operation from 30 degrees below to 80 degrees above horizontal, with lock or latching mechanism. Nozzle shall be non aspirating air aspirating type, adjustable while in operation from straight stream to fan-spray. Nozzle shall be capable of retaining the pre-pressurized adjusted setting once the desired pattern has been set. Nozzle shall produce a straight stream of 150 feet. Nozzles shall provide a minimum foam application rate of 5 cfm per square foot over the entire containment area. Provide normally open OS&Y gate valve in supply line at each monitor location.

2.13 HAND HOSE LINES

At each hose station, provide flow-through reel with 1 1/2-inch hard rubber hose and nozzle. Provide minimum 50 feet of hose. Nozzle shall have pistol-grip ball shutoff valve. Nozzle shall be [non aspirating air aspirating type. Provide normally closed quarter-turn valve in supply line at each hose station. Nozzle flow rate shall be 100 gpm minimum.

2.14 WALL FOAM HYDRANTS

Provide dual outlet connections with integral gate valves and locate about 3 feet above grade. Provide each outlet with 2 1/2-inch male National Standard hose threads with cap and chain. Hydrant shall be controlled by OS&Y gate valve located on foam tanks. Provide wall escutcheon plate with "FOAM HYDRANT" in raised letters cast in plate. Hydrant shall permit testing of each pre-pressurized foam system riser at full design flow without charging the system supplied by the riser.

2.15 ABOVEGROUND PIPING SYSTEMS

2.15.1 Pipe, Fittings, and Mechanical Couplings

NFPA 13, except steel piping shall be Schedule 40 for sizes smaller than 8 inches. Pipe nipples 6 inches long and shorter shall be Schedule 80 steel pipe. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall only be permitted in pipe sizes 1 1/2 inches and larger. Use of restriction orifices, reducing flanges, and plain-end fittings with mechanical couplings (which utilize steel gripping devices to bite into the pipe when pressure is applied) are not permitted.

Pipe and fittings in contact with AFFF foam shall be material resistant to the corrosive effects of AFFF foam as approved by the manufacturer of the proportioning system. Fittings on foam lines shall be flanged or welded only. Screwed or mechanical fittings will not be permitted.

2.15.2 Jointing Material

MIL-T-27730, Polytetrafluoroethylene (PTFE) tape. Pipe joint compound (pipe dope) is not acceptable.

2.15.3 Duplex Basket Strainers

FS WW-S-2739, Style Y (Y pattern). Provide duplex basket strainers with removable screens having standard perforations, 0.125-inch in diameter in the riser beneath the deluge valves.

2.15.4 Pipe Hangers and Supports

NFPA 13.

2.15.5 Valves

Provide valves as required by NFPA 13 and of types approved for fire service. Gate valves shall open by counterclockwise rotation. Check valves shall be flanged clear opening swing check type with flanged inspection and access cover plate for sizes 4 inches and larger. Provide an OS&Y valve beneath each deluge valve in each riser, when more than one valve is supplied from the same water supply pipe. Butterfly valves are not acceptable.

2.15.6 Identification Signs

Attach properly lettered approved metal signs conforming to NFPA 13 to each valve and alarm device. Permanently affix design data nameplates to the riser of each system.

2.15.7 Inspector's Test Connection

Provide test connections about 6 feet above the floor for each sprinkler system and locate at the hydraulically most remote part of each system. Provide test connection piping to a location where the discharge will be readily visible and where water may be discharged without damage.

2.15.8 Main Drains

Provide drain piping to discharge at safe points outside each canopy or to sight cones attached to drains of adequate size to readily receive the full flow from each drain under maximum pressure. Provide auxiliary drains as required by NFPA 13.

2.15.9 Pipe Sleeves

Provide where piping passes through service building walls, floors, roofs, canopy docks and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 1/4-inch space between exterior of piping and interior of sleeve. Firmly

pack space with insulation and calk at both ends of the sleeve with plastic waterproof cement.

2.15.9.1 Sleeves in Masonry and Concrete Walls, Floors, Roofs

ASTM A 53, schedule 40 or standard weight, zinc-coated steel pipe sleeves. Extend sleeves in floor slabs 3 inches above the finished floor.

2.15.9.2 Sleeves in Partitions

Provide zinc-coated steel sheet having a nominal weight of not less than 0.90 pounds per square foot.

2.15.10 Escutcheon Plates

Provide one piece or split hinge type plates for piping passing through floors, walls and ceilings, in both exposed and concealed areas. Provide chromium plated metal plates where pipe passes through finished ceilings. Provide other plates of steel or cast iron with aluminum paint finish. Securely anchor plates in place.

2.15.11 Fire Department Inlet Connection

Two way type with 2 1/2-inch National Standard female hose threads with plug, chain, and identifying fire department connection escutcheon plate. Provide inlet connections not less than 3 feet above grade.

2.16 BURIED PIPING SYSTEMS

2.16.1 Pipe and Fittings

NFPA 24, outside coated cement lined ductile iron pipe and fittings for piping under the building and to a point 5 feet outside the building walls. Anchor the joints in accordance with NFPA 24 using pipe clamps and steel rods. Minimum pipe size shall be 6 inches. Minimum depth of cover shall be 3 feet. Piping more than 5 feet outside the building walls shall be outside coated cement lined ductile iron pipe and fittings conforming to NFPA 24 provided under Section 02660, "Exterior Water Distribution System" "Water Lines".

2.16.2 Valves

Provide as required by NFPA 24 for fire service. Gate valves shall conform to AWWA C500 or UL 262 with cast iron body and bronze trim, and shall open by counterclockwise rotation.

2.16.3 Post Indicator Valves

Provide with operating nut located not less than 3 feet above grade. Gate valves for use with indicator post shall conform to UL 262. Indicator posts shall conform to UL 789. Paint each indicator post with one coat of primer and two coats of red enamel paint.

2.16.4 Valve Boxes

Except where indicator posts are provided, provide each gate valve in buried piping with an adjustable cast-iron valve box of a size suitable for the valve on which it is to be used. Boxes outside of paved areas may be of Acrylonitrile-Butadiene- Styrene (ABS) plastic or of inorganic fiber reinforced black polyolefin plastic. The head shall be round and the lid shall have the word WATER cast on it. The least diameter of the shaft of the box shall be 5 1/4 inches. Coat each cast-iron box with bituminous paint.

2.16.5 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be CAUTION BURIED WATER PIPING BELOW or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

PART 3 EXECUTION

3.1 EXCAVATION, BACKFILLING, AND COMPACTING

Provide under this section as specified in Section 02225, "Excavation, Backfilling, and Compacting for Utilities" 02222, "Excavation, Trenching, and Backfilling for Utilities Systems".

3.2 PRE-PRESSURIZED (FOAM) TANK AFFF SYSTEM INSTALLATION

Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the NFPA standards referenced herein. Install piping straight and true to bear evenly on hangers and supports. Conceal piping to the maximum extent possible. Piping shall be inspected, tested and approved before being concealed. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard reducing pipe fittings; do not use bushings. Cut pipe accurately and work into place

without springing or forcing. Ream pipe ends and free pipe and fittings from burrs. Clean with solvent to remove all varnish and cutting oil prior to assembly. Make screw joints with PTFE tape applied to male thread only.

3.3 FIELD PAINTING

Clean, prime, and paint new pre-pressurized tank foam systems including valves, piping, conduit, hangers, miscellaneous metal work, and accessories. Apply coatings to clean dry surfaces using clean brushes. Clean the surfaces in accordance with SSPC SP 3 and SSPC SP 11. Immediately after cleaning, prime the metal surfaces with one coat of FS TT-P-664 or SSPC Paint 25 primer applied to a minimum dry film thickness of 1.5 mils. Exercise care to avoid the painting of sprinkler heads and operating devices.

Upon completion of painting, remove materials which were used to protect sprinkler heads and operating devices while painting is in process. Remove sprinkler heads and operating devices which have been inadvertently painted and provide new clean sprinkler heads and operating devices of the proper type. Finish primed surfaces as follows:

3.3.1 Foam Systems in Unfinished Areas

Unfinished areas are defined as spaces above canopy deck ceilings, foam tanks, pipe chases, and other spaces where ceilings are not painted or not constructed of a prefinished material. Paint primed surfaces with two coats of FS TT-E-489 red enamel applied to a minimum dry film thickness of 1.5 mils.

3.3.2 Foam Systems in All Other Areas

Paint primed surfaces with two coats of paint to match adjacent surfaces, except paint valves and operating accessories with two coats of FS TT-E-489 red enamel applied to a minimum dry film thickness of 1.5 mils. Provide piping with 2-inch wide red bands spaced at maximum 20-foot intervals throughout the piping systems. Bands shall be red enamel or self adhering red plastic tape.

3.3.3 Piping Labels

Provide permanent labels in foam rooms, spaced at 20-foot maximum intervals along pipe, indicating "WATER", "FOAM CONCENTRATE", and "FOAM SOLUTION" on corresponding piping.

3.3.4 Field Touch-Up

Clean damaged areas of shop coated tanks in accordance with SSPC SP 11 and coat cleaned areas with the same materials used for the shop applied coating system.

3.4 ELECTRICAL WORK

Electrical work is specified in Section 16402, "Interior Wiring Systems" 16415, "Electrical Work, Interior", except for control and fire alarm wiring. Fire alarm system is specified in Section 16722, "Interior Fire Alarm System" "Fire Alarm and Fire Detecting Systems (Local)" 16721, "Fire Detection and Alarm System".

3.4.1 Wiring

Provide control wiring and connections to fire alarm systems, under this section in accordance with NFPA 70, NFPA 72, and NFPA 72E. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing may be used in dry locations not enclosed in concrete or where not subject to mechanical damage. Do not run low voltage DC circuits in the same conduit with AC circuits. Run wiring to UV-IR detectors alone in separate conduit if required by the detector manufacturer.

3.5 FIELD QUALITY CONTROL

Prior to initial operation, inspect equipment and piping systems for compliance with drawings, specifications, and manufacturer's submittals. Perform tests in the presence of the Contracting Officer to determine conformance with the specified requirements.

3.5.1 Preliminary Tests

Each piping system shall be hydrostatically tested at 200 psig in accordance with NFPA 13 and shall show no leakage or reduction in gage-pressure after 2 hours. The Contractor shall conduct complete preliminary tests, which shall encompass all aspects of system operation. Individually test all detectors, manual actuation stations, alarms, control panels, and all other components and accessories to demonstrate proper functioning. Test water flow alarms by flowing water through the inspector's test connection. When tests have been completed and all necessary corrections made, submit to the Contracting Officer a signed and dated certificate, similar to that specified in NFPA 13, attesting to the satisfactory completion of all testing and stating that the system is in operating condition. Also include a written request for a formal inspection and test.

3.5.2 Formal Inspection and Tests

The Northern Division, Naval Facilities Engineering Command Fire Protection Engineer, will witness formal tests and approve all systems before they are accepted. The system shall be considered ready for such testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and the Contracting Officer and written certification to this effect is received by the Division Fire Protection Engineer. Submit the request for formal inspection at least 15 working days prior to the date the

inspection is to take place. The control panel(s) and detection system(s) shall be in continuous service for a "break-in" period of at least 15 consecutive days prior to the formal inspection.

Experienced technicians regularly employed by the Contractor in the installation of both the mechanical and electrical portions of such systems shall be present during the inspection and shall conduct the testing. All AFFF pressurized foam tanks, instruments, including UV-IR detector test lamp and function test kit, personnel, appliances and equipment for testing shall be furnished by the Contractor. All necessary tests encompassing all aspects of system operation shall be made including the following, and any deficiency found shall be corrected and the system retested at no cost to the Government.

3.5.2.1 Systems and Device Testing

The entire initiating, alarm, actuation systems shall be operated. As a minimum, operation and supervision of the following functions and devices shall be demonstrated:

a. All operational and supervisory functions of the control and annunciator panels.

b. Each manual actuation station and associated circuit(s).

c. All detectors and associated circuits.

d. All alarms and associated circuits.

e. All actuator circuits and system control valve(s) (without foam discharge).

f. Activation of the service building fire evacuation alarm system.

g. Activation of the Base fire alarm system (receipt of fire alarm at alarm office).

h. All of the above tests shall then be repeated with the system on battery power only.

3.5.2.2 AFFF Discharge and Pressurized Foam Testing

When all of the initiating, alarm, actuation, and supervisory functions of the system operate to the satisfaction of the system manufacturer's technical representative, the Division Fire Protection Engineer, and the Contracting Officer, a complete discharge test of each system shall be performed to demonstrate satisfactory performance, proper AFFF concentration, mechanical operation and operation of valves, release devices, alarms, and interlocks which control the protected areas. These tests shall be conducted by experienced personnel according to the equipment and AFFF manufacturers' recommendations.

a. Test each pre-pressurized foam tank (deluge) system at their design flow rate for at least 20 seconds with temporary hose lines and nozzles connected to a test header. Furnish hose and nozzles required for tests.

The manufacturer's representative shall test samples of foam solution taken from each system to ensure proper AFFF foam concentration. Provide protection for all electrical fixtures and equipment exposed to possible damage during tests and protect doors and other openings leading from the protected area(s), to prevent migration of foam solution into other areas or spaces.

3.5.2.3 Flushing and Rinsing

After completion of tests flush all piping carrying pressurized AFFF. Piping normally containing AFFF foam concentrate when the system is in standby mode need not be flushed. Rinse all equipment and building surfaces exposed to AFFF discharge.

3.5.3 Environmental Protection

Provide temporary measures to prevent AFFF from entering storm drains, sanitary sewers, drainage ditches, streams and water courses. Do not allow AFFF concentrate or solution to come in contact with earth. Contain all discharged AFFF on paved surfaces. Collect all discharged AFFF and rinse and flushing water and dispose of it in an EPA - approved waste-water treatment facility which provides secondary (biological) treatment. At least 15 days prior to the date flow testing is to take place, submit written plan for AFFF containment and disposal methods(s) to the Contracting Officer for approval.

3.5.4 Acceptance Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system shall be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, the Contracting Officer shall be notified when the additional work has been completed, to arrange a new inspection and test of the system. All tests required shall be repeated prior to final acceptance, unless directed otherwise.

3.5.5 AFFF Pressurized System Storage Tanks Fill-Up

Fill storage tanks including reserve tanks and piping normally containing foam when the system is in standby mode with Contractor furnished AFFF foam tanks after acceptance of the system.

3.5.6 Manufacturer's Representative

Provide the services of representatives or technicians from the manufacturers of the foam system, and control panel, and UV-IR detectors], experienced in the installation and operation of the type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of the system and to provide instruction to Government personnel.

3.6 OPERATING INSTRUCTIONS

Provide operating instructions at control equipment and at each remote control station. Instructions shall clearly indicate all necessary steps for the operation of the system. Submit the proposed legend for operating instructions for approval prior to installation. Instructions shall be in engraved white letters on red rigid plastic or red enameled steel backgrounds and shall be of adequate size to permit them to be easily read.

3.7 TRAINING REQUIREMENTS

Prior to final acceptance, the Contractor shall provide two sessions of 4 hours each of operation and maintenance training to the Base Fire Department and Public Works Civil Engineering personnel on two different days to accommodate both shifts of the Base Fire Department. Each training session shall include emergency procedures, and unique maintenance and safety requirements. Training areas will be provided by the Government in the same building as the protected areas. The training conducted shall use operation and maintenance manuals specified in paragraph entitled "Operations and Maintenance Manuals." Dates and times of the training period shall be coordinated through the Contracting Officer not less than two weeks prior to the session.

-- End of Section --

SECTION 15780

PACKAGED AIR CONDITIONING UNITS

PART 1 GENERAL

1.1 REFERENCES

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

ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)

AHAM RAC-1	1982 Room Air Conditioners

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI DCAACP	Directory of Certified Applied Air-Conditioning Products
ARI DCUAC	Directory of Certified Unitary Air-Conditioner Equipment
ARI 210/240	1989 Unitary Air-Conditioning and Air-Source Heat Pump Equipment
ARI 310	1990 Packaged Terminal Air-Conditioners
ARI 350	1986 Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
ARI 360	1986 Commercial and Industrial Unitary Air-Conditioning Equipment

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE 15	1992 Safety Code for Mechanical Refrigeration

ASHRAE 52	1976 Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	1989 (Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM C 534	1988 Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM D 1654	1979 (Rev. A) (R 1984) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM F 872	1984 (R 1990) Filter Units, Air Conditioning: Viscous-Impringment Type, Cleanable
ASTM F 1040	1987 Filter Units, Air Conditioning: Viscous-Impringment and Dry Types, Replaceable

FEDERAL SPECIFICATIONS (FS)

FS 00-A-373	(Rev. C) (Int Am. 1) Air Conditioners, Single Package Type

MILITARY SPECIFICATIONS (MIL)

MIL-C-5541	(Rev. E) Chemical Conversion Coatings on Aluminum and Aluminum Alloys

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	1988 (Rev. 1-2) Industrial Control and Systems
NEMA ICS 2	1988 Industrial Control Devices, Controllers and Assemblies

NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Controls and Systems
NEMA MG 1	1987 (Rev. 2) Motors and Generators

UNDERWRITERS LABORATORIES, INC. (UL)

UL 484	1982 (R 1990) (Bul. 1992) Room Air Conditioners
UL 873	1988 (R 1991) Temperature-Indicating and Regulating Equipment

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Room air conditioners

For packaged terminal units, include noise rating.

1.2.2 SD-06, Instructions

a. Room air conditioners

1.2.3 SD-12, Field Test Reports

a. Start-up and initial operational tests

1.2.4 SD-18, Records

a. Posted operating instructions

Submit text.

1.2.5 SD-19, Operation and Maintenance Manuals

a. Room air conditioners, Data Package 3

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

1.3 QUALITY ASSURANCE

1.3.1 Modification of References

Accomplish work in accordance with the referenced publications, except as modified by this section. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may" wherever they appear. Interpret reference to "the Authority having jurisdiction", "the Administrative Authority," "the Owner," or "the Design Engineer" to mean the Contracting Officer.

1.3.2 Safety

Design, manufacture, and installation of unitary air conditioning equipment shall conform to ASHRAE 15.

1.4 POSTED OPERATING INSTRUCTIONS

Provide posted operating instructions for each packaged air conditioning unit.

PART 2 PRODUCTS

2.1 ROOM AIR CONDITIONERS

AHAM RAC-1 and UL 484. Provide one (1) 7,000 BTU unit in each new building (R-6 and C-20). Each is to be removable from inside the building for servicing without removing the outside cabinet. Construct outside cabinets, including metal grilles to protect condenser coils, of zinc-coated steel or aluminum. Steel and zinc-coated surfaces shall receive at least one coat of primer and manufacturer's standard factory-applied finish. Insulate cabinets to prevent dripping and running off of moisture. Provide mounting hardware made of corrosion-resistant material or protected by a corrosion-resistant finish. Provide air filters of the throw-away type removable without the use of tools and arranged to filter both room and ventilating air. Arrange exhaust or fresh air intake so that it can take place simultaneously with cooling. Remove condensate by means of a drain or by evaporation and diffusion. Provide with metal or plastic mounting flanges on each side, top and bottom of unit. For thru-the-wall installations provide shop painted zinc-coated steel flanged telescopic wall sleeves. Design wall sleeves to restrict driving rain. For window mounted units provide shop-painted metal mounting brackets, braces, and sill plates. Mount compressors on vibration isolators. Minimum cooling capacity shall be not less than that indicated. Provide units listed in the AHAM RAC-1 Directory of Certified Room Air Conditioners.

2.1.1 Units for Operation on 208 or 230 Volts

Minimum EER shall be 8.0. Provide 3-wire cords of manufacturer's standard length. If not existing, provide a receptacle within reach of the standard length cord. Cords shall have a 15-, 20-, or 30-amp, 3-pole, 250-volt ground type plug to match receptacle.

2.1.2 Controls

Mount controls in cabinet. Manual controls shall permit operation of either the fan or the fan and refrigerating equipment. Fan control shall provide two fan speed settings. Automatic controls shall include a thermostat for controlling air temperature. Thermostat shall have an adjustable range, including 72 to 80 degrees F and shall automatically turn the refrigeration system on or off to maintain the preselected temperature within plus or minus 4 degrees F.

2.1.3 Noise Rating

Rate in accordance with ARI 350. Rating shall not exceed 60 bels while entire unit is operating at any fan or compressor speed.

2.2 FILTERS

Provide filters to filter outside air and return air and locate as indicated inside air conditioners. Provide replaceable (throw-away) type. Filters shall conform to UL 900, Class 1 or Class 2. Polyurethane filters shall not be used on units with multiframe filters.

2.2.1 Replaceable Type Filters

ASTM F 1040 throw-away frames and media, standard dust holding capacity, 350 fpm maximum face velocity, and one inch thick.

2.3 MOTORS AND STARTERS

NEMA MG 1, NEMA ICS 1, and NEMA ICS 2. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Provide motors to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motor size shall be sufficient for the duty to be performed and shall not exceed its full load nameplate current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide reduced voltage type motor starters. Provide explosion proof type starter enclosures in accordance with NEMA ICS 6. Provide energy efficient motors per Section 16011, "Electrical General Requirements."

2.4 FINISHES

Provide steel surfaces of equipment including packaged terminal units, heat pumps, and air conditioners, that do not have a zinc coating conforming to ASTM A 123, or duplex coating of zinc and paint, with a factory applied coating or paint system. Provide a coating or paint system on actual equipment identical to that on salt-spray test specimens with respect to materials, conditions of application, and dry-film thickness.

2.5 SOURCE QUALITY CONTROL

2.6.1 Salt-Spray Tests

Salt-spray test the factory-applied coating or paint system of equipment including packaged terminal units, heat pumps, and air conditioners in accordance with ASTM B 117. Conduct test for 500 hours for equipment installed outdoors, or 125 hours for equipment installed indoors. Test specimens shall have a standard scribe mark as defined in ASTM D 1654. Upon completion of exposure, evaluate and rate the coating or paint system in accordance with procedures A and B of ASTM D 1654. Rating of failure at the scribe mark shall not be less than six, average creepage not greater than 1/8 inch. Rating of the unscribed area shall not be less than 10, no failure.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Install equipment and components in a manner to ensure proper and sequential operation of equipment and equipment controls. Install equipment not covered in this section, or in manufacturer's instructions, as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, supports. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated.

3.1.1 Room Air Conditioners

Install units in accordance with manufacturer's instructions and provided with structural mounting, panels, and seals for weathertight assembly. Pitch unit as recommended by manufacturer to ensure condensate drain to drain pan without overflow.

3.2 AIR FILTERS

Allow access space for servicing filters. Install filters with suitable sealing to prevent bypassing of air.

3.3 IDENTIFICATION TAGS AND PLATES

Provide equipment, gauges, thermometers, valves, and controllers with tags numbered and stamped for their use. Provide plates and tags of brass or suitable nonferrous material, securely mounted or attached. Provide minimum letter and numeral size of 1/8 inch high.

3.4 FIELD QUALITY CONTROL

3.4.1 Leak Testing

Upon completion of installation of air conditioning equipment, test factory and field-installed refrigerant piping with an electronic-type leak detector. Use same type of refrigerant to be provided in the system for leak testing. If leaks are detected at time of installation or during warranty period, remove the entire refrigerant charge from the system, correct leaks, and retest system.

3.4.2 Start-Up and Initial Operational Tests

Test the air conditioning systems and systems components for proper operation. Adjust safety and automatic control instruments as necessary to ensure proper operation and sequence. Conduct operational tests for not less than 8 hours.

3.4.3 Performance Tests

Upon completion of leak testing, and proper adjustment of controls, test the systems to demonstrate compliance with performance and capacity requirements. Test systems for not less than 8 hours, record readings hourly. At the end of the test period, average the readings, and the average shall be considered to be the system performance.

-- End of Section --

SECTION 16011

ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	1990 National Electrical Safety Code

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag out)

FEDERAL SPECIFICATIONS (FS)

FS L-P-387	(Rev. A) (Int Am. 2) Plastic Sheet, Laminated, Thermosetting (for Designation Plates)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 100	1988 Dictionary of Electrical and Electronics Terms, Fourth Edition

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Controls and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1990 National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 16, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of Section 01300, "Submittals" and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

1.4.1 Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

1.4.2 Drawings

Submit drawings a minimum of 14 inches by 20 inches in size using a minimum scale of 1/8 inch per foot , except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.4.3 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

1.4.4 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

1.4.4.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.4.4.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.4.5 Operation and Maintenance Manuals

Comply with the requirements of Section 01730 and the technical sections.

1.4.5.1 Operating Instructions

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

1.5 QUALITY ASSURANCE

1.5.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

1.5.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.5.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4 Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.5.5 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.5.6 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

1.6 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.7 NAMEPLATES

FS L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, and switch. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches. Lettering shall be a minimum of 0.25-inch high normal block style.

1.8 WARNING SIGNS

Provide warning signs for the enclosures of electrical substations, transformers, and switchgear having a nominal rating exceeding 600 volts. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 inches by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3-inch high white letters on a red and black field.

Electric work shall conform to NEC Article 514, "Gasoline Dispensing and Service Stations" as defined by the NEC and as indicated on Contract Drawings.

1.9 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each cable or wire located in manholes, handholes, and vaults. Tag only new wire and cable provided by this contract. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The first position on the tag shall denote the voltage. The second through sixth positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek "theta" symbol. The last position shall denote the cable size. Tag legend shall be as indicated. The tags shall be polyethylene. Do not provide handwritten letters. As an example, a tag could have the following designation: "11.5 NAS 1-80A500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, Phase A, sized at 500 MCM.

1.9.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 4500 pounds per square inch; and that are 0.035-inch thick, non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 300 degrees F. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have block letters, numbers, and symbols on-inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

1.10 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to ANSI C2, NFPA 70, and requirements specified herein.

1.10.1 Motors and Equipment

Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, and other devices functioning to control mechanical equipment, including control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors will not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 16.

1.10.2 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment under Section 16402, "Interior Wiring Systems." Power wiring and conduit shall conform to Section 16402, "Interior Wiring Systems." Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.11 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

1.13 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected start-up or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 15, "Mechanical."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical sections.

3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09900, "Painting" the section specifying the associated electrical equipment.

3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.4 CABLE TAG INSTALLATION

Install cable tags in each manhole, handhole, and vault as specified, including each splice. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

-- End of Section --

SECTION 16208

DIESEL ENGINE-GENERATOR SETS - PRIME AND STANDBY - 10 TO 500 KW

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S335	1989 Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.3	1985 Malleable Iron Threaded Fittings Classes (ANSI/ASME B16.3)
ANSI B16.11	1980 Forged Steel Fittings, Socket-Welding and Threaded
ANSI B18.2.1	1981 Square and Hex Bolts and Screws Inch Series
ANSI C12.10	1987 Electromechanical Watthour Meters
ANSI C37.13	1990 Low-Voltage AC Power Circuit Breakers Used in Enclosures (ANSI/IEEE C37.13)
ANSI C37.16	1988 Switchgear - Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendation
ANSI C37.17	1979 (R 1988) Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers
ANSI C37.20.1	1987 Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear (ANSI/IEEE C37.20.1)
ANSI C39.1	1981 Electrical Analog Indicating Instruments

ANSI S1.4	1983 Sound Level Meters (ASA 47)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	1989 Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B15.1	1984 (Addenda 1986) Mechanical Power Transmission Apparatus
ASME B16.1	1989 Cast Iron Pipe Flanges and Flanged Fittings (ASME/ANSI B16.1)
ASME B16.5	1988 (Errata 1988) Pipe Flanges and Flanged Fittings (ASME/ANSI B16.5)
ASME B16.39	1986 Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300 (ASME/ANSI B16.39)
ASME B31.1	1989 (Addenda 1989) Power Piping
ASME BPVC SEC VIII D1	1989 (Addenda 1990) Boiler and Pressure Vessel Code: Section VIII Pressure Vessels, Division 1
ASME PTC 26	1962 Speed-Governing Systems for Internal Combustion Engine-Generator Units

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 126	1984 Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 181/A 181M	1990 Forgings, Carbon Steel, for General Purpose Piping
ASTM A 193/A 193M	1990 (Rev. A) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	1990 (Rev. A) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 234/A 234M	1990 (Rev. A) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

ASTM A 307	1990 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C651	1986 (Addendum 1990) Disinfecting Water Mains

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards

DIESEL ENGINE MANUFACTURERS ASSOCIATION (DEMA)

DEMA SDGE	1972 Stationary Diesel and Gas Engines (Sixth Edition)

FEDERAL SPECIFICATIONS (FS)

FS WW-T-799	(Rev. F) Tube, Copper, Seamless, Water (For Use with Solder-Flared or Compression-Type Fittings)
FS VV-F-800	(Rev. D) (Am. 2) Fuel Oil, Diesel
FS O-S-801	(Rev. C) (Am. 3) Sulfuric Acid, Electrolyte, for Storage Batteries

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC	Uniform Building Code (UBC)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 115	1983 Synchronous Machines
IEEE 126	1959 (R 1983) Speed Governing of Internal Combustion Engine-Generator Units
IEEE 421.1	1986 Definitions for Excitation Systems for Synchronous Machines
IEEE C37.2	1991 Electrical Power System Device Function Numbers
IEEE C57.13	1978 (R 1987) Instrument Transformers (ANSI/IEEE C57.13)

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA S18.1	1979 (R 1985) Annunciator Sequences and Specifications

MILITARY SPECIFICATIONS

MIL-T-152	(Rev. B) (Valid Notice 1) Treatment, Moisture-and Fungus-Resistant, of Communications, Electronic, and Associated Electrical Equipment
MIL-V-173	(Rev. C) (Valid Notice 1) Varnish, Moisture and Fungus Resistant (for Treatment of Communications, Electronics, and Associated Equipment)
MIL-T-5544	(Rev. B) (Valid Notice 3) Thread Compound, Anti-Seize, Graphite-Petrolatum
MIL-T-5624	(Rev. N) (Am. 1) Turbine Fuel, Aviation, Grades JP-4, JP-5 and JP-5/JP-8 ST
MIL-V-12003	(Rev. F) (Am. 1) Valves, Plug: Cast Iron or Steel, Manually Operated
MIL-S-16165	(Rev. E) Shielding Harnesses, Shielding Items and Shielding Enclosures for Use in the Reduction of Interference from Engine Electrical Systems
MIL-F-16884	(Rev. H) (Am. 2) Fuel, Naval Distillate
MIL-C-17596	(Rev. F) Compressors, Reciprocating or Rotary Power Driven (EMD) Air, Base Mounted, 10 HP to 300 HP
MIL-P-17608	(Rev. C) Pumps, Rotary, Power-Driven, Viscous Liquids
MIL-G-17713	(Rev. D) Gages, Liquid Level Measuring, Tank
MIL-V-18436	(Rev. F) Valves, Check: Bronze, Cast-Iron, and Steel Body
MIL-T-22361	(Am. 1) Thread Compound, Antiseize, Zinc Dust-Petrolatum

MIL-I-24092	(Rev. C) (Supp. 1) Insulating Varnishes and Solventless Resins For Applications by the Dip Process

MILITARY STANDARDS (MIL-STD)

MIL-STD-461	(Rev. C) (Notice 2) Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-70	1990 Cast-Iron Gate Valves, Flanged and Threaded Ends
MSS SP-80	1987 Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	1987 Steel Pipe Unions Socket-Welding and Threaded
MSS SP-85	1985 Cast Iron Globe & Angle Valves Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	1985 (Rev. 1-2) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	1986 (Rev. 1) Molded Case Circuit Breakers and Molded Case Switches
NEMA MG 1	1987 (Rev. 1) Motor and Generators
NEMA PB 2	1984 Dead-Front Distribution Switchboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	1990 Flammable and Combustible Liquids Code
NFPA 37	1990 Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	1990 National Electrical Code
NFPA 99	1990 Health Care Facilities

UNDERWRITERS LABORATORIES INC. (UL)

UL 429	1982 (R 1988) Electrically Operated Valves, Third Edition
UL 489	1986 (R 1990) (Bul. 1991) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures, Seventh Edition
UL 891	1984 (R 1991) (Bul. 1991) Dead-Front Switchboards, Eighth Edition
UL 1008	1989 (Bul. 1990) Automatic Transfer Switches, Fourth Edition
UL 1236	1986 (R 1990) Battery Charges, Third Edition

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements" applies to this section with the additions and modifications specified herein.

1.3 DEFINITION

a. Intercooling, as used in this specification denotes cooling of charged air after it leaves the turbocharger compressor.

b. IEEE device numbers referred to in this specification are described in IEEE Standard IEEE C37.2.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.4.1 SD-02, Manufacturer's Catalog Data

a. Engine-generator set

b. Engine-generator unit guarantees

c. Diesel engine

d. Generator and exciter

1.4.1.1 Engine-Generator Set Data

Submit the following data pertaining to each engine and to the proposed auxiliary equipment.

a. Manufacturer of engine

b. Type or model of engine

c. Gross bhp rating of engine. Gross rating shall be the total rated power output before deducting power requirements of electric motor-driven equipment. Net ratings shall be equal to gross ratings minus the total power requirements of electric motor-driven accessories normally constituting part of "engine assembly" as defined in DEMA SDGE and hereinafter referenced to as DEMA requirements.

d. Net bhp rating of engine. Net ratings shall include a deduction in power output for the following parasitic loads:

(1) Scavenging blower with auxiliary equipment for two-cycle engines only.

(2) Lubricating oil pump for lubricating oil circulation and piston cooling service.

(3) Fuel oil booster pump.

(4) Cooling system power requirements including pumps, radiator fans, and any other power consuming devices required to provide cooling as specified.

Some of these devices may be electric motor-driven or engine-driven. Engine net output rating shall be reduced by the horsepower required to operate the engine-driven devices where not already done so by the engine manufacturer. Corrections shall be made to engine output, or generator output for the electric motor-driven devices to determine the net rating of the engine or engine-generator set. It may not be possible to estimate the engine-driven loads for a manufacturer's standard plant test. In this case the net rating shall be further reduced by applying corrections for the cooling system provided to obtain a net power output exclusive of parasitic loads.

e. Strokes per cycle

f. Number of cylinders

g. Bore and stroke, inches

h. Engine speed, rpm

i. Piston speed, fpm

j. BMEP at full load (psig)

k. kW rating of generator

l. kVA rating of generator and power factor

m. Gross kW rating of engine-generator set

n. Net kW rating of engine-generator set

o. Make of turbochargers

1.4.2 SD-04, Drawings

a. Engine-generator unit and auxiliary equipment

b. Engine-generator unit electrical drawings

1.4.2.1 Engine-Generator Unit and Auxiliary Equipment

Submit outline and installation drawings or catalog cuts of the sets containing installation details.

1.4.2.2 Engine-Generator Unit Electrical Drawings

Submit electrical drawings including elementary, schematic, wiring, and interconnection diagrams for the generator switchboard.

1.4.3 SD-08, Statements

1.4.3.1 Diesel Engine Generator Successful Operation

Submit certificates within 30 calendar days after award certifying that not less than two engines of identical number of cylinders and cylinder size, identical or higher rotative speed, up to a maximum of 1,800 rpm, and identical or higher brake mean effective pressure (BMEP), and the same basic configuration (In-line or Vee) as the engine to be provided, have driven generators which have produced, in satisfactory operation, not less than 500 kWh of electricity for each kW of generator nameplate capability within a 2-year period. Certificates shall include:

a. A list of at least two engine-generator set installations meeting the experience requirements in paragraph entitled "Experience Requirements."

b. Owner and location of each such installation.

c. Date of initial operation of each such installation.

d. Number of kWh produced per kW of generator net rated capability of each engine installation.

e. Horsepower rating, kW rating, and rotative speed of each set.

f. BMEP rating of each engine.

g. Design characteristics of each unit, such as bore and stroke, number of cylinders, and configuration (In-line, or Vee).

1.4.4.2 Field Welding Procedures (Piping)

Before performing field welding, submit to the Contracting Officer, welding procedure specifications for metals included in the work, with proof of qualifications as outlined in ASME B31.1.

1.4.5 SD-10, Test Reports

a. Switchgear bus continuous current test

1.4.5.1 Switchgear Bus Continuous Current Test

Certify that switchgear bus meets the ANSI C37.20.1 rated continuous current design test by listing bus size, bus quantity, bus material, rated amperes used, plus the measured temperature rise and the ambient temperature used during the test.

1.4.6 SD-11, Factory Test Reports

a. Engine tests

b. Generator tests

c. Radio frequency interference (RFI) tests

Submit certified factory test report within 15 calendar days after completion of tests. Provide in accordance with the requirements set forth in paragraph entitled "Source Quality Control."

1.4.7 SD-12, Field Test Reports

a. Piping tests

b. Preliminary operation

c. Phase relationship tests

d. Control panel and switchboard tests

e. Insulation resistance tests

f. Engine-generator set acceptance tests

g. Auxiliary equipment test

Submit test and inspection reports for work required under the paragraph entitled "Field Quality Control."

1.4.8 SD-18, Records

a. Posted operating instructions for diesel engine-generator set

Submit text for each piece of equipment.

1.4.9 SD-19, Operation and Maintenance Manuals

a. Engine-generator unit and auxiliary equipment, Data Package 4

b. Engine speed governing system, Data Package 3

c. Engine-generator set voltage regulator, Data Package 5

d. Engine control panel, Data Package 5

e. Generator switchboard, Data Package 5

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data." Manual shall include fuel adjustment procedures.

1.5 QUALITY ASSURANCE

1.5.1 Experience Requirements

Engines installed shall meet the following operating experience requirements:

a. Only electric generation service is considered as equivalent experience. Engines driving pumps or compressors, or those in marine propulsion or railroad service, are not acceptable.

b. Only experience on the same engine model is acceptable. Engine model is considered to be a given series or class of identical bore and stroke and of the same type of engine, such as In-line or Vee. In-line and Vee engines with identical bore and stroke are considered as two separate models of engines.

c. Only experience at the identical or higher rotative speed as that which is specified is acceptable.

d. Only experience at the identical or higher BMEP as that which is specified is acceptable.

e. Only experience with diesel-fueled engines is acceptable.

1.5.2 Regulatory Requirements

a. Provide devices designed and installed to comply with the following requirements:

(1) Power transmission apparatus: Guard in accordance with ASME B15.1.

(2) Electrical installations: Conform to NFPA 70.

(3) Operator protection: Guard in accordance with 29 CFR 1910 as follows:

(a) Fan blades: Part 1910.212(a)(5).

(b) Fixed ladders: Part 1910.27.

(c) Platforms and access openings: Part 1910.23.

(4) Mercury: Use of mercury in instruments, contacts, and manometers is not permitted.

b. File inspection certificates for compressed air storage system with the proper authorities as may be required by law and furnish a copy to the Contracting Officer.

1.6 DELIVERY, STORAGE AND HANDLING

Deliver equipment on pallets or blocking and with each entire unit or pelletized unit wrapped in heavy-duty plastic wrapping, sealed to protect parts and assemblies from moisture and dirt. Plug and seal shut piping, conduit, exhaust, and air intake openings. Generator switchboard shall be packed in shipping sections which can be handled and installed at the site. Protect and prepare batteries for shipment as recommended by the battery manufacturer. Store equipment and allied equipment at the site in covered enclosures, protected from atmospheric moisture, dirt, and ground water. Properly label each package on the exterior of the wrapping as to the identity of the enclosed equipment, contract number, manufacturer, and purchaser. The manufacturer's standard practice in product protection and identification, meeting the above requirements, will be acceptable.

1.7 SITE CONDITIONS

The components of the engine-generator sets, including cooling system components, pumps, fans, and similar auxiliaries, shall be capable of the specified outputs in the following environment:

a. Site locations: Building C-17 & R6 Fueling Stations, Building C-50.

b. Site elevation: Building C-17, Building R6 and Building C-50 all at approximately 100 ft. above MSL (Mean Sea Level).

c. Ambient temperatures:

(1) Maximum 110 degrees F dry bulb, 98 degrees F wet bulb.

(2) Minimum -10 degrees F dry bulb.

d. Seismic zone: 5 as defined by ICBO UBC.

e. Design wind velocity: 90 mph (Gale Force, 1 in 10 years).

f. Prevailing wind direction: West to East.

g. Atmospheric conditions: Moist dust-laden non-corrosive.

1.8 EXTRA MATERIAL

1.8.1 Paint

Furnish one gallon of the identical paint used for the engine generator assembly in the paint manufacturer's sealed containers with each engine-generator set.

1.8.2 Oil Filters

Furnish two spare replacement elements in their original containers for each filter with each unit.

1.9 POSTED OPERATING INSTRUCTIONS

Furnish operating instructions laminated between matte-surface thermoplastic sheets that are suitable for placement adjacent to corresponding equipment. Install operating instructions where directed.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials and equipment of manufacturers regularly engaged in production of such materials or equipment, and the manufacturer's latest standard design that complies with specification requirements. Where two units of the same class of equipment are required, these units shall be products of a single manufacturer; however, component parts of the system need not be

products of the same manufacturer. Each major component of equipment shall have the manufacturer's name, address, and model and serial number on a nameplate securely affixed in a conspicuous place; nameplate of the distributing agent will not be acceptable. Nameplates shall not be painted.

2.2 ENGINE-GENERATOR SETS

Provide 3 engine-generator sets with electrical output capacities as shown on drawings, each correctly coordinated by the engine-generator manufacturer to ensure an installed rating in the environment described in the paragraph entitled "Site Conditions." Each set shall consist of a diesel engine direct-connected to an ac generator having a brushless excitation system, and shall be provided with necessary accessories, auxiliaries, appurtenances, control equipment, and cooling systems, resulting in a complete set and, except for external service connections, ready for operation. Mount each engine-generator set on a structural steel subbase sized to support the engine; generator-exciter, engine-generator control panel; lubricating oil filters, heat exchangers and pump; fuel oil filters day tanks, and pumps; jacket coolant heat exchangers and pumps; and interconnecting piping and wiring for systems. Engine unit-mounted radiators and auxiliaries shall also be mounted on the engine-generator set subbase. The engine-generator set shall include electric starters, controls, and related wiring for electric starting. Batteries, battery racks and charger assembly shall be mounted on the set subbase. Air supply compressors and receivers shall be mounted separately. Structural subbase shall be provided with vibration isolators suitable for the loads and lateral forces involved in seismic zones. Isolators shall be as recommended by the engine-generator set and isolator manufacturer to suit the specific equipment involved. Electrical and mechanical field connections shall be made with flexible connectors. Where standard with the manufacturer, the combustion air filter/silencer units and exhaust muffler units may be mounted separately from the set, and connections made to the engine with corrosion-resistant flexible connections. Engines and generators shall be factory aligned on the subbase and securely bolted into place in accordance with the manufacturer's standard practice. Each set, after assembly, shall be painted overall with the manufacturer's standard paints and colors. After tests and before shipping, each set shall be thoroughly cleaned and the painting retouched as necessary to provide complete protection to the set. Sets shall be arranged for automatic unattended starting in addition to manual start-and-stop by control panel pushbuttons. Each engine-generator set shall be capable of automatically starting, coming up to synchronous speed, and providing full rated power within 10 seconds after failure of normal power. Each engine-generator set shall be completely housed in a weatherproof enclosure for outdoor installation.

2.2.1 Equipment Rating and Capability

Each engine-generator set shall have a net continuous rating capacity of 10, 25, and 30 kW (refer to drawings for more specific capacity requirements) at 1.0 power factor and shall be designed to supply 208Y/120-volt, 60-Hz ac output. Both the engine and generator of the set shall be capable of

satisfactorily carrying a load 10 percent in excess of the net rated generating capacity at 1.0 power factor for a period of 2 continuous hours out of 24 consecutive hours. Auxiliary equipment shall be designed for continuous duty at 100 percent of rated net capacity of the engine-generator set. Cooling system components and auxiliaries shall be properly sized relative to the engine coolant specified under cooling system.

2.2.2 Critical Speeds

Each complete engine-generator set shall be free of critical speeds of either a major or minor order that might endanger satisfactory operation of the set. Satisfactory operation will be considered endangered, if torsional vibration stresses exceed 5,000 psi within 10 percent above or below rated engine speed.

2.3 DESIGN AND CONSTRUCTION

Rotating or reciprocating parts, or other parts that present a potential hazard to operating personnel, shall be isolated or shielded to minimize danger.

2.3.1 Space Heaters

Space heaters shall be thermostatically controlled and shall be provided in the enclosures of generators, exciters, and outdoor motors. Heaters shall be 120-volt ac, single-phase, of ratings as recommended by the manufacturer for the atmosphere specified under the paragraph entitled "Site Conditions."

2.3.2 Diesel Engines

Comply with MIL-S-16165 relative to radiated radio interference. For generators and other devices capable of producing radio interference comply with MIL-STD-461 relative to radiated and conducted radio interference.

2.3.3 Fungus Control

For electrical components, fungus control is required as follows:

a. Electrical components such as switches, fuses, contacts, heater elements, distributors, spark plugs, and magnetos shall not be treated. Other materials and components which are inherently fungus-resistant or are protected by hermetic sealing need not be treated.

b. Circuit elements, not covered above and which have a temperature rise of not more than 75 degrees F when operating at full load, shall be coated with a fungus-resistant varnish conforming to MIL-V-173. Method of treatment shall be in accordance with MIL-T-152. Circuit elements include, but are not limited to, cable, wire, switchboards, terminal and junction blocks, junction boxes, capacitors, and coils.

c. Circuit elements, such as motor coils, generator and transformer windings, and similar electrical components, which have a temperature

rise exceeding 75 degrees F when operating at full load, shall not be coated with a fungitoxic compound. Instead, such components shall be given two initial coats of varnish and one seal coat of varnish, all conforming to MIL-I-24092, Class 220, Type M. Apply coats by the vacuum-pressure immersion, centrifugal, pulsating pressure, or built-up method so as to fill interstices in the coils and prevent the entrapment of air or moisture. The sealer coat may also be applied by brushing and spraying.

2.4 DIESEL ENGINES AND ACCESSORIES

Engines shall be two-cycle, naturally aspirated, or turbocharged and intercooled; or four-cycle, turbocharged and not intercooled or turbocharged and intercooled; vertical In-line or vertical Vee type; designed for continuous duty, stationary service. Provide each engine designed and constructed to eliminate undue heating, vibration, and wear and be efficient and trouble free in operation. Engine shall be capable of operating on diesel fuel oil conforming to FS VV-F-800, Grade DF-2 MIL-F-16884 MIL-T-5624. Limiting characteristics of the engines shall be as follows:

a. Maximum BMEP, psi:

	Naturally Aspirated
(1) Two-cycle engines	
(a) Prime duty	
10 to 300 kW	90
(b) Standby/emergency duty	90

	Turbocharged Not Intercooled
(2) Four-cycle engines	
(a) Prime duty	
10 to 300 kW	135
(b) Standby/emergency duty	150

b. Maximum engine speed, rpm:

10 to 300 kW	1,800

2.4.1 Construction

Construct engine to withstand sudden changes from no load to rated load, and to preserve alignment of integral components under all conditions of operation. The design shall incorporate pressure lubrication of bearings and wrist pins, and the bearing journals shall be hardened or chromium plated to provide a hard shock-resistant surface with ductile core. Counterbalance crankshafts to

reduce vibration to a minimum. Crankshaft and connecting rod bearings shall be the replaceable precision sleeve type. Construct piston rings of a heat-resisting alloy steel or chromium plated cast-iron. Camshafts shall be gear driven, and shall be high wear-resistant, at cams and journals. Clearly indicate timing marks on the crankshaft and gears. For 25 Kw and 30 kW, valves shall have removable stem guides and seat inserts. Flywheel shall be balanced, and shall be capable of being rotated 50 percent above the maximum rated engine rotative speed without danger of breaking or exploding. Provide flywheel housing with a drain hole at the lowest point. Provide means for turning the crankshaft manually. Turbocharger lubricating oil system shall not be a separate system, but shall be a part of the engine lubricating oil system.

2.4.2 Assembly

Completely factory-assemble each engine. Mount turbocharger and intercooler and piping integral with the engine, on the engine.

2.4.3 Engine Speed Governing System, IEEE Device 65

Provide engine speed governing system suitable for controlling the speed of the generator set to meet the performance requirements specified in IEEE 126, Section II, when tested in accordance with ASME PTC 26. Performance shall be met without intermediate adjustment and shall maintain the specified stability without hunting or cycling. Provide the governor with a reversible synchronizing, electric motor or pneumatic speed changer, connected to the speed adjusting mechanism by a slip coupling and arranged for remote manual operation. Electric motors shall be direct current suitable for the starting battery voltage.

2.4.4. Engine Protective Devices

Provide each engine with protective devices as follows:

a. Engine shutdown: Equip each engine with shutdown devices listed. These devices shall shut down the engine by shutting off the fuel supply to the fuel injectors. Shutdown devices shall be positive, direct in action and independent of the governor. Shutdown devices shall have factory-set fixed set points, and shall be equipped with either auxiliary electrical contacts and cranking circuitry, relays or equivalent device. Auxiliary contacts shall be suitable for starting battery voltage. Shutdown shall open the generator main circuit breaker. Provide the following shutdown devices:

b. Electrical interlocks and alarms: Equip throttle valves or starting mechanism with auxiliary contacts for interlocking with the generator main breaker control circuit as determined by manufacturer. Auxiliary contacts shall be suitable for starting battery voltage.

2.4.5 Engine Alarm Contact Devices

Equip each engine with alarm devices, relays, and auxiliary contacts, as required, to actuate alarm system on the associated engine control panel. Auxiliary contacts shall be suitable for the starting battery voltage. Alarm devices shall have factory-set fixed set points. Provide the following alarm contact devices:

a. Throttle valve limit switch or starting mechanism contacts or equivalent device operating to energize a portion of alarm system only when the engine is running and not during cranking or shutdown.

b. Pressure switch in jacket coolant manifold piping at the engine to operate when jacket coolant pressure drops below a preset value.

c. Pressure switch in engine and turbocharger lubricating oil system piping from engine to operate when pressure drops below a preset value due to failure of engine-driven lubricating oil pump. In addition to alarm contacts, provide set of contacts to start an auxiliary oil pump, if such a pump is standard with the engine manufacturer.

d. Temperature switch in the jacket coolant discharge piping from the engine to operate when temperature exceeds a preset value. Device shall have an adjustable range between 100 and 212 degrees F.

e. Temperature switch in lubricating oil piping manifold leaving the engine to operate when temperature exceeds a preset value, or as recommended by the manufacturer.

f. Other alarm devices and voltage regulator as recommended by the engine manufacturer.

2.4.6 Engine Accessories

Provide the following accessories for each engine-generator set where recommended by the manufacturer:

a. Piping on engine-generator set to inlet and outlet connections, including nonstandard companion flanges.

b. Foundation bolts, nuts, isolators, and sleeves for engine-generator set.

c. Level jack screws or shims, if applicable.

d. Chocks and shims for installation and leveling of engine-generator set subbase, if applicable.

e. Manually operated barring gear.

f. Indicating thermometer or temperature indicator in accordance with manufacturer's standard on engine coolant inlet and outlet and, where turbocharger intercooler outlet is a separate circuit, provide an indicating thermometer.

g. Drilled and tapped holes for attachment of manometer to measure crankcase pressure or vacuum, if standard with the manufacturer.

h. Removable guard or housing around flywheel, generator, and exciter. Support guard or housing entirely on either the engine or the subbase and to suit manufacturer's standard.

i. Weather protection shroud.

2.4.7 Air Intake and Exhaust Systems

Provide air intake and exhaust systems for each engine. Field installed piping shall be in accordance with the manufacturer's requirements. Mount air intake and exhaust systems on or support from the engine subbase assembly. For two-cycle engines, an air intake shutoff shall be provided which shall be operated by the engine overspeed device.

a. Air intake filters: Provide dry type filter for each engine as standard with the engine manufacturer. Filter shall be capable of removing a minimum of 92 percent of dirt and abrasive 3 microns and larger, from intake air. Size filter to suit engine requirements at 100 percent of rated full load. Unit shall be designed to permit easy access to the filter for maintenance purposes.

b. Air intake silencers: Provide for each engine to limit noise of intake air systems to a level below the audible mechanical noise level of the engine. Silencers shall be as recommended by the silencer manufacturer for the engine furnished.

c. Exhaust silencers: Provide an exhaust silencer for each engine to reduce the exhaust sound spectrum to, or below, the following listed levels, when measured with a sound level meter conforming to ANSI S1.4, 75 feet from the outlet, under full engine load and clear weather. Silencer shall be complete with handhole openings and necessary brackets for supporting purposes. Sizing of silencer shall be in accordance with the engine and silencer manufacturer's recommendations. Flanged inlet and outlet connections shall be provided.

Octave Band Center Frequency Hz	Maximum Sound Level Decibels Residential
63 and below	78
125	68
250	60
500	53
1,000	48
2,000	44
4,000	42
8,000	41

d. Expansion (flexible) joints: Provide sections of multiple corrugated stainless steel expansion joints with liners in the engine exhaust piping for each engine to absorb expansion strains and vibration in the piping. Flexible joints in exhaust piping shall be suitable for continuous operation at 200 degrees F above the normal exhaust gas temperature at 100 percent load. Air intake expansion joints shall be as specified for exhaust piping or may be metal reinforced rubber type suitable for the service. Joints shall be of the same size as the pipe and provided with flanged connections conforming to drilling dimensions of ASME B16.1 for 125 pounds flanges. Air intake expansion joints may be for plain end pipe.

e. Air intake piping: Conform to the manufacturer's recommendations for size, type, and connections.

f. Exhaust piping: Provide piping for each engine complete with necessary fittings, flanges, gaskets, bolts, and nuts. Pipe shall be lap-welded, or seamless steel pipe conforming to ASTM A 53. Exhaust piping shall be Schedule 40 pipe for 12 inch and smaller sizes and for larger sizes shall have wall thickness not less than 0.375 inch. Exhaust piping shall slope away from engine. Flanges shall be 150-pound slip-on forged steel welding flanges conforming to ASME B16.5, with material in accordance with ASTM A 181/A 181M, Grade I. Fittings shall be butt-welding conforming to ASTM A 234/A 234M, with wall thickness same as adjoining piping. Built-up miter welded fittings may be used. Fittings shall be of same material as pipe. Miter angles of each individual section shall not exceed 22.5 degrees total and not more than 11.25 degrees relative to the axis of the pipe at any one cut. Gaskets for piping shall be of high temperature asbestos-free material suitable for the service. Bolting material for exhaust flanges shall be alloy-steel bolt-studs conforming to ASTM a 193/A 193M, and alloy-steel nuts conforming to ASTM A 194/A 194M. Bolts shall be of sufficient length to obtain full bearing on the nuts and shall project not more than two full threads beyond the nut.

2.5 GENERATORS AND EXCITATION AND VOLTAGE REGULATION SYSTEM

2.5.1 Generator

Provide 1.0 power factor, synchronous, ac, brushless-excited, revolving field, air-cooled, self-ventilated unit conforming to NEMA MG 1 and rated as specified in the paragraph entitled "Equipment Rating and Capability." Enclosure frame shall be dripproof. Match generator speed to that of the engine. Drive generator directly from the engine crankshaft in a manner approved by both the engine and generator manufacturers. Generator shall be capable of carrying at rated voltage and 1.0 power-factor, a load equal to the net kW rating of the engine without exceeding the temperature limits specified in NEMA MG 1 for continuous duty. Winding insulation shall be Class B or F. An amortisseur winding shall be provided and the generator and flywheel shall have sufficient flywheel effect to meet the requirements of regulation specified. Generator field voltage shall be solidly grounded. Ground the generator enclosure at two opposite mounting legs.

2.5.2 Excitation and Voltage Regulation Systems

Comply with IEEE 421.1.

2.5.2.1 Exciter

Integral with generator; synchronous, rotating armature, rotating rectifier type. Rotating rectifier assembly shall be mounted in a manner to provide ready access for inspection and replacement of the rectifier diodes. Semiconductor rectifiers shall have minimum factor of safety of 300 percent for peak inverse voltage, and forward current ratings for operating conditions, including 100 percent generator output at 40 degrees C ambient. Safety devices for protection of rectifiers against overload currents and voltages shall be provided unless the design provides this protection inherently. Acceptable ratio of exciter ceiling voltage to exciter nominal voltage shall be not less than three to two. Exciter shall be equipped with surge protection devices. Output of exciter alternator shall be three-phase and shall be rectified by full-wave solid-state rotating rectifier mounted on the generator shaft. Rotating rectifier shall consist of hermetically sealed diodes connected between exciter and generator field without intervening brushes, slip-rings, or commutators. Exciter field shall be stationary.

2.5.2.2 Voltage Regulator, IEEE Device 90

Provide a solid state voltage regulator that automatically controls the generator field current through action on the exciter. Reference voltage shall be three-phase averaged and shall be obtained from the generator output transformers, if required. Voltage regulator shall enable manual adjustment of the set output voltage, while the set is operating, by potentiometer adjustment at the generator control panel. Voltage regulator shall enable parallel operation with like sets. Provide automatic field flashing using power from the starting battery and suitable means to limit the flashing current to a safe value with controls for the circuit, to be installed in the generator control panel.

a. Operation: Voltage regulator shall have characteristics and sensors which enable the generator to operate alone or in parallel with other generators in isochronous load sharing mode and in conjunction with common solid-state control to operate isochronously with proportional load sharing. Install instrument transformers and the voltage regulator in the generator control panel along with a manual voltage setting control system consisting of a manual voltage adjusting rheostat or variable autotransformer and a manual-automatic-off switch.

b. Regulation: Voltage regulator/excitation systems shall be capable of voltage regulation within plus or minus 1/2 percent from no-load to full-load, and capable of maintaining a long-time voltage stability of within plus or minus one percent. A 5 percent variation in frequency and the effects of field heating shall not affect the units regulation performance. Provide full-field-forcing series boost excitation system supplied as necessary and in conjunction with the voltage regulator to furnish a relatively constant voltage to the regulation power stage during operating conditions including generator overload and short circuit.

c. Electromagnetic interference (EMI) suppression: Provide as an integral part of the regulator, EMI suppression for conducted and radiation emissions complying with MIL-STD-461, Class C2.

2.6 FUEL OIL SYSTEM

Conform to NFPA 30 and NFPA 37 and the requirements herein.

2.6.1 Day Tanks

Provide fuel oil day tank of sufficient size to allow 8 hours of engine-generator set operation at full load. Provide tank gauges conforming to MIL-G-17713.

2.6.2 Level Alarm Switches

Provide high and low level switches designed for use with fuel oil tanks. Mount float gauges with isolating and drain valves. Contacts to operate at starting battery voltage.

2.6.3 Fuel Oil Transfer Pumps

Each pump unit shall consist of a horizontal, positive-displacement, rotary pump driven by an electric motor. Direct-connect each pump to its driving motor through a flexible coupling. Provide three-phase motors with the pumps in accordance with the paragraph entitled "Motors." Mount pump and motor on a common steel or cast-iron base plate and provide a suitable coupling guard. Equip each pump with a bypass relief valve. Each pump shall conform to MIL-P-17608, except as modified herein. Pumps shall be capable of pumping 30 gpm of fuel oil at a temperature of -10 degrees F against total head of 25 psi.

2.6.4 Duplex Fuel Oil Strainer

Provide the type having two straining chambers and arranged to divert the flow from one chamber to the other without interruption at any point of the changeover. Design shall allow for cleaning by permitting removal of the strainer basket not in use while the other strainer basket is in use. Construct strainer baskets of corrosion-resistant metal. Strainer mesh, type, and free area shall be as recommended by the engine manufacturer.

2.6.5 Fuel Oil Meters

Provide positive displacement type. Maximum variation from absolute accuracy measurement over entire range of meter shall be not greater than plus or minus five-tenths of one percent. Provide meters with horizontal setback registers and calibrated to read in gallons and tenths of gallons. Construct meters with cast-iron bodies, with working parts made of corrosion-resistant steel to resist wear, friction, and corrosion and suitable for handling oil containing a small percentage of sulphur. Each meter shall have a capacity to measure a maximum of 30 gpm with pressure drop through meter not exceeding 6 psi.

2.6.6 Day Tank Makeup Control Valve

Valve shall be a solenoid valve actuated by the level control switch in the day tank that also controls the fuel transfer pump operation. Solenoid valve shall conform to UL 429 for fuel oil service. The solenoid valve shall be two-way, direct acting, normally closed, open when energized, closed when de-energized, with brass body and resilient seat material. Electrical rating shall be 120 volt, single-phase, 60-Hz. Body connections shall be same size as connecting piping.

2.7 LUBRICATING OIL SYSTEM

2.7.1 Auxiliary Lubricating Oil Pumps

Where recommended by the engine manufacturer, provide one pump for each engine, each suitable for "before-and-after" lubricating and cooling service as required by the engine. Equip each pump with a bypass relief valve.

2.7.2 Lubricating Oil Filtration

Provide each engine with a pressurized lubricating oil filtration system capable of filtering the full rate of oil flow from the oil pumps at the maximum engine speed in accordance with the standard practice of the engine manufacturer. Means shall be provided to ensure delivery of lubricating oil to vital wearing surfaces regardless of the condition of the filters without removing the engine from service. Additionally, the filters must provide means of automatically bypassing the filter if it should become flow-restricting. Means shall be provided to maintain the oil contained in filters to a minimum temperature of -10 degrees F in accordance with the manufacturer's standard practice. When electric heaters are used, provide thermostatically controlled type suitable for the indicated electrical supply. Filter elements shall be of the throwaway type with filter elements as recommended by the engine manufacturer.

2.7.3 Lubricating Oil Coolers

If recommended by the engine manufacturer, provide coolers for each engine to maintain the lubricating oil within the temperature limits recommended by the engine manufacturer under all operating conditions. The cooling system and components shall be as specified by the engine manufacturer for use with the class of engine being provided, and the cooling medium to be used. Engine jacket coolant from the radiator shall be used as cooling medium. Fresh water at a maximum temperature of 78 degrees F shall be used as the cooling medium. Each thermostat used in the oil cooling system shall be of the nonadjustable type and factory set at the temperature recommended by the engine manufacturer.

2.7.4 Thermostatic Control Valves

If recommended and standard practice with the engine manufacturer for the proposed engine, provide a valve installed in the lubricating oil system for each engine to maintain a constant lubricating oil temperature from the engine. Valve shall be as specified in the paragraph entitled "Thermostatic Control Valves." Valve shall be capable of passing the total lubricating oil flow requirement of the engine as determined by the engine manufacturer with a pressure drop across the valve not to exceed 5 psi.

2.8 COOLING SYSTEM

Provide cooling system of the type specified. If the engine manufacturer considers that a different arrangement is more suitable for the engine to be installed, the Contractor may submit to Contracting Officer information on the proposed cooling system arrangement. If proposed arrangement is approved by the Contracting Officer, the Contractor shall provide the proposed system at an agreed upon reduction in contract price. Provide coolant as specified in the paragraph entitled "Radiators."

2.8.1 Jacket Coolant Pumps

Provide one pump for each engine driven from engine-generator set unit crankshaft or camshaft. Each pump shall have ample capacity to circulate the required flow of coolant specified through the system to remove the total heat rejected from the engine and, where provided by design, from the lubricating oil and intercoolers. Heat shall be rejected to the jacket coolant to maintain optimum jacket coolant temperature leaving and entering engine as recommended by the engine manufacturer.

2.8.2 Expansion Tanks

Provide one jacket water expansion tank for each engine-generator set. Tank may be the standard design as provided by the engine manufacturer or shall be constructed as specified in the paragraph entitled "Tank Construction." Each tank shall have capacity as recommended by the engine manufacturer. If the engine manufacturer has adopted use of a standpipe in lieu of the elevated expansion tank, the standpipe as sized by the engine manufacturer will be acceptable. Provide each tank or standpipe with a gage glass and pet cook assembly. Include connections of the indicated size for open inlet, outlet, overflow, engine vent, vent drain, and gage glass.

2.8.3 Radiators

Provide one radiator unit for each engine-generator set. Provide engine subbase mounted radiators of the forced draft type with horizontal or vertical air discharge as standard with the engine manufacturer.

a. Design conditions: Each radiator unit shall have ample capacity to remove not less than the total Btu per hour of heat rejected by its respective engine at 100 percent full-rated load to the jacket coolant and lubricating oil system and that necessary for turbocharger intercooler. Radiator capacity shall be rated at optimum temperature of coolant leaving the engine and intercooler as recommended by the engine manufacturer, with a dry bulb air temperature of 110 degrees F. Pressure drop through the radiator shall not exceed 6 psi when circulating the maximum required coolant flow. Radiator air velocity shall be a maximum of 900 feet per minute. Coolant solution shall be a mixture of clean water and a commercial standard methoxy-propanel type coolant providing protection to 10 degrees F. Mixture shall be to the proportions

recommended by the engine manufacturer to meet site conditions. Provide an antifreeze solution tester suitable for the solution used.

b. Engine subbase-mounted radiator construction: Radiator fan shall direct the air flow from the engine outward through the radiator. Fan may be driven directly from the engine crankshaft through V-belt drive. Radiator shall have sufficient capacity to meet design conditions against a static restriction of 0.5-inch of water as may be imposed by louvers and ductwork. Cooling section shall have a tube and fin type core. Engine-driven fans shall be the engine manufacturer's standard units, selected for quiet vibration-free operation. Provision shall be made for coolant expansion either by self-contained expansion tanks or separately mounted expansion tanks, as standard with the manufacturer. Provide suitable guards for each fan and drive.

(1) Include provisions for each radiator to protect exposed cooling coils from damage resulting from hail.

(2) If recommended by manufacturer, provide plenum chamber of each radiator unit with rolling doors arranged with a hand wheel for operation from ground level, or vertical sliding doors to control admission of air to the fans. Furnish a heavy canvas cover of a size to fit over the top of each radiator unit complete with suitable fasteners.

(3) Provide heavy-duty industrial shutter, interlocking type, to cover the entire area of the coil sections. Construct blades of steel not higher than 14-gage. If necessary, provide intermediate support plates with bronze bearings. Blades shall have formed edges for strength and to permit interlocking for shut-tight operation. Position blades through linkages to a common drive shaft supported by lubricated sleeve bearings. Provide control motors for positioning the shutters. Control motors shall be heavy-duty reversible type with not less than five positions, and designed for single-phase operation with high torque characteristics, gear reduction, and built-in limit switches conforming to the paragraph entitled "Motors." Unit shall be complete with necessary accessories and linkage and a five-position rotary selector switch with position indication for mounting on engine control panel for remote manual control.

2.8.4 Thermostatic Control Valves

If recommended and standard with the engine manufacturer for the proposed engine, provide a valve installed in the jacket coolant system for each engine to maintain a constant jacket coolant temperature from the engine. Valve shall be as specified in the paragraph entitled "Thermostatic Control Valves." Valve shall be capable of passing coolant flow, as determined by the engine manufacturer.

2.8.5 Starting Aids

Provide a factory-installed, electrically operated, jacket coolant heating system to ensure rapid starting. Heater shall be thermostatically controlled at the temperature recommended by the engine manufacturer. Power leads shall be brought to a junction box which shall provide fusing and manual disconnection of the heater. Installation shall include necessary equipment, piping, controls, wiring, and accessories.

2.9 ELECTRIC STARTING SYSTEM

Provide a 24-volt dc starting battery installation for starting of each engine-generator set utilizing an electric cranking system. Electric cranking system shall be capable of rotating the engine at a speed sufficient for rapid starting in an ambient temperature of -10 degrees F. Signal for starting shall come from the engine-generator set control system.

2.9.1 Cranking

Electric cranking system shall be energized from negative polarity grounded starting batteries, dc electrical circuit. Provide heavy-duty type cranking motors with capacity to crank the engine continuously to start the engine. Drive mechanism for engaging the starting motors with the engine flywheel shall be designed to inherently engage and release without binding. When the engine starts, a "stop cranking" switch shall be engine-speed actuated and shall cause disengagement of the starting gearing and the shutdown of the starting motors. Automatic cranking panel shall crank the engine as specified under the paragraph entitled "Engine Cranking Relay."

2.9.2 Starting Battery Installation

Provide a nickel-cadmium pocket plate type engine cranking battery designed for diesel engine starting of sufficient size and capacity and in a fully charged condition to start the engine-generator set six consecutive times. Provide battery racks or enclosures, properly ventilated for the batteries and charger. Provide necessary cabling.

2.9.3 Starting Battery Charger

Provide enclosed, automatic, dual-rate, solid-state, constant voltage type battery charger having ac voltage compensation, dc voltage regulation, and current limiting. Charger shall employ transistor-controlled magnetic amplifier circuits to provide continuous taper charging. Charger shall have two ranges, float and equalize, with 0 to 24 hour equalizer time, dc cranking relay, silicon diode full-wave rectifiers, automatic surge suppressors, dc ammeter, dc voltmeter, and fused inputs and outputs. Charger shall have a continuous rated output of not less than 10 amperes. Battery charger shall conform to UL 1236.

2.10 PIPING SYSTEMS

2.10.1 Engine Jacket Coolant and Fresh Water Piping Systems

Piping systems shall conform to the following except that factory installed piping may conform to the engine-generator set manufacturer's standards:

a. Piping: Provide seamless steel pipe, Schedule 40, conforming to ASTM A 53, Grade A.

b. Fittings and flanges: Fittings, 1 1/2-inch or smaller, shall be malleable iron conforming to ANSI B16.3 for 300-pound threaded type. Fittings, 2 inches and larger, shall be steel butt-welding conforming to ASME B16.9. Utilize either ASME B16.1 or Class A of ASTM A 126 for 125-pound cast-iron flanged fittings. Flanges shall be in accordance with ASME B16.5 for 150-pound slip-on or welding neck forged steel welding flanges, material conforming to ASTM A 181/A 181M. Provide flat face flanges for connecting to 125-pound standard cast-iron valves, fittings, and equipment connections.

c. Valves:

(1) Gate valves: For valves, 1 1/2-inch and smaller, provide double disk, rising stem, inside screw, union bonnet type, 150-pound class bronze gate conforming to MSS SP-80. For valves, 2-inch and larger, provide double-disk, parallel seat type, hydraulic-rated, 125-psi class, outside screw and yoke type with flanged ends and bronze trim conforming to MSS SP-70. Provide stem packing of material suitable for the service encountered.

(2) Globe valves: For valves: 1 1/2-inch and smaller, provide rising stem, inside screw, union bonnet type, 125-pound class bronze valves conforming to MSS SP-80. For valves 2-inch and larger, provide 150-pound class cast iron, flanged ends, bronze trim globe valves conforming to MSS SP-85. Valves shall have renewable composition discs suitable for the service encountered.

(3) Check valves: Provide MIL-V-18436, swing check type.

2.10.2 Fuel Oil and Lubricating Oil Piping Systems

Piping systems shall conform to the following, except that factory-installed piping may conform to the engine-generator set manufacturer's standards:

a. Piping: Provide seamless steel, conforming to ASTM A 53, Grade A. Screwed piping, 1 1/2-inch and smaller, shall be Schedule 80; remaining piping shall be Schedule 40. The Contractor may substitute FS WW-T-799 Type K copper tubing with wrought copper, high-temperature soldered or threaded fittings, where the use of copper

piping is standard with the generator set manufacturer. Provide threaded adapters or flanges for valves and equipment connections.

b. Fittings and flanges: Fittings for steel piping, 1 1/2-inch and smaller, shall be 3,000-pound forged steel socket welding, conforming to ANSI B16.11. Fittings, 2-inch and larger, shall be steel butt-welding, conforming to ASME B16.9. Flanges shall be per ASME B16.5 for 150-pound slip-on or welding neck forged steel welding flanges, material conforming to ASTM A 181/A 181M. Provide flat face flanges for connecting to 125-pound standard cast-iron valves, fittings, and equipment connections.

c. Unions: For steel piping, 1 1/2-inch and smaller, unions shall conform to MSS SP-83 with socket welding ends. For piping 2-inch and larger a pair of flanges may be used in lieu of a union.

d. Plug valves: Utilize lubricated tapered plug type in conformance with MIL-V-12003, 125 pound class. Valves, 4-inch and smaller, shall be wrench-operated. Provide valves, 6-inch and larger, with worm gear hand wheel operator. Valves, 1 1/2-inch and smaller, shall have screwed ends. Valves, 2-inch and larger, shall have flanged ends.

e. Gaskets: Provide woven nonasbestos fibers with fluorocarbon plastic binder or compressed with nitrile or neoprene binder suitable for either diesel fuel oil or lubricating oil.

2.10.3 Bolts, Studs, and Nuts

a. For temperatures up to 450 degrees F: Material for bolts or studs shall be ASTM A 307, Grade B, and for nuts ASTM A 194/A 194M, Grade 2. Threads and dimensions for bolts or studs shall comply with ANSI B18.2.1 for square head dimensions.

b. For temperatures over 450 degrees F: Material for bolts or studs shall be ASTM A 193/A 193M, Grade B7, and for nuts ASTM A 194/A 194M, Grade 7. Threads and dimensions for bolts or studs shall comply with ASNI B18.2.1 for square head dimensions and with ASME B1.1 coarse thread series, for one inch and smaller.

2.11 ENGINE-GENERATOR SET CONTROLS

Provide an engine-generator control panel mounted on each engine-generator set subbase, located adjacent to indoor mounted ATS.

2.11.1 Engine-Generator Control Panel

Provide an enclosed panel fabricated of not lighter than 14-gage sheet steel in compliance with NEMA 250, Type 12 3R. Construct cabinet with angle iron framework, if required, for proper stiffness and support. Size cabinet to accommodate specified equipment when arranged in an orderly and approved

manner. Factory-mount panel on engine unit subbase. Provide isolation mounting material between subbase and panel to isolate the panel from engine vibrations. Provide panel-mounted devices with nameplates of laminated black gloss-finished plastic with white engraved lettering. Provide connecting piping, tubing, and wiring installed in conduit where not otherwise enclosed.

2.11.1.1 Engine Control Panel

Provide devices of the type standard with the manufacturer utilizing minimum 2-inch nominal diameter gages. Instruments subject to rapid pressure surges shall be provided with dampening devices to give a steady reading. Provide the following panel-mounted devices as a minimum:

a. Engine controls: Install engine controls on the generator control panel, except provide an emergency stop switch on the engine control panel.

b. Engine instrumentation:

(1) Fuel oil pressure gage

(2) Lube oil pressure gage

(3) Coolant temperature gage

(4) Elapsed time meter

c. Engine safety circuit devices: Provide the following devices to stop the engine-generator set and to simultaneously open its main circuit breaker. Stop switch may be connected to this safety circuit if recommended by the manufacturer. Source of energy for engine safety circuit devices shall be the starting battery.

(1) Overcranking

(2) Overspeed

(3) Excessive coolant temperature

(4) Dangerously low lubricating oil pressure.

2.11.1.2 Generator Control Panel

Install controls in the engine-generator control panel. Provide generator controls and instrumentation as follows:

a. Generator controls

(1) Generator circuit breaker, IEEE Device 52

(2) Voltage regulator and associated controls.

b. Generator instrumentation

(1) Voltmeter and control switch

(2) Ammeter and control switch

(3) Automatic transfer and bypass isolation combination switch

(4) Surge arrester and capacitor assembly

2.11.1.2 Generator Units

Provide to switch and control the electrical output of each engine-generator set.

2.11.1.2 Feeder Units

Provide feeder units to switch and control each feeder and bus tie.

2.11.2 Remote Alarm Panel

Provide prealarms and shutdown alarms in accordance with paragraphs entitled "Generator Control Panel," Part d.

2.11.3 Generator Control Panel Devices

Conform to the following requirements for each device.

2.11.3.1 Generator Circuit Breaker, IEEE Device 52

Provide a circuit breaker having a solid-state tripping device with adjustable long-time and short-time tripping characteristics. Provide a stored-energy closing mechanism for rapid and safe closing of the circuit breaker against fault currents within the short-time rating of the circuit breaker independent of the operator's strength or effort in closing the handle. Size the circuit breaker for the 100 percent full-load capacity of the engine-generator set and provide lugs for the indicated electrical connection.

a. Type: Provide a molded-case circuit breaker conforming to NEMA AB-1 and UL 489 and having 100-percent rating. Switchboard construction shall conform to NEMA PB 2 and UL 891. Provide a low-voltage power circuit breaker conforming to ANSI C37.13 and ANSI C37.16 for all circuit breakers. Switchboard construction shall conform to ANSI C37.20.1 for metal-enclosed low-voltage power circuit breaker switchgear. Trip ratings shall conform to ANSI C37.17.

b. Operation: Switchboard type control switch and red and green indicating lights shall be provided for power circuit breakers.

c. Circuit breaker test set: Provide a test set capable of performing routine calibration and maintenance tests on low-voltage power circuit breakers furnished with the switchboard. Test set shall be capable of making operational tests, internal power supply tests, pickup current and time delay tests, and trip signal output tests. Tests shall be suitable for use on a 20-ampere, 120-volt, 60-Hz circuit.

2.11.3.2 Generator Voltage

Install manual voltage setting control system as specified under paragraph entitled "Voltage Regulator."

2.11.3.3 Instrument and Control Switches

Utilize rotary-enclosed, rear-mounted switches having positive means of maintaining contacts, which shall be silver-to-silver type, identifying escutcheon plates, and handle targets to indicate switch position. Utilize knurled handles for instrument switches, standard pistol grip handles for circuit breaker and governor control switches. Provide red and green indicating lights for circuit breaker control switches.

2.11.3.4 Indicating Lights

Provide front removable, low drain, push-to-test, indicating lights equipped with dropping resistors suitable for 120-volt ac service, as required and color caps as specified.

2.11.3.5 Instruments

Provide semiflush-mounted, rectangular, switchboard instruments with rear connecting terminals and conforming ANSI C39.1. Construct with taut-band suspension movement and 250-degree scales in a nominal 4.5-inch square case. Design and calibrate for vertical or horizontal mounting, as required. Elapsed time meters shall totalize engine running time to 9999.9 hours total.

2.11.3.6 Instrument Transformers

Provide indoor, dry-type conforming to IEEE C57.13. Coordinate mechanical and thermal ratings with circuit breakers and other apparatus in the switchboard in accordance with ANSI C37.20.1. Provide voltage transformers as shown or as required of the nondrawout type with current-limiting primary fuses and secondary fuses.

2.11.3.7 Engine Starting Switch

Four-position rotary, enclosed rear mounting, maintained-position type. Switch positions shall be "Automatic," "Off," "Test," and "Manual" and shall be connected to provide the following operation:

a. In the "Automatic" position, the engine-generator set shall start automatically in response to loss of voltage, as described in paragraph entitled "Automatic Controls."

b. In the "Off" position, the engine-generator set starting circuits shall not function.

c. In the "Test" position, the engine may be started and brought up to speed, but the engine-generator set cannot be put on line.

d. In the "Manual" position, the switch shall start and bring the engine-generator set up to speed and then connect it to the line.

2.11.3.8 Engine Cranking Relay

Provide to operate as follows:

a. When actuated, device shall close contacts to actuate the engine starting system.

b. Should the engine fail to start at once, cranking shall continue for 25 seconds (adjustable) after which a 10-second "off" period (adjustable) shall occur, followed by a 7-second starting period (adjustable) and another 7-second "off" period (adjustable). Durations of cranking and "off" periods listed above may be modified in accordance with the engine manufacturer's recommendations.

c. Repeat the above cranking cycle described for three starting attempts.

d. If the engine still fails to start, the cranking device shall lock out further starting attempts until it is manually reset. When the cranking relay locks out, an alarm light shall be energized on the panel and remain lighted until it is manually reset.

2.11.3.9 Engine Shutdown Relay

Provide and actuate by the engine protective devices as specified in paragraph entitled "Engine Safety Circuit Devices." Shutdown relay shall disable engine starting circuits until manually reset. Provide reset pushbutton on switchboard.

2.11.3.10 Automatic Transfer and Bypass Isolation Switch

Provide an automatic transfer switch and associated isolation and bypass switch with the number of poles, amperage, voltage, and withstand ratings as shown.

a. Automatic transfer switch: Listed to meet UL 1008 as a recognized component for emergency systems and rated for all classes of loads when installed in an unventilated enclosure. Electrical operation shall be accomplished by a nonfused momentarily-energized, solenoid

direct-operating mechanism or stored-energy operator. Provide mechanical locking in each direction. Operation shall be inherently double-throw where normal and emergency contacts operate with no intentional delay in midposition. Main-pole structures shall be designed so that fault currents result in increased main contact pressure. An overload or short circuit shall not cause the switch to go to a neutral position. Main contacts shall be designed from automatic transfer switch service. Inspection and replacement of main and separate arcing contacts, moving and stationary, shall be possible from the front of the switch without disassembly of operating linkages or power conductors.

b. Automatic transfer switch accessories: A separately mounted unitized control module including the following:

(1) Nonadjustable (one-second, nominal) time delay to override momentary dips in normal power source.

(2) Phase voltage relay supervision of three phases of the normal source 65 to 70 percent dropout (DO) and 92 to 95 percent pickup (PU) to detect "brown-out" conditions.

(3) Voltage/frequency lockout relay, 90 percent PU, nominal, to prevent premature transfer.

(4) System test switch, momentary type.

(5) Engine starting control contacts, one normally closed and one normally opened.

(6) Auxiliary pilot contacts rated 10 amperes at 480 volts ac, one closed on "N" (normal) and one closed on "E" (emergency).

(7) Adjustable 2 to 25 minutes time delay on retransfer to normal power source.

(8) Full-rated neutral transfer contacts driven by the main contact shaft.

(9) Adjustable time delay, 5 to 15 minutes, on shutdown of engine-generator set after retransfer of the load to "normal."

(10) Pilot lights to indicate source to which the load is connected.

c. Automatic transfer switch bypass/isolation switch: Provide manual bypass/isolation switch for the automatic transfer switch, arranged to bypass the emergency or the normal source of power directly to the load in one operation, isolating the automatic transfer switch from the load and both normal and emergency sources for automatic transfer switch maintenance purposes. Bypass/isolation switch shall be lockable in the "isolated" position. Arrangement shall permit

electrical testing of the automatic transfer switch before the load is reconnected. Interlocks shall prevent operation of the automatic transfer switch, except for testing purposes, when the automatic transfer switch is in the "isolated" position. Enclosure shall be designed so that the automatic transfer switch and the isolation switch shall be accessible through individual door openings and installed in separate barriered compartments to eliminate exposure to the operator when servicing the automatic transfer switch while the bypass isolation switch is in the bypass/isolation position. Bypass isolation switch compartment shall include a pilot light arranged to indicate when the automatic transfer switch is in the bypass/isolation position. Bypassing the automatic transfer switch shall not cause interruption of power to the load. Current, voltage, phase, pole (with switched neutral), and short circuit ratings of the bypass isolation switch shall be at least equal to the automatic transfer switch ratings. Bypass/isolation switch may be a nonloadbreak device, but shall have at least an equal short circuit withstand rating as the automatic transfer switch has. When the bypass isolation switch is installed in a nonventilated enclosure and is carrying rated current, its contact temperature shall not exceed the limitations designed for the automatic transfer switch.

2.11.3.11 Surge Arrester and Capacitor Assemblies

Surge arrester and capacitor assemblies designed for use on a three-phase, four-wire solidly grounded system shall be installed when specified and shall be designed for the engine-generator set voltage level. Provide surge arresters of the metal-oxide type designed for a maximum 10-kiloampere discharge. Provide surge capacitors specifically designed for use with the associated surge arrester. Provide capacitors for generators with built-in resistors and designed for rotating machine protection.

2.12 MOTORS

Provide continuous-duty electric motors complying with NEMA MG 1- unless motors are specified to be engine driven. Nameplate horsepower ratings shall be as required to drive associated equipment under the maximum specified conditions of operation without consideration of service factor. Provide induction motors with Class B insulation. Motors shall have general purpose drip-proof or totally enclosed fan-cooled enclosures as specified or shown. Motor shall have sleeve bearings or grease-lubricated ball bearings.

2.12.1 Three-Phase Motors

Provide single- or two-speed motors as specified or shown, squirrel cage type rated at the engine-generator set voltage level for 1/2 hp and larger units.

2.12.2 Single-Phase Motors

Provide motors rated 115 volts, 60-Hz for 1/3 hp and smaller units.

2.13 MOTOR CONTROL

Comply with the requirements specified in Section 16402, "Interior Wiring Systems."

2.14 MISCELLANEOUS ENGINE SYSTEM REQUIREMENTS

2.14.1 Tank Construction

Construct tanks of not less than 3/16-inch steel plate with welded joints and necessary stiffeners on the exterior of the tank. Provide an adequately braced structural steel framework support. Weld tank top tight and provide an access opening with a dustproof, removable 24-inch cover.

2.14.2 Flange Connections

Where not otherwise indicated, flange piping connections in accordance with ASME B16.1 for 125-pound flanges.

2.14.3 Thermostatic Control Valves

Valves shall be modulating type utilizing self-contained thermostats without the use of external bulbs, and equipped with three-way valve action. Provide valves with one or more interchangeable thermostatic elements. Thermostat shall be nonadjustable type, and the operating temperature shall be factory-set at the temperature recommended by the engine manufacturer. Provide valve designed to fail-safe, permitting flow through the engine. Provide flanged connections in accordance with the paragraph entitled "Flange Connections."

2.14.4 Meter Racks

Provide meter racks of sufficient size and strength to accommodate the fuel oil and lubricating oil meters. Construct racks of angle iron framework and provide with a drip collector pan constructed of not lighter than 10-gage sheet steel. Provide pans on fuel oil meter racks with a drain connection for piping to the fuel oil drip tank. Slope the bottom toward the drain to provide complete drainage.

2.15 WIRE AND CABLE

Provide wire and cable required for a complete electrical system as shown. Comply with the requirements specified in Section 16402, "Interior Wiring Systems."

2.16 SOURCE QUALITY CONTROL

2.16.1 Engine Tests

Perform customary commercial factory tests on each engine, including, but not necessarily limited to, the following:

a. Perform hydrostatic test on water jackets and piping to ensure that water seals and water jackets are water tight. Test report shall indicate pressure at which test was made and the results.

b. Place engine-generator set in continuous operation without stoppage for a period of not less than 8 hours. Operate not less than one hour at each load point, that is 1/2, 3/4, and full load. If stoppage becomes necessary during this period, repeat the 8-hour run. Record the following data for all sets at the start, at 15-minute intervals, and at the end of each load run: Fuel consumption; exhaust temperatures; engine coolant temperatures; lubricating oil temperatures and pressures; and any other data of importance.

2.16.2 Generator Tests

Ensure that temperature tests on one generator's windings are performed by the manufacturer of the generator in manufacturer's own plant. Temperature tests shall be in accordance with IEEE 115. Prototype tests for generators that are physically and electrically identical to those provided under the Contract are acceptable. Calculations of the subtransient reactance shall be included in the test report.

2.16.3 Radio Frequency Interference (FRI) Tests

Conduct test in accordance with MIL-S-16165 and MIL-STD-461. Furnish testing equipment, instruments, personnel for conducting the tests, a test location which shall be reasonably free from radiated and conducted interference, and other necessary facilities. Tests for RFI will not be required for items that are physically and electrically identical to those that have previously met the requirements of the specifications.

PART 3 PRODUCTS

3.1 INSTALLATION

Installation shall be in strict accordance with manufacturer's instructions. Provide labor, tools, equipment, and other necessities for erection and installation of the equipment. Use cribbing and shoring as required to protect construction from moving-in damage. Protect flooring and finished surfaces with heavy planking. After equipment has been installed, remove shoring and repair damage to floors and other parts of the building. Furnish the services of one or more Diesel-Generator representative or technicians, experienced in the installation and operation of the type of systems being provided, to supervise the installation.

3.1.1 Installation of Engine-Generator Sets

Install engine-generator sets on a concrete foundation as indicated. Provide vibration isolators to isolate vibrations from the engine-generator set to the foundation. Type, number, and arrangement of the isolators shall be as recommended by the manufacturer of the engine-generator set.

3.1.2 Equipment Supports and Installation

Provide devices to support equipment not supported on the engine-generator structural steel subbase as required. Fabricate the required supports of structural steel sections, plates or rods, and arrange to provide rigid and sturdy support. Provide connections and fasteners required between equipment supports and building structures.

a. Batteries and chargers: If batteries are to be stored during the construction period, follow manufacturer's instructions for charging and protection from environmental damage.

3.1.3 Instruction of Operators

After equipment is ready to be placed in service, the Contractor and equipment manufacturer's representative shall fully instruct plant operators in operation and maintenance of the equipment. Posted operating instructions for diesel engine-generator set shall be provided adjacent to the unit.

3.1.4 Piping

Piping connecting the engine and equipment mounted on the engine-generator subbase shall be factory installed and shall conform to the manufacturer's standards for the set sizes involved. Piping extensions from the engine-generator and subbase to remote cooling systems, fuel and lubricating oil systems are included, and, unless stated otherwise, fabrication, assembly, welding, soldering, and brazing shall conform to ASME B31.1. Arrange piping to provide a workable arrangement, with convenient access to valves and specialty items. Maintain adequate clearance between runs of piping to permit access around adjacent pipe for dismantling, repair, and maintenance of valves. Piping shall be straight, plumb, and run direct as possible. Do not install piping over electrical equipment. Install piping by competent and skilled workmen.

3.1.4.1 Shop Fabrication

Shop fabricate pipe to the greatest extent possible. Plug ends of piping and openings prior to shipment to plant site.

3.1.4.2 Welding

Preparing, bending, cleaning, and welding of piping shall conform to ASME B31.1. Welds shall be visually examined and meet acceptance standards of ASME B31.1.

3.1.4.3 Field Cleaning

Before placing in position, clean the inside of black steel pipe by rapping along its full length to loosen sand, mill scale, and other foreign matter. Pipe 2-inch and larger shall have a wire brush of a diameter larger than that of the inside of the pipe drawn through its entire length several times. Before final connections are made to apparatus, wash out interior of coolant piping with water. Blow out air, fuel, and lubricating oil lines with 80-to-100 psi dry air or nitrogen. Sterilize potable-water piping by means of liquid chlorine or lime in accordance with AWWA C651 before being placed in service.

3.1.4.4 Pickled Piping

Clean steel lubricating oil and fuel oil piping and pickle internally by chemical cleaning. Cleaning process shall remove grease, oil, dirt, mill scale, lacquer, and corrosion products. Clean piping either by circulating the cleaning solution through the completed piping systems or by soaking prefabricated piping sections in a tank of the solution. Provide and remove after use pumps, temporary piping connections, tanks, heaters, and other equipment required to accomplish cleaning of piping. After cleaning is completed, thoroughly flush, drain, and dry piping and take necessary precautions to prevent rerusting before pipe is used. While cleaning, remove or isolate instrumentation, valves, and equipment installed in the piping which contain bronze or brass. Cleaning solution shall not come in contact with bronze or brass. Cleaning solution shall not be circulated through the engine, engine lubricating-oil sump, or lubricating oil cooler or pumps in the oil piping systems. Provide cleaning solution of the type as recommended by the engine manufacturer and a chemical manufacturer for the specific purpose.

3.1.4.5 Provisions for Expansion

Provide for expansion of piping subject to temperature change by using suitable flexible piping connectors expansion joints, bends, ball joints, offsets, and loops in a manner that will prohibit development of excessive stresses between anchor points or at equipment connections. Use bends loops and offsets wherever practical to prevent overstressing of piping systems due to thermal expansion and to provide adequate flexibility. A piping system may be cold sprung by an amount no greater than 50 percent of the total linear expansion to alleviate end thrusts and moments. Method of cold springing shall be as approved.

3.1.4.6 Reducing Fittings

Use for changes in pipe size except where taps are permitted. Use of busings is prohibited. In horizontal mains containing liquids, use eccentric reducers.

3.1.4.7 Unions or Flanges

Place where necessary to permit easy connection of piping and apparatus. Provide each connection having valves with screwed ends with a union. In long lines inside buildings, place unions or flanges not farther apart than 100 feet, except in pipe lines of welded construction where unions or flanges shall be placed as indicated.

3.1.4.8 Valves

Install in positions accessible for operation and repair. Install stems preferably in a vertical position with handwheels or operators on top, or install in a horizontal position. Do not install handwheels on stop valves below the valve. Install globe valves with flow direction from below the disk.

3.1.4.9 Connections to Equipment

Make piping connections to equipment shown and provide reducers, increasers, unions, and valves to make a complete installation. Make connections to equipment with unions or flanged joints. Valves shall be the same size as the piping in which they are installed.

3.1.4.10 Joints

a. Flanged joints: Face pipe flanges true to line and thoroughly clean before assembly. Gasket faces shall be free of burrs or bruises. Make up flanged joints prior to completing the last weld in connecting piping. Coat bolt threads with a mixture of equal parts of graphite and boiled linseed oil or with an approved commercial coating.

b. Screwed joints: Use graphite pipe-joint compound conforming to MIL-T-5544; apply to male threads only. Red or white lead and zinc compound conforming to MIL-T-22361 may be used, except lead compounds are prohibited in potable water lines. Piping shall be free of fins and burrs. Ream pipe ends or file out to size of bore; remove chips.

3.1.4.11 Pipe Sleeves

Provide where pipes and tubing pass through masonry or concrete walls, floors, roofs, and partitions. Sleeves in outside walls above grade, in floor, or in roof slabs shall be steel pipe. Sleeves in floor slabs shall extend 3 inches above the finished floor. Firmly pack space between the pipe or tubing and the sleeve with oakum and caulk on both ends of the sleeve with elastic cement, except for sleeves in the plant operating floor which shall be free of packing and elastic cement.

3.1.4.12 Excavation and Backfill

Perform necessary trenching and backfill for outside piping to be furnished and installed. Excavate bottom of trenches to grade, with bell holes provided at each joint. Bottom of each length of pipe shall bear firmly against undisturbed earth for full length of barrel. Rocks larger than 3 inches in diameter in soil beneath the pipe shall not come into physical contact with the pipe. Make changes in grade or alignment with suitable fittings. After outside piping is installed and tested, backfill trenches. Backfill shall be consolidated by mechanical tamping in layers not exceeding 6 inches. Remove excess materials from trenches and deposit as directed by the Government. Restore trench areas to original condition.

3.1.4.13 Slope, Drainage, and Ventilating

Slope piping to permit complete drainage. Install drain valves at low points in piping. Drain valves shall be 1/2-inch gate valves for pipe lines smaller than 3 inches and 3/4-inch gate valves for lines 3 inches and larger, except where specific sizes are shown. Drain valves shall be of the same class as the piping drained. Install vent valves at high points in piping. Vent valves shall be 1/2-inch globe valves.

3.1.4.14 Flashing

Flashing and counterflashing for pipes and supports passing through exterior walls above ground and through roof shall conform to details as indicated.

3.1.4.15 Capped or Plugged Outlets

For connections to future equipment, if not located exactly by the drawings, locate outlets as directed.

3.1.4.16 Anchors, Guides, and Supports

Anchor and support piping in a manner such that expansion and contraction will take place in the desired direction. Prevent vibration by use of vibration dampers and prevent undue strains on equipment served. Hangers used for support of piping of 2-inch pipe size and larger shall be the type permitting adequate adjustment after erection while still supporting the load. Provide supports to adequately carry weight of lines and to maintain proper alignment. Provide inserts and sleeves for supports in concrete where necessary, and in new construction place before concrete is poured.

3.2 FIELD QUALITY CONTROL

Perform and report on field tests and trial operations, and conduct field inspections, except final field inspection. Provide labor, calibrated and approved test equipment, and incidentals required for the tests. The Contracting Officer will witness field tests and trial operations and will conduct final field inspections. Give the Contracting Officer 15 days notice of the dates and times scheduled for tests, trial operations, and inspections which require the presence of the Contracting Officer. Deficiencies found shall be rectified and work affected by such deficiencies shall be completely retested.

3.2.1 Piping Tests

Test piping system after lines have been cleaned. Test piping systems at a pressure of 1.5 times the design working pressure, and in no case less than 100 psig. Hydrostatically test piping, except for air, oil, and gas, using water not exceeding 100 degrees F. Test air, oil, and gas lines with clean, dry air or nitrogen. For air lines operating at pressure greater than 100 psig, test at the design working pressure. In all tests, remove gages, traps, and other apparatus which may be damaged by the test pressure, or valve off before the tests are made. Install a calibrated test pressure gage in the system tested with air with a soapy water solution to check for leaks. Maintain the required test pressure for a sufficient length of time to enable inspection of joints and connections. Rectify defects which develop during testing, and retest piping systems until they show no defect or weakness and are tight.

3.2.2 Preliminary Operation

Make alignment and adjustments to equipment to ensure proper operation as instructed by the manufacturers of the equipment. Lubricate equipment prior to operation in accordance with the manufacturer's instructions. Upon approval by the Contracting Officer or the Contracting Officer's authorized representative, operate engine-generator sets at varying loads throughout the load range for a sufficient time to demonstrate that operation is proper and that pressures and temperatures are normal and within the specified limits. Operate engines for a period of time sufficient to ensure that the units are ready to carry the test loads specified in paragraph entitled "Engine-Generator Set Acceptance Tests" without damage to engine parts. During this preliminary operation, check the operation and ensure the proper functioning of auxiliary equipment. Make necessary adjustments to equipment to place auxiliary equipment in operating condition.

3.2.3 Electrical Equipment and Materials Tests

Test procedures, inspections, and sampling shall be as specified and noted below:

a. Phase relationship tests: Check connections to equipment for proper phase relationship. During such check, disconnect devices which could be damaged by the application of voltage or reversed phase sequence.

b. Control panel tests: Following installation and immediately prior to energization, perform field dielectric tests in accordance with ANSI C37.20.1. Test and adjust meters and relays in accordance with the applicable referenced specifications.

c. Insulation resistance tests: Test cables and equipment furnished. Minimum acceptable values of insulation resistance of circuits and equipment shall be as recommended by the manufacturer.

3.2.4 Engine-Generator Set Acceptance Tests

When installation is complete and in operating condition, notify the Contracting Officer in writing that the engine-generator sets and auxiliary equipment are ready for final field tests. The Contracting Officer or Contracting Officer's authorized representative will witness final acceptance tests. Perform such other tests as necessary to make certain that equipment is functioning properly. Tests shall include the following:

a. A test to determine generating unit speed regulation under a gradual change from zero to full load.

b. A test to determine generating unit instantaneous speed change with 25 percent load on or off.

c. A test to ensure proper functioning of the overspeed trip.

d. An individual test of each alarm device.

Inspect auxiliary equipment including, but not limited to, pumps, fans, radiators, instruments, and special valves to ensure proper operation. Auxiliary equipment may be field tested at the option of the Contracting Officer. Auxiliary equipment test shall be in accordance with the latest ASME and IEEE performance test codes, if applicable. If no code exists for the equipment to be tested, perform tests as prescribed by the Contracting Officer. Perform engine-generator set tests in accordance with the provisions of the "Field Test Code," as set forth in DEMA requirements, except as modified herein. Furnish and connect a suitable water air rheostat for loading the engine-generator set under test. Perform operational tests at varying loads to demonstrate satisfactory automatic operation. Check oil after tests for presence of metal filings and water. Provide and install temporary instrumentation, piping, and electrical wiring and make electrical connections required for the engine-generator set tests.

3.2.4.1 Test Reruns

If the specified performance is not met by these tests, make such adjustments and changes, as necessary, and conduct additional tests, as necessary, to further check the performance of the equipment.

3.2.4.2 Failure to Meet Requirements

In the event equipment fails to meet specified performance or fails to operate satisfactorily, the Government shall have the right to operate the equipment until the defects have been corrected. Equipment proved to be faulty or inadequate for the service specified will be rejected, but the Government shall have the right to operate the rejected equipment until such time as new equipment is provided by the Contractor to replace the equipment rejected.

3.3 MANUFACTURER'S REPRESENTATIVE

Furnish the services of one or more Diesel-Generator representative or technicians, experienced in the installation and operation of the type of systems being provided, to supervise the testing, adjustment of each system, and to instruct Government personnel.

-- End of Section --

SECTION 16375

UNDERGROUND ELECTRICAL WORK

PART 1 GENERAL

1.1 REFERENCES

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

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	1987 Thermoplastic and Crosslinked Polyethylene Insulated Shielded Power Cable Rated 5 Through 35 kV
AEIC CS6	1987 (R 1989) Ethylene Propylene Rubber Insulated Shielded Power Cable Rated 5 Through 69 kV

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	1990 National Electrical Safety Code
ANSI C119.1	1986 Electrical Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621	(Rev. E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole
FS RR-G-661	(Rev. E) (Am. 1) Grating, Metal, Bar Type (Floor Except for Naval Vessels)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 48	1990 High-Voltage Alternating-Current Cable Terminations
IEEE 400	1991 Making High- Direct-Voltage Tests on Power Cable Systems in the Field

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA RN 1	1986 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	1983 Electrical Plastic Tubing (EPT) and Conduit (EPC40 and EPC80)
NEMA TC 3	1990 PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TC 6	1990 PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 9	1990 Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation
NEMA WC 7	1988 Cross-Linked Thermosetting-Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	1988 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1990 National Electrical Code

RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA 345-6	1978 Splicing Plastic-Insulated Cables (PC-2)
REA 345-67	1987 Filled Telephone Cables (PE-39)

UNDERWRITERS LABORATORIES INC. (UL)

UL 6	1981 (R 1989) (Bul. 1991) Rigid Metal Conduit
UL 44	1983 (R 1990) (Bul. 1990) Rubber-Insulated Wires and Cables
UL 83	1991 (R 1991) Thermoplastic-Insulated Wires and Cables
UL 467	1984 (R 1986) Grounding and Bonding Equipment

UL 486A	1991 (R 1991) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	1991 (R 1991) Wire Connectors for Use with Aluminum Conductors
UL 510	1986 (R 1986) Insulating Tape
UL 514A	1983 (R 1990) Metallic Outlet Boxes
UL 514B	1989 (R 1990) Fittings for Conduit and Outlet Boxes
UL 854	1991 Service-Entrance Cables
UL 1242	1983 (R 1991) Intermediate Metal Conduit

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements" applies to this section with additions and modifications specified herein.

1.3 DEFINITIONS

In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.4.1 SD-02, Manufacturer's Catalog Data

a. Conduit

b. Insulating tape

c. Medium voltage cable

d. Medium voltage cable joints

e. Medium voltage cable terminators

f. Fireproofing tape

g. Precast concrete structures

h. Manhole and Handhole Frames and Covers

i. Cable lubricants

j. Sealing material for precast manhole and handhole joints

k. Telephone cable and splices

l. Cast-in-place manholes handholes

1.4.2 SD-04, Drawings

a. Conduit

b. Insulating tape

c. Medium voltage cable

d. Medium voltage cable joints

e. Medium voltage cable terminators

f. Fireproofing tape

g. Precast concrete structures

h. Manhole and Handhole Frames and Covers

i. Cast-in-place manholes handholes

j. Proposed precast sectional underground duct bank

1.4.3 SD-06, Instructions

a. Ground megger

b. Terminator

c. Termination kit

d. Splice kit

1.4.3.1 Test Instrument and Procedure

Submit for use of ground megger with proposed method indicated.

1.4.4 SD-08, Statements

a. Cable splicer/terminator

Thirty days before making splices or terminations, submit names of the cable splicers to be employed, together with proof that splicer has at least 3 years experience in splicing the type and rating of cables specified. Submit certification for each splicer by the cable joint kit manufacturer in the use of manufacturer's kits.

1.4.5 SD-10, Test Reports

a. Factory engineered heat shrinkable joint kit

1.4.5.1 Manufacturer's Test

Submit the manufacturer's test report indicating that performance of the heat shrinkable joint kit is equivalent to the cable rating, in accordance with the applicable sections of IEEE 48, IEEE 404, and AEIC CS1.

1.4.6 SD-11, Factory Test Reports

a. Arc-proofing test for cable fireproofing tape

b. Medium voltage cable of X-Y corona discharge plot

Submit for approval 7 days before the materials are used.

1.4.7 SD-12, Field Test Reports

a. Insulation resistance test

b. Continuity test

c. High potential (hi-pot) test

d. 600 voltage cable tests

e. Medium voltage cable tests

f. Grounding systems test

g. Medium voltage cable, plot of calculated resistance versus step voltage.

Identify each cable for 600-volt, and medium voltage cable tests. When testing grounding electrodes and systems, identify each electrode and system for each test.

1.4.8 SD-13, Certificates

a. Precast concrete structures

b. Manhole handhole frames and covers

c. Medium voltage cable

d. Medium voltage cable terminators

e. Medium voltage cable joints

1.5 QUALITY ASSURANCE

Each cable splicer may be required to make an approved dummy splice in the presence of the Contracting Officer in accordance with cable manufacturer's instructions. The Contractor shall furnish the material for dummy splices.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Conduit

2.1.1.1 Rigid Metal Conduit

UL 6, galvanized steel.

2.1.1.2 Rigid Metal Conduit, PVC Coated

NEMA RN 1.

2.1.1.3 Intermediate Metal Conduit

UL 1242, galvanized steel.

2.1.1.4 Plastic Conduit and Tubing

NEMA TC 2, Type EPC-PVC. EPC-40-PE or EPC-40-PVC as indicated.

2.1.2 Fittings

2.1.2.1 Metal Fittings

UL 514A and UL 514B, with steel conduit, rigid shall be cast-metal with gasketed closures.

2.1.2.2 PVC Fittings

NEMA TC 3 and NEMA TC 9

2.1.3 Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.1.4 Power Wire and Cable

2.1.4.1 Wire and Cable Conductor Sizes

Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be used.

a. Conductors: Conductors indicated to be No. 6 AWG and smaller shall be copper. Conductors indicated to be No. 4 AWG and larger shall be copper, unless the type of conductor material is specifically indicated or specified or unless the equipment manufacturer requires a specific type. Conductors shall be copper.

b. Equipment Manufacturer Requirements: Where Contractor provides equipment whose manufacturer requires copper conductors at the terminations, or requires that only copper conductors be provided between components of equipment, the Contractor shall provide copper conductors, or necessary splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.1.5 Medium Voltage Cable

Rated as indicated, with both conductor and insulation shielding, and a PVC or polyethylene jacket. Cable shall meet NEMA WC 7 and AEIC CS5 for cross-linked polyethylene insulation or NEMA WC 8 and AEIC CS6 for ethylene-propylene-rubber insulation. The year of manufacture shall be durably marked on the outer surface of each cable at regular intervals throughout cable length. Type UD cables that are for direct burial in earth shall have an overall PVC or polyethylene jacket.

2.1.6 Medium Voltage Cable Terminators

IEEE 48 Class 1 2. Components shall be from one manufacturer. Furnish installation instructions including stress relief devices.

2.1.6.1 Medium Voltage Cable Terminators

IEEE 48, Class 1. Provide terminators for termination of single and multiconductor cables. Terminator installations shall include stress relief cones for shielded cables. Terminators for use with lead-sheathed cable shall be the wiped joint type. Those for mounting on conduit shall be the stuffing

box type with conduit coupling and means for securing and sealing the cable. Include means for securing and grounding armor of the metallic armored cable as necessary. Do not use aluminum and copper bearing parts in contact with each other.

IEEE 48, Class 2. Terminators for extruded insulation nonmetallic jacketed cables shall be porcelain insulator type. Apply terminators to single conductor cables or to each conductor of multiple conductor cables. Terminator shall not exude filler compound under either test or service. The terminator shall consist of a porcelain insulator, cable connector-hoodnut assembly and aerial lug as required, metal body and supporting bracket, sealed cable entrance, and internal stress relief device for shielded cable, and insulating filler compound or material.

2.1.6.2 Cast Epoxy Resin Type Termination

IEEE 48, Class 1. Provide termination as specified herein for terminating single conductor, or the single conductors of multiconductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 15 KV outdoor and 15 KV indoor. Terminations for shielded conductors shall include stress control, with a shield ground connection brought out through the insulation and covering, and grounded at installation. Terminations exposed to the weather shall include porcelain insulator and weather shield.

2.1.6.3 Terminator, Modular, Molded Rubber Type

IEEE 48, Class 1. Provide terminator as specified herein for terminating single conductor, or the single conductor of multiconductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 35 KV outdoor. The terminator shall consist of a stress control, ground clamp, nontracking rubber skirts, crimp-on connector, rubber cap and aerial lug. Do not use separate parts of copper or copper alloy in contact with aluminum or aluminum alloy parts in the construction and installation of the terminator.

2.1.6.4 Terminator, Heat Shrinkable Type

a. Provide as specified for terminating single conductor, or the singe conductor of multiconductor, extruded dielectric, nonmetallic jacketed type cables for service voltage up to 35 KV. The indoor and outdoor terminator shall be the product of one manufacturer who shall furnish components in the form of a kit, including complete instructions which shall be followed for assembly and installation, suitable for the type and materials of the cable terminated. The terminator shall consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition.

b. Provide heat shrinkable sheds or skirts of the same material for outdoor application as well as ground braid and clamp.

2.1.6.5 Terminator, Cold-Shrink Rubber Type

IEEE 48, Class 1. Provide termination as specified herein for terminating single conductor, or the single conductors of multiconductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 35 kV outdoor and 35 kV indoor. Termination shall be rated for continuous operation at 90 degree C, with an emergency overload temperature rating of 130 degree C. Terminator shall be a one-piece design where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber, mussel gray in color. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for the lugs) required to make three terminations. Termination shall be designed for installation in low or highly contaminated indoor and outdoor locations.

2.1.7 Fireproofing Tape

Furnish tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.1.8 Telephone Cable and Splices

REA 345-67. Indicate the number of pairs. Splices shall conform to REA 345-6.

2.1.9 Pull Wire

No. 14 hot-dip galvanized steel or plastic rope having a minimum tensile strength of 200 pounds in each empty duct. Leave a minimum of 24 inches of slack at each end of the pull wires.

2.1.10 Grounding and Bonding Equipment

UL 467.

2.1.11 Drainage Pipe and Fittings

Cast-iron, extra strength. Drains shall be cast-iron, coated or uncoated, plain pattern, bottom outlet with perforated or slotted hinged cover.

2.1.12 Cast-In-Place Manholes Handholes

Cast-in-place reinforced concrete manholes shall be as indicated. Floor surfaces shall have a steel trowel finish. The complete manholes handholes shall be rated for nontraffic AASHTO H20 wheel loading per AASHTO HB14. Covers shall fit frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have smooth finish and sharp lines and arises. Provide necessary lugs, rabbets,

and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. The words "electric" and "telephone" shall be cast in the top face of power and telephone manhole covers, respectively.

2.1.12.1 Optional Precast Concrete Construction

In lieu of cast-in-place concrete manholes, the Contractor may, at his option, provide precast concrete structures, subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and handholes.

a. General: Precast concrete structures shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 4000 psi. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

b. Construction Structure top, bottom, and wall shall be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed of future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel compressed of at least two No. 4 bars around window openings. The minimum concrete cover for reinforcing steel shall be 2 inches. Provide drain sumps for precast structures a minimum of 12 inches in diameter and 4 inches deep.

c. Joints: Provide tongue-and-groove or shiplap joints on mating edges of precast components. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.1.12.2 Metal Frames and Covers

Shall be made of cast iron steel. Cast-iron frames and covers shall meet FS RR-F-621. Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled steel floor plate having an approved antislip surface. Covers shall be rated AASHTO H20.

2.1.12.3 Pulling-In Irons

Shall be steel bars bent in the form indicated and cast in the walls and floors. In the floor they shall be centered under the cover and in the wall they shall be not less than 6 inches above or below, and opposite the conduits entering the manhole. Pulling-in irons shall project into the manhole approximately 4 inches. Iron shall be hot-dipped galvanized after fabrication.

2.1.12.4 Cable Racks

Including rack arms and insulators, shall be sufficient to accommodate the cables. Racks in power manholes shall be spaced not more than 3 feet apart, and each manhole wall shall be provided with a minimum of two racks. Racks in signal manholes shall be spaced no more than 16 1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. The wall bracket shall be channel steel. Slots for mounting cable rack arms shall be spaced at 8-inch intervals. The cable rack arms shall be of steel or malleable iron and shall be of the removable type. Insulators shall be dry-process glazed porcelain. The metal portion of racks shall be hot-dip galvanized after fabrication.

2.1.12.5 Grounding in Manholes Handholes

Provide No. 6 AWG bare copper grounding pigtails on walls of each manhole handhole. The pigtails shall be exothermically welded to the reinforcing bars and shall extend at least 8 inches into manhole handhole. Two pigtails shall be provided in each manhole handhole.

2.1.12.6 Precast Manholes Handholes Installation

Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted granular fill, 3/4-inch size, extending 12 inches beyond the manhole handhole on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator.

2.1.12.7 Field Painting

Cast-iron frames and covers not buried in masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint. Steel frames not buried in masonry and steel covers shall be cleaned of mortar, dirt and grease by an approved blasting process. Surfaces that cannot be cleaned satisfactorily by blasting shall be cleaned to bare metal by wire brushing or other mechanical means. Surfaces contaminated with rust, dirt, oil, grease, or other contaminants shall be washed with solvents until thoroughly cleaned. Immediately after cleaning, surfaces shall be coated with a pretreatment coating or be given a crystalline phosphate coating. As soon as practicable after the pretreatment coating has dried, treated surfaces shall be primed with a coat of zinc-chromate primer and one coat of synthetic exterior gloss enamel.

PART 3 EXECUTION

3.1 INSTALLATION

NFPA 70 and ANSI C2 and CALPUC G.O. 128.

3.1.1 Concrete

Concrete work for electrical requirements shall conform to the requirements of Section 03300, "Cast-in-Place Concrete." Shall be composed of fine aggregate, coarse aggregate, portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture. Fine aggregate shall be of hard, dense, durable, clean, and uncoated sand. The coarse aggregate shall be reasonably well graded from 3/16 inch to one inch. The fine and coarse aggregates shall be free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities. Concrete shall have a compressive strength of 3000 4000 psi at the age of 28 days. Slump shall not exceed 3 inches. Retempering of concrete will not be permitted. Exposed, unformed concrete surfaces shall be given a smooth, wood float finish. Concrete shall be cured for a period of not less than 7 days, and concrete made with high early strength portland cement shall be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed by the Contracting Officer.

3.1.2 Direct Burial System

Bury cables directly in earth, except under railroad tracks, paved areas, and roadways, and install cables in conduit encased in concrete. Install cables buried directly in earth in the following manner:

a. Slope ducts to drain.

b. Excavate trenches in which the cables are placed by hand or with mechanical trenching equipment, and provide a minimum cable cover of 24 inches below finished grade for power conductors operated at 600 volts and less, and 30 inches to the top of the cables for over 600 volts. Trenches shall be not less than 8 inches wide, and shall be in straight lines between cable markers. Cable plows shall not be used. Bends in trenches shall have a radius of not less than 36 inches. Where two or more cables are laid parallel in the same trench, space cables laterally at not less than 3 inches apart.

c. When rock is encountered, remove to a depth of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch.

d. Do not unreel and pull cables into the trench from one end. However, the cable may shall be unreeled on grade and lifted into position on a 3-inch sand bedding with 3 inches more sand placed on top of cable and a redwood plank placed on top of the sand the entire length of the cable run. Plank shall be 2- by 8-inch redwood, brush treated three coats with a pentachlorophenol light oil solution. Cable bedding and cover shall consist of material which would pass a 1/4-inch screen with no sharp material.

e. Provide color, type and depth of warning tape as specified in paragraphs "BURIED WARNING AND IDENTIFICATION TAPE" in Section 02220 02225.

3.1.2.1 Cutting Cable

Use heat shrink adhesive coated caps on cable ends or tape cable ends immediately after cutting to prevent moisture from entering the cable. Varnish the tape when cable is not expected to be connected for at least 72 hours.

3.1.2.2 Restoration

Replace sod which has been removed, as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, pad construction, and other work to original condition and maintain until final acceptance. Provide necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging or mulching. Perform work in accordance with Section 02930, "Turf," and Section 02950, "Trees, Plants, and Ground Cover."

3.1.2.3 Grossing Cables

Separate cables crossing other cables or metal piping from each other by not less than 12 inches of well tamped earth.

3.1.2.4 Connections

Provide cables in one piece without splices between connections except where the distance exceeds the lengths in which cables are manufactured.

3.1.2.5 Bends

Bends in cables shall have an inner radius not less than 12 times the cable diameter.

3.1.2.6 Horizontal Slack

Leave a horizontal slack of approximately 3 feet in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought aboveground. Where cable is brought aboveground, leave additional slack to make necessary connections. Enclose splices in lead-sheathed or armored cables in split-type cast-iron boxes; after completion of the connection, tightly clamp the box.

3.1.2.7 Identification Slabs Markers

Provide a slab at each change of direction of cathodic protection cable, over the ends of conduits which are installed under paved areas and roadways, and over each splice. Identification slabs shall be of concrete approximately 20 inches square by 6 inches thick and shall be set flat in the ground so that top surface projects not less than 3/4 inch, nor more than 1 1/4 inches aboveground. The concrete shall have a compressive strength of not less than 4000 psi and have a smooth troweled finish on exposed surface. Inscribe an identifying legend such as "electric cable," "cathodic protection cable," or "splice,". Inscribe circuit identification symbols on slabs as directed. Letters or figures shall be approximately 2 inches high and grooves shall be approximately 1/4 inch in width and depth. Install slabs so that the side nearest the inscription on top shall include an arrow indicating the side nearest the cable.

3.1.2.8 Cable End Seal

Ends of cable shall be taped immediately after cutting to prevent moisture from entering the cable. Where the cable is not expected to be connected for at least 72 hours, the tape shall also be varnished.

3.1.3 Underground Conduit/Duct Without Concrete Encasement

3.1.3.1 Conduit

The type of conduit shall be EPC-40-PE. The top of the conduit shall be not less than 24 inches below grade, and shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points. Run conduit in straight lines except where a change of direction is necessary. As each conduit run is completed, draw a nonflexible testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. Provide not less than 3 inches clearance from the conduit to each side of the trench. A minimum clearance of 2 12 inches shall be provided between adjacent conduits. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4-inch sieve. Provide color, type and depth of warning tape as specified in paragraphs "BURIED WARNING AND IDENTIFICATION TAPE" in Section 02220.

3.1.4 Underground Duct with Concrete Encasement

Construct underground duct lines of individual conduits encased in concrete. Except where rigid galvanized steel conduit is indicated or specified, the conduit shall be PVC Type DB. Do not mix different kinds of conduit in any one duct bank. Ducts shall not be smaller than 5 inches in diameter unless otherwise indicated. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 1/2 inches, except separate light and power conduits from control, signal, and telephone conduits by a minimum concrete thickness of 3 inches.

a. Under roads, paved areas, and railroad tracks, encase ducts in concrete. Extend the concrete encasement at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks. Conduits to be installed under existing paved areas which are not to be disturbed, roads, and railroad tracks shall be zinc-coated, rigid steel, jacked into place. Do not use the hydraulic jet method. Where conduit runs under existing roads, cut and patch the pavement as indicated.

b. The top of the concrete encasement shall not be less than 18 inches below grade except that under roads and pavement it shall be not less than 24 inches below grade and under railroad tracks not less than 50 inches below top of rails.

3.1.4.1 Duct and Conduit Placement

Duct lines shall have a continuous slope downward toward manholes and away from buildings with a pitch of not less than 3 inches in 100 feet. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.

3.1.4.2 Termination and Cleaning of Conduit

Terminate conduits in end-bells where duct lines enter manholes handholes. Separators shall be of precast concrete, high impact polystyrene, steel, or a combination of these. Stagger conduit joints by rows and layers to provide a duct line having the maximum strength. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand, and dirt with suitable conduit plugs. As each section of a duct line is completed from manhole handhole to manhole handhole, draw a stiff bristle brush having the same diameter of the duct through the duct, until duct is clear of particles of earth, sand, and gravel; then immediately install end plugs.

3.1.4.3 Optional Precast Sectional Underground Duct Bank

The Contractor may choose the option to substitute concrete, precast, sectional, underground duct bank, with PVC conduits, for the cast-in-place underground conduit with concrete encasement. Key and tie together precast sections in a manner to provide the strength and integrity of a cast-in-place structure. Keep conduits in alignment from section to section to provide a smooth surface for pulling cables. Lock precast sections to provide a smooth surface for pulling cables. Lock precast sections together so that the maximum gap after settlement does not exceed 1/4 inch. Fill gaps between concrete sections with flexible plastic grouting material to prevent entry of water and foreign material. Install rebar in precast sections in accordance with the requirements of cast-in-place duct banks. Key the precast duct bank into manholes, with a cast-in-place section, of 3 feet minimum, joining the last section to each manhole. The alignment vertically and horizontally of any two adjacent sections shall not vary more than 1/4 inch when measured from end of conduit to end of conduit. Concrete strength shall be the same as for cast-in-place units. Precast duct banks without the PVC conduits will not be permitted.

3.1.4.4 Connections to Existing Ducts

Where connections to existing duct lines are indicated, excavate the lines to the maximum depth necessary. Cut off the lines and remove loose concrete from the conduits before installing new concrete encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines. Remove existing cables which

constitute interference with the work. Abandon in place those no longer used ducts and cables which do not interfere with the work.

3.1.4.5 Connections to New Manholes

Construct concrete-encased duct lines connecting to underground structures to have a flared section adjacent to the manhole to provide shear strength. Construct underground structures to provide for keying the concrete encasement of the duct line into the wall of the structure. Use vibrators when this portion of the encasement is poured to ensure a seal between the encasement and the wall of the structure.

3.1.4.6 Connections to Existing Manholes

For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and extend into bend out to tie into the reinforcing of the duct line encasement. Chip out the structure wall to form a key for the duct line encasement.

3.1.4.7 Connections to Existing Concrete Pads

For duct line connections to concrete pads, break an opening in the pad out to the dimensions required and preserve steel in pad. Cut the steel and extend into bend out to tie into the reinforcing of the duct line encasement. Chip out the opening in the pad to form a key for the duct line encasement.

3.1.4.8 Removal of Ducts

Where duct lines are removed from existing manholes, close openings and waterproof manhole. Chip out the wall opening to provide a key for the new section of wall.

3.1.5 Underground Conduit for Service Feeders Concrete Encased

Underground conduit for service feeders into buildings shall be rigid steel from the service equipment to a point 5 feet beyond the building and projections thereof. Protect the ends of the conduit by threaded metal caps or bushings, and coat the threads with graphite grease or other suitable coating. Clean and plug conduit until cable duct is installed.

3.1.6 Conduit Protection at Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations shall be protected by a PVC sheath at the penetration; PVC sheath be 40-mils thick conforming to -NEMA RN 1-, and shall extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.1.7 Cable Pulling

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Accumulate cable slack at each manhole or junction box where space permits by training cable around the interior to form one complete loop. Maintain minimum allowable bending radii in forming such loops.

3.1.7.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables. Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic jacketed cables. Lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.

3.1.7.2 Cable Pulling Tensions

Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

3.1.7.3 Secondary Cable Runs in Nonmetallic Duct Conduit

Although not indicated, include an insulated copper equipment grounding conductor sized as required by the rating of the overcurrent device supplying the phase conductors, in nonmetallic duct conduit, for secondary cable runs, 600 volts and less.

3.1.7.4 Installation of Cables in Manholes and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators at a maximum of 18 inches. In existing manholes, where new cables are to be installed, locate the existing installation of cables, cable supports and grounding as required for a uniform installation with cables carefully arranged and supported. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space opening or future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure. Provide 2 cable racks in each underground structure through which cable is run.

3.1.7.5 Cable Markers (or Tags) in Manholes

Provide as specified in Section 16011, "Electrical General Requirements."

3.1.7.6 Conductors Installed in Parallel

Conductors shall be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor.

3.1.8 Cable Terminating

Protect terminations of insulated power from accidental contact, deterioration of coverings and moisture by providing terminating devices and materials. Install terminations of insulated power cable joints and medium voltage terminations in accordance with the manufacturer's requirements. Make terminations with materials and methods as indicated or specified herein or as designated by the written instructions of the cable manufacturer and termination kit manufacturer.

3.1.8.1 Splices for 600 Volt Class Cables

Splice in underground systems only in accessible locations such as manholes and handholes, with a compression connector on the conductor and by insulating and waterproofing by one of the following methods suitable for continuous submersion in water and pass ANSI C119.1.

a. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package. Do not allow the cables to be moved until after the splicing material has completely set.

b. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold. Do not allow cables to be moved until after the splicing materials have completely set.

c. Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which should be applied by a clean burning propane gas torch. Cables may be moved when joint is cool to the touch.

d. Where aluminum conductors are provided, use particular care in making up joints and terminations. Remove surface oxides by cleaning with a wire brush or emery cloth. Provide joint compound on conductors, and UL listed solid aluminum connectors for connecting aluminum to aluminum. When connecting aluminum to copper, provide connectors specifically designed for connecting aluminum to copper.

3.1.8.2 Medium Voltage Cable Joints

Provide power cable joints suitable for direct burial or continuous immersion in water and made only in accessible locations in manholes. Clearly mark joints buried directly in earth by an identification slab.

a. Make medium-voltage joints by using a kit of one manufacturer and with written approval of the manufacturer of the cable which is to be spliced. Provide the Contracting Officer with a copy of the manufacturer's instructions before jointing is started. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Joint design shall have been proof tested in accordance with IEEE 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion.

(1) Epoxy Cast -Type Joint Methods: Provide cast-type joint insulation by means of a molded casting process employing a thermosetting epoxy resin insulating material which shall be applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package. Do not allow cables to be moved until after the jointing material has completely set.

(2) EPR Cast-Type Joint: Provide insulation by means of a molded casting process employing an ethylene propylene-rubber (EPR) jointing compound which results in an inseparable bond between the jointing material and cable insulation. The molding process shall include injection of molding material into the mold to ensure void-free joints.

(3) Watertight Taped-Type Joint: Consists of an approved connector, self-fusing tape (splicing compound), self-bonding semiconducting tape, tinned copper shielding tape or braid, and plastic tape.

(4) Tape Overcast-Type Joint: Watertight taped-type, overcast with anepoxy resin construction for the cast-type, pressure method. Provide joint suitable for the rated voltage of the cable, to a limit of 15 KV.

(5) Valcanized-Type Joint: Heat-pressure process of an approved type and employing materials and equipment suitable for the type and voltage of cables for which it is used. Materials used in the jointing process shall be fully and permanently compatible with materials in the cables. Provide joint suitable for the rated voltage of the cable, to a limit of 5 KV.

(6) Heat-Shrinkable Joint: A uniform cross-section heat-shrinkable polymeric construction consisting of a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating. Provide joint suitable for the rated voltage of the cable.

b. Joints in Shielded Cables: Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice. Provide a No. 6 AWG bare copper ground connection brought out in a watertight manner and grounded to a 3/4-inch by 10-foot ground rod as part of the joint installation. Wire shall be trained to the sides of the enclosure in a manner to avoid interference with the working area.

c. Lead-Sheathed Cable Joints: Prepare for jointing by cutting the lead sheath back the required distance and belling the remaining cable sheath to prevent damage to the conductor insulation. Clean insulated conductors and tape and cut insulation to expose bare wires for the required distance. Clean conductor thoroughly, then join by a split or slotted tinned copper connector or other approved connector. Solder conductors and connector and connector and wrap joint with compatible semiconducting tape and insulating tape as recommended by the manufacturer so that insulation will be at least equal to the rated insulation of the cable. Center the lead sleeve over the prepared joint, and fill with an insulating oil fill with an insulating compound and solder seal. Alternately use a factory-engineered heat shrinkable joint kit to complete the splice. Heat shrinkable splice kit shall contain necessary materials except connector to provide oil stop and oil seal, electrical stress, control, insulation, shielding and environmental sealing. Kit shall allow for external grounding.

3.1.8.3 Certificate of Competency for Cable Splicer/Terminator

Certification of the qualification of the cable splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made in medium voltage (5kV to 35kV) cables. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splic/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require

additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

3.1.9 Fireproofing of Cables in Manholes, Handholes and Vaults

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in manholes, handholes, and vaults.

3.1.9.1 Fireproofing Tape

Install tape in accordance with manufacturer's instructions.

3.1.9.2 Tape-Wrap

Tape-wrap lead-sheathed or other metallic-sheathed or metallic armored cables without a nonmetallic protective covering over the sheath or armor prior to application of fireproofing. Wrap shall be in the form of two tightly applied half-lapped layers of a pressure-sensitive 10 mil thick plastic tape, and shall extend not less than one inch into the duct. Even out irregularities of the cable, such as at splices, with insulation putty before applying tape.

3.1.10 Grounding Systems

Shall be as indicated, and as required by NFPA 70 and ANSI C2.

3.1.10.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 6 inches, installed when indicated to provide an earth ground of the value before stated for the particular equipment being grounded.

3.1.10.2 Grounding Connections by Exothermite Type Process

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermite type process. Make thermit welds strictly in accordance with the weld manufacturer's written recommendations. Welds which have "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at thermit weldments.

3.1.10.3 Compression Ground Grid Connector

For accessible connections in lieu of a thermit type process, a compression ground grid connector of a type which uses a hydraulic compression tool to provide the correct circumferential pressure may be used. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.10.4 Grounding Conductors

Bare soft-drawn copper wire No. 8 AWG minimum unless otherwise indicated or specified.

3.1.10.5 Ground Rod Connections

Connect copper-clad steel solid-copper ground rods, minimum 3 feet into soil, only to insulated TW ground conductor and weld the connection. Insulate entire area of the rod in the vicinity of the weld and the connecting wire and seal against moisture penetration.

3.1.10.6 Conduit

Provide empty conduits with a No. 14 AWG zinc coated steel wire or a plastic rope having a breaking strength of at least 200 lbs. Leave 24 inches of spare at each end of the pull.

3.1.10.7 Fence Grounding

Fences shall be grounded as indicated. Fences shall be grounded with a ground rod at each fixed gate post and at each corner post. Drive ground rods until the top is 12 inches below grade. Attach a No. 4 AWG copper conductor by fusion weld process, 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 wire to post and the other to bond wire to fence. Each gate section shall be bonded to its gatepost by a 1/8-inch by 1-inch flexible braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.1.11 Earthwork For Utilities

Section 02225, "Excavation, Backfilling, and Compacting for Utilities."

3.1.11.1 Backfilling

Section 02225, "Excavation, Backfilling, and Compacting for Utilities."

3.1.12 Reconditioning of Surfaces

3.1.12.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct or direct burial cable. Preserve and replace sod or topsoil after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.1.12.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces. Make repairs as specified in Division 2 and 3 of these specifications.

3.2 FIELD QUALITY CONTROL

As an exception to requirements that may be stated elsewhere in the contract, notify the Contracting Officer 15 working days prior to each tests.

3.2.1 Distribution Conductors 600 Volt Class

Perform 600 volt cable tests to verify that no short circuits or accidental grounds exist. Make tests using an instrument which applies a voltage of approximately 500 volts to provide a direct reading in resistance; minimum resistance shall be 250,000 ohms.

3.2.2 Medium Voltage Cables

After installation, and before placing in service, perform a dc High Potential Test on cables rated above 600 volts. Perform medium voltage cable tests after installation in accordance with the requirements of the appropriate "Voltage Tests After Installation" paragraphs in the particular IPCEA specification for the cable involved. Adhere to precautions and limits as specified in the applicable standards. Current sensing circuits in test equipment shall measure only the leakage current associated with the cable under test, and shall not include internal leakage current of the test equipment. Perform the following test procedures and record the results for each cable test as outlined on the D.C. High Voltage Cable Test Report attached at the end of this section. Submit this report with a cover letter and with data typed in.

a. Record temperature and relative humidity. Do not perform tests unless weather is clear and relative humidity is below 70 percent.

b. Test each conductor individually with other conductors grounded. Shields shall be grounded.

c. Terminations shall be properly corona suppressed by guard ring, field reduction sphere, or other suitable methods.

d. Perform insulation resistance and continuity test prior to hi-pot test.

e. Apply a dc hi-pot in at least five equal increments until maximum test voltage is reached. Record a dc leakage current at each step after a constant stabilization time consistent with system charging current decay. One hundred percent voltage shall be reached in a maximum of 60 seconds.

f. Separable insulated connectors shall be plugged into insulated bushings.

g. Raise the test conductor to a maximum test voltage and hold for a total of 15 minutes except 5 minutes for 5kV PILC cables. Readings of leakage current shall be recorded each minute.

h. Reduce the conductor test potential to zero and apply the grounds for at least 10 minutes.

i. The dc test voltage shall be 120 KV.

j. Furnish the Contracting Officer with three copies of test results.

3.2.2.1 Splicing New Cables Into Existing Cables

When new cables are spliced into existing cables, perform the hi-pot test on the new cable prior to splicing. After test results are approved for new cable and splice is made, perform an insulation resistance test, continuity test and a dc hi-pot test at 120 KV on the length of cable including the splice; and test the existing cable to the nearest disconnection point.

3.2.3 Medium Voltage Cables

Perform insulation resistance test on medium voltage cables. Conduct the tests in three phases: for the existing conductors, for the new conductors after installation, and for the combined new and existing conductors after splicing. Prior to conducting these tests, disconnect the conductors from the equipment.

3.2.3.1 Insulation Resistance Between Conductor and Insulation Shield

Measure between each conductor and insulation shield, that is shielded cables. Use a 1 KV or 2.3 KV megger for this test. Insulation resistance values less than one megohm for each 1 KV of operating voltage are not acceptable. Bring to the attention of the Contracting Officer unsatisfactory test results. Record insulation resistance readings.

3.2.3.2 High Potential (Hi-Pot) Test

Make a hi-pot by applying a direct current (dc) voltage between each conductor of the system as one terminal, and the ground and the sheaths or shields of the wires and cables connected together as the other terminal. Perform the dc hi-pot test using an instrument designed for this purpose. Slowly raise the voltage in 5 KV (for 30 KV cables) increments and hold for a period of one minute at each level. Record the value of the measured leakage current for

each voltage step and plot a curve of the leakage current versus voltage. When the final voltage step is reached, maintain that voltage for 5 minutes and at the end of that interval, record the leakage current reading. Test new cables in increments up to 60 KV (for 30KV cables). The Government will furnish the test voltages for existing cables and new cables spliced to existing cables. Notify the Contracting Officer 15 days prior to hi-pot tests. Submit recorded test recordings and voltage versus current curves for approval.

3.2.4 Approval of Test Results

Medium voltage cable test results shall be approved by NORTHDIV.

-- End of Section --

SECTION 16402

INTERIOR WIRING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	1983 Rigid Steel Conduit - Zinc Coated
ANSI C80.3	1991 Electrical Metallic Tubing - Zinc Coated
ANSI C80.5	1990 Rigid Aluminum Conduit

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	1985 Hard-Drawn Copper Wire
ASTM B 8	1986 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

FEDERAL SPECIFICATIONS (FS)

FS W-C-375	(Rev. B) (Valid Notice 1) Circuit Breaker, Molded Case; Branch Circuit and Service
FS L-P-387	(Rev. A) (Int Am. 2) Plastic Sheet, Laminated, Thermosetting (for Design Plates)
FS W-S-896	(Rev. E) (Valid Notice 1) Switches, Toggle (Toggle and Lock), Flush Mounted

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	1986 (Rev. 1) Molded Case Circuit Breakers and Molded Case Switches
NEMA BU 1	1988 Busways

NEMA FU 1	1986 Low Voltage Cartridge Fuses
NEMA ICS 1	1988 (Rev. 1-2) Industrial Control and Systems
NEMA ICS 2	1988 Industrial Control Devices, Controllers and Assemblies
NEMA ICS 4	1983 (R 1988) (Rev. 1) Terminal Blocks for Industrial Use
NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Control and Systems
NEMA WD 1	1983 (R 1989) Wiring Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1990 National Electrical Code

UNDERWRITERS LABORATORIES, INC.

UL 1	1985 Flexible Metal Conduit, Eighth Edition
UL 6	1981 (R 1989) Rigid Metal Conduit, Ninth Edition
UL 50	1988 (R 1989) Cabinets and Boxes, Ninth Edition
UL 67	1988 (R 1990) (Errata 1990) Panelboards, Tenth Edition
UL 83	1983 (R 1989) (Bul. 1990) Thermoplastic-Insulated Wires and Cables, Ninth Edition
UL 198C	1986 (Bul. 1992) (R 1992) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198E	1988 (R 1988) (Bul. 1992) Class R Fuses
UL 198H	1988 (R 1990) (Bul. 1992) Class T Fuses
UL 360	1986 (R 1990) (Bul. 1991) Liquid-Tight Flexible Steel Conduit

UL 467	1984 (R 1986) Grounding and Bonding Equipment, Sixth Edition
UL 486A	1980 (Errata 1992) (R 1989) Wire Connector and Soldering Lugs for Use with Copper Conductors
UL 486B	1991 (Errata 1992) (R 1992) Wire Connectors and Soldering Lugs for Use with Aluminum Conductors
UL 486C	1983 (R 1989) Splicing Wire Connectors, First Edition
UL 489	1986 (Bul. 1990) (R 1990) (Errata 1990) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures, Seventh Edition
UL 498	1986 (R 1990) (Bul. 1990) Attachment Plugs and Receptacles, Eleventh Edition
UL 506	1989 Specialty Transformers
UL 508	1989 (Bul. 1991) (Bul. 1992) Industrial Control Equipment
UL 510	1986 (R 1986 Insulating Tape
UL 514A	1991 Metallic Outlet Boxes
UL 514B	1989 (R 1990) (Errata 1991) (Bul. 1992) Fittings for Conduit and Outlet Boxes
UL 514C	1988 (R 1989) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 719	1985 (Bul. 1992) (R 1992) Nonmetallic-Sheathed Cable
UL 797	1983 (R 1991) Electrical Metallic Tubing
UL 845	1988 (R 1989) Motor Control Centers
UL 854	1991 (Bul. 1992) Service-Entrance Cables
UL 857	1990 (Errata 1990) Busways and Associated Fittings

UL 869	1989 (R 1991) (Bul. 1992) Service Equipment
UL 886	1985 (R 1991) (Bul. 1992) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 943	1985 (R 1990) (Bul. 1992) Ground-Fault Circuit Interrupters
UL 984	1991 Hermetic Refrigerant Motor-Compressors
UL 1010	1991 (R 1991) Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1242	1983 (R 1991) Intermediate Metal Conduit
UL 1569	1983 (R 1991) (Bul. 1992) Metal-Clad Cables

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements", applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Circuit breakers G

b. Conduit and fittings (each type) G

c. Wires and cables G

d. Outlet boxes and covers G

1.3.2 SD-12, Field Test Reports

a. Grounding system test G

1.3.2.1 Format

Submit test results for approval in report form.

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall be rigid steel (zinc-coated) conduit, rigid aluminum conduit, intermediate metal conduit (IMC), electrical metallic tubing (EMT), electrical nonmetallic tubing (ENT), plastic coated rigid steel and IMC conduit, and flexible metal conduit, liquid tight flexible conduit, conforming to the following:

2.2.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1, UL 6

2.2.2 Rigid Nonmetallic Conduit

PVC Type EOC-40, and EPC-80 in accordance with NEMA TC 2, or fiberglass conduit, in accordance with NEMA TC 14.

2.2.4 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.5 Electrical Metallic Tubing (EMT)

UL 797, ANSI C80.3

2.2.6 Electrical Nonmetallic Tubing (ENT)

NEMA TC 13.

2.2.7 Plastic Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40 (40 mils thick).

2.2.8 Flexible Metal Conduit

UL 1.

2.2.8.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.9 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.9.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.9.2 Fittings for EMT

Compression type.

2.2.9.3 Fittings for Use in Hazardous (Classified) Locations

UL 886.

2.2.10 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3.

2.3 SURFACE METAL RACEWAY AND FITTINGS

UL 5, two-piece painted steel, totally enclosed, snap-cover type. Provide multiple outlet-type raceway with grounding-type receptacle where indicated. Receptacles shall be as specified herein and shall be spaced minimum of one every 18 inches. Alternate receptacles shall be wired on different circuits.

2.4 BUSWAYS

NEMA BU 1, UL 857. Buses shall be copper. Busways shall be rated 600 volts, 60 continuous current amperes, 3-phase, 4-wire, and include integral or internal 50-percent ground bus. Short circuit rating shall be 10,000 root mean square (rms) symmetrical amperes minimum as indicated. Busway systems shall be suitable for use indoors. Enclosures shall be metallic. Hardware shall be plated or otherwise protected to resist corrosion. Joints in ratings shall be one-bolt type with through-bolts, which can be checked for tightness without deenergizing system. Maximum hot spot temperature rise at any point in busway at continuous rated load shall not exceed 55 degrees C above maximum ambient temperature of 40 degrees C in any position. Provide internal barriers to prevent movement of superheated gases. Contractor shall coordinate proper

voltage phasing of entire bus duct system, for example where busway interfaces with transformers, switchgear, switchboards, motor control centers, and other system components.

2.4.1 Feeder Busways

Provide ventilated, except that vertical busways within 6 feet of floors shall be unventilated, unventilated, totally enclosed low-impedance busway. Bus bars shall be fully insulated from one another, except at stabs. Entire busway system shall be polarized.

2.4.2 Plug-In Busways

Unventilated type. Plug-in units shall be fusible, switch type, horsepower-rated circuit breaker-type, switch type, equipped with high interrupting-capacity, current-limiting fuses. Bus bars shall have insulating sleeving entire length, except at joints.

2.5 CABLE TRAYS

NEMA VE 1. Cable trays shall form a wireway system, and shall be of nominal 6-inch depth. Cable trays shall be constructed of aluminum copper-free aluminum steel that has been zinc-coated after fabrication. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be 24 inches. Radius of bends shall be as indicated.

2.5.1 Trough-Type Cable Trays

Sized as indicated of nominal 12-inch width.

2.5.2 Ladder-Type Cable Trays

Sized as indicated of nominal 12-inch width with maximum rung spacing of 6 inches.

2.5.3 Channel-Type Cable Trays

Sized as indicated 4 inches wide. Trays shall be one-piece construction having slots spaced not more than 4 1/2 inches on centers.

2.5.4 Solid Bottom-Type Cable Trays

Sized as indicated nominal 12-inch width.

2.6 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal.

2.6.1 Outlet Boxes in Hazardous (Classified) Locations

UL 886

2.6.2 Floor Outlet Boxes

Boxes shall be adjustable and concrete tight. Each outlet shall consist of nonmetallic or cast-metal body with threaded openings, or sheet-steel body with knockouts for conduits, adjustable ring, brass flange ring, and cover plate with 3/4-inch or 1-inch threaded plug. Telephone outlets shall consist of surface-mounted, horizontal (thermoset) bakelite type material housing with one-inch bushed side opening 3/4-inch top opening; outlets shall have provisions to accommodate 10-wire telephone terminal block. Receptacle outlets shall consist of surface-mounted, horizontal (thermoset) bakelite type material housing with duplex-type receptacle. Provide gaskets for all receptables to ensure watertight installation.

2.7 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.8 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.8.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote-control and signal circuits, classes 1, 2 and 3, may be stranded. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. Conductors indicated to be No. 6 AWG or smaller diameter shall be copper.

2.8.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.8.1.2 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 20 AWG.

2.8.2 Color Coding

Provide for branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, 3-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, 3-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

c. 120/240 volt, single phase: Red and black

2.8.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN conforming to UL 83 grounding wire may be type TW conforming to UL 44, excrpt that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.8.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.8.5 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

2.8.6 Nonmetallic Sheathed Cable

UL 719, Type NM or NMC.

2.8.7 Wire and Cable for 400 Hertz (Hz) Circuits

Insulated copper conductors.

2.8.8 Metal-Clad Cable

UL 1569; NFPA 70, Type MC cable.

2.8.9 Armored Cable

UL 4; NFPA 70, Type AC cable.

2.8.10 Mineral-Insualted, Metal-Sheathed Cable

UL listed; NFPA 70, Type MI cable. Sheathing containing asbestos fibers shall not be used.

2.8.11 Flat Conductor Cable

UL listed; NFPA 70, Type FCC.

2.9 SPLICES AND TERMINATION COMPONENTS

UL 486A and UL 486B, as applicable, for wire connectors and UL 510 for insulating tapes. Connectors for wires No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.10 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlets, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, othr suitable plates may be provided. Plates on finished walls shall be urea or phenolic, minimum 0.10-inch wall thickness. Plates shall be same color as receptacle or toggle switch with which they are mounted. Plates on finished walls shall be satin finish stainless steel phenolic minimum 0.03-inch thick. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.11 SWITCHES

2.11.1 Toggle Switches

FS W-S-896, totally enclosed with bodies of thermosetting plastic and mounting strap. Handles shall be brown or ivory. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.11.2 Pilot Lights

Provide yoke-mounted, candelabra-base sockets rated 125 volts and fitted with glass or plastic jewels. Provide clear, 6-watt lamp in each pilot switch. Jewels for use with switches controlling motors shall be green, jewels for other purposes shall be read or amber.

2.11.3 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuese, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 7, enclosure per NEMA ICS 6.

2.11.4 Breakers Used as Switches

For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.12 RECEPTACLES

UL 498 and NEMA WD 1, general grade, heavy-duty, UL 498, hospital grade, grounding-type. Ratings and configurations shall be as indicated. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap.

2.12.1 Switched Duplex Receptacles

Provide separate terminals for each ungrounded pole. Top receptacle shall be switched when installed.

2.12.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Provide UL listed receptacle in "wet locations."

2.12.3 Ground-Fault Circuit Interrupter (GFCI) Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFCI devices.

2.12.4 Receptacles in Hazardous (Classified) Locations

UL 1010.

2.12.5 Special Purpose Receptacles

Receptacles serving unit heaters and air conditioner are special purpose. Provice in ratings indicated. NEMA 7 (Explosion-Proof) configuration, rated 60 amperes, 220 volts. Furnish one matching plug with each receptacle.

2.12.6 Plugs

Provide heavy-duty, rubber-covered 4, wire cord of required size, provide plugs and attach to equipment. Plugs shall be UL listed and compatible with receptacles, complete with grounding blades. Where equipment is not available, turn over plugs and cord assemblies to the Government.

2.13 PANELBOARDS

UL 67 and UL 50. Panelboards for use as service disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit of panelboard. Directories shall also indicate source of service (upstream panel, switchboard, motor control center, etc.) to panelboard. Type directories and mount in holder behind transparent protective covering.

2.13.1 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet. In addition to equipment grounding bus, provide second "isolated" ground bus, where indicated.

2.13.2 Circuit Breakers

FS W-C-375, UL 489, thermal magnetic-type solid state-type with interrupting capacity as indicated of 10,000 minimum amperes rms symmetrical. Solid state type may be equipped with UL listed rating plug, for establishing or changing ampere trip rating. Breaker terminals shall be UL listed as suitable for the type of conductor provided. Plug-in circuit breakers unacceptable.

2.13.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.13.2.2 Circuit Breaker With GFCI

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A GFCI devices.

2.13.3 Fusible Switches for Panelboards

NEMA KS 1, hinged door-type. Provide horsepower rated switches serving as motor disconnect means.

2.14 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated. Enclosure type as indicated. Provide solid neutral.

2.15 MOTOR CIRCUIT PROTECTORS (MCP)

Motor circuit protectors; NEMA AB 1 and UL 489. MCPs shall consist of an adjustable instantaneous trip circuit breaker in conjunction with a combination motor controller which provides coordinated motor circuit overload and short circuit protection. MCPs shall be rated in accordance with NFPA 70.

2.16 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch panel and control center. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.16.1 Cartridge Fuses, Current Limiting Type (Class R)

UL 198E, Class RE-1 RK-5 time delay-type. Associated fuseholders shall be Class R only.

2.16.2 Cartridge Fuses, Current Limiting Type (Classes J, L, and CC)

UL 198C, Class J for zero to 600 amps, Class L for 601 to 6,000 amps, and Class CC for zero to 30 amps.

2.16.3 Cartridge Fuses, Current Limiting Type (Class T)

UL 198H, Class T for zero to 1,200 amps, 300 volts; and zero to 800 amps, 600 volts.

2.17 TRANSFORMERS

NEMA ST 20, general purpose, dry-type, self-cooled, ventilated unventilated sealed. Provide transformers in NEMA 7 enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 80 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 80 degrees C temperature rise shall be capable of carrying continuously 130 percent of nameplate kVA without exceeding insulation rating. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.18 MOTORS

NEMA MG 1; Hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.

2.18.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

2.18.2 High Efficiency Polyphase Motors

Polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

2.18.3 Motor Sizes

Provide size for duty to be perfomed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.19 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. Selector switch shall have means for locking in any position. For each motor not in sight of controller; or where controller disconnecting means is not in sight of motor location and driven machinery location: controller disconnecting means shall be capable of being locked in open position or, alternatively, manually operated nonfused switch which disconnects motor from source of supply shall be placed within sight of motor location. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position. Minimum short circuit withstand rating of combination motor controller shall be 10,000 rms symmetrical amperes.

2.19.1 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. Provide fuses in each ungrounded primary feeder. One secondary lead shall be fused; other shall be grounded. For designated systems, as indicated, provide backup power supply, including transformers connected to emergency power source. Provide for automatic switchover and alarm upon failure of primary control circuit.

Control circuits shall have maximum voltage of 120 volts derived from a separate control source. Provide terminals and terminal boards. Provide separate control disconnect switch within controller. One secondary lead shall be fused; other shall be grounded. For designated systems, as indicated, provide backup power supply, including connection to emergency power source. Provide for automatic switchover and alarm upon failure of primary control circuit.

2.19.2 Enclosures for Starters and Controllers

NEMA ICS 6.

2.19.3 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers shall have compelling relays and shall be multiple-button, station-type with pilot lights for each speed.

2.19.4 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.19.5 Pilot and Indicating Lights

Provide transformer, resistor, or diode type.

2.19.6 Terminal Blocks

NEMA ICS 4.

2.19.7 Reduced-Voltage Controllers

Provide for polyphase motors 3 horsepower and larger. Reduced-voltage starters shall be single-step, closed transition autotransformer, reactor, primary resistor-type, solid state-type, or as indicated, and shall have adjustable time interval between application of reduced and full voltages to motors. Wye-delta reduced voltage starter or part winding increment starter having adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the previously mentioned reduced-voltage starters for starting of motor-generator sets, centrifugally operated equipment, or reciprocating compressors provided with automatic unloaders.

2.20 MANUAL MOTOR STARTERS

Three pole designed for surface mounting with overload protection and pilot lights.

2.21 MOTOR CONTROL CENTERS

UL 845, NEMA ICS 2. Wiring shall be Class I, Type A, in NEMA Type 7 enclosure. Provide control centers suitable for operation on 220-volt, 3-phase, 4-wire, 60 Hz system and shall have minimum short-circuit withstand and interrupting rating of 100,000 amperes rms symmetrical. Incoming power feeder shall be bus duct cable entering at the top bottom of enclosure and terminating on terminal lugs main protective device. Main protective device shall be molded case circuit breaker fusible switch rated at 100,000 amperes rms symmetrical interrupting capacity. Arrange busing so that control center can be expanded from both ends. Interconnecting wires shall be copper. Terminal blocks shall be plug-in-type so that controllers may be removed without disconnecting individual control wiring.

2.21.1 Bus Systems

Provide the following bus systems. Power bus shall be braced to withstand fault current of 100,000 amperes rms symmetrical. Wiring troughs shall be isolated from horizontal and vertical bus bars.

2.21.1.1 Horizontal and Main Buses

Horizontal bus shall have continuous current rating of 600 800 1000 1200 amperes. Main bus shall be aluminum, tin-plated copper, silver-plated enclosed in isolated compartment at top of each vertical section. Main bus shall be isolated from wire troughs, starters, and other areas.

2.21.1.2 Vertical Bus

Vertical bus shall have continuous current rating of 300 amperes, and shall be copper, silver-plated. Vertical bus shall be enclosed in flame-retardant, polyester glass "sandwich."

2.21.1.3 Ground Bus

Copper ground bus shall be provided full width of motor control center and shall be equipped with necessary lugs.

2.21.1.4 Neutral Bus

Insualted neutral bus shall be provided continuous through the motor control center; neutral shall be full rated. Lugs of appropriate capacity shall be provided, as required.

2.22 TELEPHONE SYSTEM

Provide system of telephone wire-supporting structures, including: conduits with pull wires and wireways, terminal boxes, outlet and junction boxes, other accessories for telephone outlets, and telephone cabinets.

2.22.1 Outlet Boxes for Telephone System

Standard type, as specified herein. Outlet boxes for wall-mounted telephones shall be 2 inches by 4 inches by 1-1/2 inches deep; mounted at height 60 inches above finished floor as indicated. Outlet boxes for handicapped telephone station shall be 2 inches by 4 inches by 1-1/2 inches deep and mounted at height 48 inches above finished floor minimum 24 inches.

2.22.2 Cover Plates

Modular telephone type with same finish specified for receptacle and switch cover plates.

2.22.3 Conduit Sizing

Unless otherwise indicated, conduit for single outlets shall be minimum of 3/4 inch and for multiple outlets minimum of one inch. Size conduits for telephone risers to telephone cabinets, junction boxes, distribution centers, and telephone service.

2.22.4 Backboards

Interior grade plywood, 3/4-inch thick, 4 by 8 feet minimum.

2.22.5 Terminal Cabinets

Construct of zinc-coatd sheet steel. Cabinets shall be constructed with interior dimensions not less than those indicated. Trim shall be fitted with hinged door and flush catch. Doors shall provide maximum-size openings to the box interiors. Boxes shall be provided with 5/8-inch backboard having a two-coat insulating varnish finish. Match trim, hardware, doors, and finishes to lighting panelboards.

2.22.6 Receptacles for Telephone Service

Provide receptacles, 125 volts, 20 amps, single phase, 60 Hz, adjacent to telephone cabinets served from panelboard circuit.

2.23 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be sectional type, copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet of 20 feet as indicated.

2.24 HAZARDOUS LOCATIONS

Electrical materials, equipment, and devices for installation in hazareous locations, as defined by NFPA 70, shall be specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Boundaries and classifications of hazardous locations shall be as indicated.

2.25 NAMEPLATES

Provide as specified in Section 16011, "Electrical General Requirements."

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Hazardous Locations

Work in hazardous locations, as defined by NFPA 70, shall be performed in strict accordance with NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Conduit shall have tapered threads.

3.1.3 Service Entrance Identification

Service entrance disconnect devices, switches, or enclosures shall be labeled or identified as such.

3.1.3.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.4 Wiring Methods

Provide insulated conductors installed in conduit, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Provide bare or insulated, green equipment grounding conductor in feeder and branch circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide bare or insulated, green conductor for grounding conductors installed in conduit. Minimum conduit size shall be 1 inch in diameter for low voltage sensor and alarm and power circuits. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be metallic on both sides of fire-rated walls, fire-rated partitions, or fire-rated floors for minimum distance of 6 inches.

3.1.5.1 Restrictions Applicable to Aluminum Conduit

Do not install underground or encase in concrete or masonry. Do not use brass or bronze fittings.

3.1.5.2 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete.

c. Do not use in areas subject to severe physical damage including but not limited to mechanical equipment rooms and electrical equipment rooms.

d. Do not use in hazardous areas.

e. Do not use outdoors.

3.1.5.3 Service Entrance Conduit, Overhead

Rigid steel or IMC from service entrance to service entrance fittings or weatherhead outside building.

3.1.5.4 Service Entrance Conduit, Underground

Galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.5.6 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel or plastic-coated steel IMC.

3.1.5.7 Conduit in Floor Slabs

Rigid steel; steel IMC.

3.1.5.8 Conduit Interior to Buildings for Circuits Rated Greater Than 600 Volts

Rigid metal conduit or IMC only.

3.1.5.9 Metal Clad Cable

Install in accordance with NFPA 70, Type MC cable.

3.1.5.10 Armored Cable

Install in accordance with NFPA 70, Type AC cable.

3.1.5.11 Flat Conductor Cable

Install in accordance with NFPA 70, Type FCC cable.

3.1.6 Conduit Installation

Unless indicated otherwise, conceal conduit within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits in crawl space under slab as if exposed.

3.1.6.1 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finish slab.

3.1.6.2 Conduit Support

Support conduit by pipe straps, wall brackets, hangers. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.

3.1.6.3 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.6.4 Pull Wire

Install pull wires in empty conduits in which wire is to be installed by others. Pull wire shall be plastic having minimum 200-pound tensile strength. Leave minimum 12 inches of slack at each end of pull wire.

3.1.6.5 Telephone and Signal System Conduits

Install in accordance with specified requirements for conduit and with additonal requirements that no length of run shall exceed 150 feet for trade sizes 2 inches and smaller and shall not contain more than two 90-degree bends or equivalent. Provide pull or junction boxes where necessary to comply with these requirements. Inside radii of bends in conduits one-inch trade size and larger shall be minimum five tmes nominal diameter. Terminate conduit at bottom edge of backboard with plastic bushing in terminal cabinet with two locknuts and plastic busing.

3.1.6.6 Conduit Installed in Concrete Floor Slabs

Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Do not stack conduits more than two diameters high with minimum vertical separation of 3 inches. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not

be visible above finish slab. Increase slab thickness as necessary to provide minimum one-inch cover over conduit. Where embedded conduits cross expansion joints, provide suitable watertight expansion fittings and bonding jumpers. Conduit larger than one-inch trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab. Where nonmetallic conduit is used, raceway must be converted to rigid steel or steel IMC before rising above floor, unless specifically indicated otherwise.

3.1.6.7 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.6.8 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.6.9 Flexible Connections

Provide flexible connections of short length, 6-foot maximum, for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow slack. Provide liquid-tight flexible conduit in wet locations. Provide separate ground conductor across flexible connections.

3.1.6.10 Exposed Conduit in Inmate Housing

Do not install exposed conduit systems in inmate housing areas and other areas normally accessible to inmates unless such installations are specifically indicated. Where exposed conduit is indicated, conduits shall be rigid metallic type and outlet boxes shall be cast metal-type with threaded hubs. Install conduits flat against wall; offsets or "kicks" shall be permitted only to enter outlet box. Support conduits on 5 foot maximum centers and within 12 inches of each outlet box using two-hole conduit straps attached to surface with nonremovable break off security type bolts.

3.1.7 Busway Installation

Installation shall comply at minimum with NFPA 70. Install busways parallel with or at right angles to ceilings, walls, and structural members. Support busways at 5-foot maximum intervals, unless otherwise designated and marked, and brace to prevent lateral movement. Hinges provided on risers shall be fixed type; spring-type are unacceptable. Provide flanges where busway makes penetrations through walls and floors, and seal to maintain smoke and fire ratings. Provide waterproof curb where busway riser passes through floor; and seal gaps. Penetrations shall be firestopped in accordance with Section 07270, "Firestopping." Provide expansion joints, but only where bus duct crosses building expanison joints.

3.1.8 Boxes, Outlets, and Supports

Provide boxes in wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when installed exposed up to 7 feet above interior floors and walkways, or when installed in hazardous areas. Boxes in other locations shall be sheet steel, and nonmetallic boxes may be used with nonmetallic sheathed cable conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configruations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports, or make adequate provisions for distributing load over ceiling support members in an approved manner. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In oopen overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support: support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.8.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4-by-2-inch boxes may be used where only one raceway enters outlet. Telephone outlets shall be minimum of 4 inches square by 1 1/2 inches deep, except for wall mounted telephones and outlet boxes for handicap telephone stations.

3.1.8.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Furnish boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.8.3 Extension Rings

Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.9 Mounting Heights

Mount panelboards, circuit breakers, and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor, receptacles not less than 18 inches above finished floor, and other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.10 Nonmetallic Sheathed Cable Installation

Where possible, install cables concealed behind ceiling or wall surfaces. Thread cables through holes bored on approximate centerline of wood members; notching of end surfaces is not permitted. Provide sleeves through concrete or masonry for threading cables. Insatll exposed cables parallel or at right angles to walls or structural members. Protect exposed nonmetallic sheathed cables less than 4 feet above floors from mechanical injury by installation in conduit or tubing. When cable is used in metal stud construction, insert plastic stud grommets in studs at each point through which cable passes, prior to installation of cable.

3.1.11 Mineral Insulated, Metal Sheathed (Type MI) Cable Installation

Mineral-insulated, metal-sheathed cable system, Type MI, may be used in lieu of exposed conduit and wiring. Conductor sizes shall be not less than those indicated for the conduit installation. Cable shall be fastened within 12 inches of each turn or offset and at 6-foot maximum intervals. Make cable terminations in accordance wit NFPA 70 and cable manufacturer's recommendations. Single-conductor cables of a circuit, having capacities of more than 50 amperes, shall terminate in a single box or cabinet opening. Individual conductors in all outlets and cabinets shall be color-coded.

3.1.12 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with Section 15951, "Space Temperature Control Systems."

3.1.13 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.14 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for covers installed in wet locations.

3.1.15 Electrical Penetrations

Openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings shall be sealed in accordance with Section 07270, "Firestopping."

3.1.16 Grounding and Bonding

In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, grounding conductor of nonmetallic sheathed cables, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are

encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.16.1 Grounding Conductor

Provide bare or insulated, green equipment grounding conductor in feeder and branch circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide bare or insulated, green conductor for grounding conductors installed in conduit or raceways.

3.1.16.2 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.18.3 Telephone Service

Provide main telephone service equipment groud consisting of separate No. 6 AWG ground wire in conduit between equipment backboard and readily accessible grounding connection. Equipment end of ground wire shall consist of coiled length at least twice as long as terminal cabinet or backboard height.

3.1.19 Elevator

Connections to the elevator shall include: (1) per NFPA 70, Article 620, provision of 120 volt, 20 ampere circuit (including circuit protection, conduit and wires) from the indicated panel to elevator machine room; terminate circuit in 120 volt, 30 ampere, 2 pole fused disconnect switch in elevator machine room. (2) in the elevator pit, provision of light fixture, with light switch adjacent to point of access, and 20 ampere duplex receptacle (weatherproof); serve from circuits as indicated.

3.1.20 Government-Furnished Equipment

Contractor shall rough-in for Government-furnished equipment shall make connections to Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.21 Repair of Existing Work

Repair of existing work, and modification of existing electrical distribution systems shall be performed as follows:

3.1.21.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.21.2 Existing Concealed Wiring to be Removed

Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.21.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, fittings, etc., back to equipment's source as indicated.

3.1.21.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Existing circuits of equipment shall remain energized. Circuits which are to remain but were disturbed during demolition shall have circuits wiring and power restored back to original condition.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 600-Volt Wiring Test

Test 600-volt wiring to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground does not exceed 5 ohms. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --

SECTION 16499

TELEPHONE SERVICE AND COMMUNICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES:

Contractor shall connect new devices (see Specification 13001, 13002, 13003, 13004, 13005, and this section) to Navy's internal phone system. Work shall include wiring and testing. Navy will activate telephone service to the equipment listed in Schedule 16499-1. Contractor shall connect devices and provide new telephones as listed in Schedule 16499-1.

Schedule 16499-1

Building	Phone Connections[1]	Connect Equipment	Reference Specification Section
C-21	One (1)	New Modem for Computer System No. 1	13004-Data Processing System
C-50	Four (4)	Standard Tank Monitoring System	13001-Standard Tank Monitoring System
		Fuel Management System	13003-Fuel Management System
		Soil Vapor Monitoring System Panel	13005-Soil Vapor Monitoring System
		Telephone	16499-Telephone Service and Communications
R-6	Four (4)	Enhanced Tank Monitoring System	13001-Enhanced Tank Monitoring System
		Fuel Management System Site Controller	13003-Fuel Management System
		Soil Vapor Monitoring System Panel	13005-Soil Vapor Monitoring

Building	Phone Connections[1]	Connect Equipment	Reference Specification Section
		Telephone	16499-Telephone Service and Communication
C-17	Five (5)	Enhanced Tank Monitoring System #1	13001-Enhanced Tank Monitoring System
		Enhanced Tank Monitoring System #2	13001-Enhanced Tank Monitoring System
		Fuel Management System Site Controller	13002-Fuel Management System
		Soil Vapor Monitoring System Panel	13005-Soil Vapor Monitoring
		Telephone	16499-Telephone Service and Communication

Notes: [1]Telephone service provided by Navy through Building C-2 Switch. Existing phone wiring exists at vicinity of each Building (C-21, C-50, R-6, and C-17). Contractor shall extend phone wires from existing locations at each Building and provide RJ-11 jacks corresponding to the number of phone connections. Refer to drawings for additional information.

1.2 RELATED SECTIONS

a. Section 13001 - Enhanced Tank Monitoring Systems
b. Section 13002 - Standard Tank Monitoring Systems
c. Section 13003 - Fuel Management Systems
d. Section 13004 - Data Processing Systems
e. Section 13005 - Soil Vapor Monitoring Systems

1.3 SUBMITTALS

a. Submit in accordance with Section 01300, "Submittals".

b. Submit details on phones specified herein.

PART 2 PRODUCTS

2.1 TELEPHONES

Furnish and install wall-mounted, touch-tone, heavy-duty telephones. Phones shall have two separate parts: The wall mounted part shall have buttons and ear/mouthpiece shall have no buttons. Color shall be black.

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 16510

INTERIOR LIGHTING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARD INSTITUTE (ANSI)

ANSI C82.1	1985 (Supp. 1990) Ballasts for Fluorescent Lamps
ANSI C82.2	1984 (R 1989) Fluorescent Lamp Ballasts - Method of Measurement

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	1985 Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 526/A 526M	1990 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 580	1990 (Rev. A) Stainless and Heat-Resisting Steel Wire
ASTM A 853	1990 Steel Wire, Carbon, for General Use
ASTM A 633	1985 Electrodeposited Coatings of Zinc on Iron and Steel

FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC RR	1976 Rules and Regulations, Vol. II, Transmittals 1 through 6

FEDERAL SPECIFICATIONS (FS)

FS QQ-N-281	(Rev. D) (Am. 2) Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE C62.41	1980 Surge Voltages in Low-Voltage AC Power Circuits (IEEE STD 587)

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES LHBK	Lighting Handbook, Reference (1984) and Application (1987) Volumes

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	1988 Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	1989 (Rev. 1) Enclosures for Industrial Controls and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1990 National Electrical Code
NFPA 101	1991 Code for Safety to Life from Fire in Buildings and Structures

UNDERWRITERS LABORATORIES INC. (UL)

UL 20	1986 (Errata 1988) (R 1991) General-Use Snap Switches, Tenth Edition
UL 773	1987 Plug-In, Locking Type Photocontrols for Use With Area Lighting, Third Edition
UL 773A	1989 Nonindustrial Photoelectric Switches for Lighting Control, Third Edition
UL 844	1990 (R 1990) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations, Tenth Edition

UL 924	1990 (R 1991) Emergency Lighting and Power Equipment, Seventh Edition
UL 935	1984 (R 1990) (Bul. 1990) Fluorescent-Lamp Ballasts, Seventh Edition
UL 1029	1986 (R 1990) (Bul. 1990) High-Intensity-Discharge Lamp Ballasts, Fourth Edition
UL 1570	1988 (R 1990) Fluorescent Lighting Fixtures, Third Edition
UL 1571	1984 (R 1991) Incandescent Lighting Fixtures, Second Edition

1.3 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16402, "Interior Wiring Systems." Lighting fixtures and accessories mounted on exterior surfaces of building are specified in this section.

1.4 DEFINITIONS

1.4.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.5 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals." Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES LHBK, as applicable, for the lighting system specified.

1.5.1 SD-02, Manufacturer's Catalog Data

a. Fluorescent lighting fixtures

b. Fluorescent lamps

c. Fluorescent core and coil ballasts

d. High-Intensity-Discharge (HID) lighting fixtures

e. HID Ballasts

f. HPS lamps

g. Low-pressure sodium lamps

h. Metal-halide lamps

i. Incandescent lighting fixtures

j. Incandescent lamps

k. Lighting contactor

l. Photocell switch

m. Time switch

n. Dimmer switch

o. Power hook fixture hangers

p. Emergency lighting equipment

q. Support hangers for lighting fixtures in suspended ceilings

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1570.

2.1.1 Fluorescent Lamps

Provide the number, type, and wattage indicated. Rapid-start lamps shall be rated 40 watts, 3150 approximate initial lumens, 20,000 hours average rated life. Energy-saving, rapid-start lamps shall be rated 34 watts, 2750 approximate initial lumens, 20,000 hours average rated life. Preheated lamps shall be rated 20 watts, 1250 approximate initial lumens, 9000 hours average rated life. Slim line lamps shall be rated 40 watts, 3000 approximate initial lumens, 9000 hours average rated life. Slim line lamps shall be rated 60 watts, 6300 approximate initial lumens, 12,000 hours average rated life. U-shaped lamps shall be rated 40 watts, 2825 approximate initial lumens, 12,000 hours average rated life.

2.1.2 Fluorescent Core and Coil Ballasts

UL 935, ANSI C82.1, and shall be labeled Certified Ballast Manufacturers (CBM) certified by Electrical Testing Laboratories (ETL). Ballast shall be high power factor type unless indicated otherwise and shall be designed to operate on the voltage system to which they are connected. Ballasts shall be Class P and shall have sound rating "A" unless otherwise noted. Fixtures and ballasts shall be designed and constructed to limit the ballast case temperature to 90 degrees Celsius (C) when installed in an ambient temperature of 20 degrees C. Provide three lamp fixtures with two ballasts per fixture.

2.1.2.1 Low Temperature Ballasts

Provide fluorescent ballast having a minimum starting temperature of zero degrees F minus 20 degrees F for 800 and 1500 milliamp lamps in fixtures mounted in unheated or low heat buildings, and as indicated.

2.1.2.2 Energy-Saving Ballasts

Provide energy-saving fluorescent ballasts of the CBM certified full light output type. Ballasts shall have an average input wattage of 86 or less when operating two F49T12 lamps 50 or less when operating one F40T12 lamp 159 or less when operating two F96T12 lamps tested in accordance with ANSI C82.2 methods. Ballast shall be compatible for use with energy-saving lamps.

2.1.3 Fluorescent Solid-State Ballasts

Provide energy-saving, solid-state fluorescent ballast of the full light output type. Electromagnetic interference shall not be greater than that allowed by the FCC RR, Part 15, Subpart J Part 18 for FR lighting devices. Ballasts shall be able to withstand voltage transients in accordance with IEEE C62.41, Category A, for normal and common modes. Minimum power factor shall not be less than 0.90. Ballasts shall operate at a frequency not less than 20,000 hertz. Ballast current third harmonic content shall be less than 33 percent. Ballast shall have an average input wattage of 71 or less watts when operating two F40T12 lamps 36 or less watts when operating one F40T12 lamp tested in accordance with ANSI C82.2 methods. Ballast shall be compatible for use with energy-saving lamps.

2.1.4 Electromagnetic Interference Filters

Provide in each fluorescent fixture mounted in shielded enclosures where indicated. Filters shall be integral to the fixture assembly with one filter per ballast and shall suppress electromagnetic interference in the AM radio band from 500 to 1700 kHz. Filters shall be in the circuit serving the lighting fixtures mounted where indicated and shall conform to the requirements of Section 16650, "Radio Frequency Interference Power Line Filters."

2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

2.2.1 HID Ballasts

UL 1029 and ANSI C82.4 and shall be constant wattage autotransformer (CWA) or regulator, high power factor type unless otherwise indicated. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on the voltage system to which they are connected.

b. Designed for installation in a normal ambient temperature range of 4 to 40 degrees C.

c. Constructed so that open circuit operation will not reduce the average life.

High-pressure sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode.

2.2.2 HPS Lamps

35-watt conforming to ANSI C78.1358 50-watt conforming to ANSI C78.1359 70-watt conforming to ANSI C78.1353 100-watt conforming to ANSI C78.1354 150-watt, 55-volt conforming to ANSI C78.1355 250-watt conforming to ANSI C78.1351 400-watt conforming to ANSI C78.1350 1000-watt conforming to ANSI C78.1352.

2.2.3 Metal-Halide Lamps

175-watt conforming to ANSI C78.1377 400-watt conforming to ANSI C78.1375 1000-watt conforming to ANSI C78.1376.

2.3 RECESS AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom. Access to ballast shall be from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as indicated.

2.4 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of the fixtures supported by the hangers. Provide with swivel hangers to ensure a plumb installation. Hangers shall be cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Hangers shall be shock-absorbing type where indicated. Hangers shall allow fixtures to swing within an angle of 20 degrees. Brace pendants 4 feet or longer provided in shops or hangers to limit swinging. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous row fluorescent fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Rods shall be a minimum 3/16-inch diameter.

2.5 FIXTURES FOR HAZARDOUS LOCATIONS

In addition to requirements stated elsewhere in this section, provide fluorescent HID fixtures for hazardous locations such as in the two fueling stations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated.

2.6 LIGHTING CONTACTOR

NEMA ICS 2, mechanically held contactor. Contacts shall be rated 240 volts, 50 amps, and 2 poles. Coils shall be rated 240 volts. Rate contactor as indicated. Provide in NEMA 7 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts and shall require no arcing contacts. Provide contactor with on-off selector switch. Contactor shall be hermetically sealed.

2.7 TIME SWITCH

A stronomic dial type arranged to turn "ON" at sunset and turn "OFF" at perdetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch rated 240 volts, having automatically wound spring mechanism to maintain accurate time for a minimum of 15 hours following power failure. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface mounted, NEMA 7 enclosure conforming to NEMA ICS 6.

2.8 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide cell rated 240 volts ac, 60 Hz with single-throw contacts single pole double-throw (SPDT) contacts for control of mechanically held contactors rated 175 watts and 240 volts. Provide switch in a cast weatherproof aluminum housing with swivel arm designed to mount on or beside each floodlight integral to the fixture in a high-impact-resistant noncorroding and nonconductive molded plastic housing with a locking-type receptacle conforming to ASNI C136.10. Switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Aim switch according to manufacturer's recommendations.

2.9 POWER HOOK FIXTURE HANGERS

Provide UL listed assembly including through-wired power hook housing, interlocking plug and receptacle, power cord, and fixture support loop. Power hook housing shall be cast aluminum having two 3/4-inch threaded hubs. Fixture support hoop shall be cast aluminum with provisions for accepting 3/4-inch threaded fixture stems. Power cord shall include 16 inches of 3-conductor No. 16 Type SO cord. Assembly shall be rated 240 volts, 50 amperes, 3-wire, 2-pole.

2.10 EXIT SIGNS

UL 924, NFPA 70, and NFPA 101. Exit signs shall be self-powered remote-powered type.

2.10.1 Self-Powered Exit Signs (Battery Type)

Provide with automatic power failure device, test switch, pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years.

2.10.2 Remote-Powered Exit Signs

Provide remote ac/dc exit signs with provisions for wiring to external ac and dc power sources. Provide signs with a minimum of two ac lamps for normal illumination and a minimum of two dc lamps for emergency lighting.

2.11 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101. Provide lamps in wattage indicated. Provide accessories required for remote-mounted lamps where indicated. Remote-mounted lamps shall be as indicated.

2.11.1 Emergency Lighting Unit

Provide as indicated. Emergency lighting units shall be rated for 12 volts, except units having no remote-mounted lamps and having no more than two unit-mounted lamps may be rated 6 volts. Equip units with brown-out sensitive circuit to activate battery when ac input falls to 75 percent of normal voltage and 15-minute time delay feature for areas with HID lighting.

2.11.2 Fluorescent Emergency System

Each system shall consist of an automatic power failure device, cover-mounted test switch and pilot light, and fully automatic solid-state charger in a self-contained power pack. Charger shall be either trickle, float, constant current or constant potential type, or a combination of these. Battery shall be sealed electrolyte type with capacity as required to supply power to 4 lamps the number of lamps shown for each system. Battery shall operate unattended and require no maintenance, including no additional water, for a period of not less than 5 years.

2.11.3 Central Emergency System

Each system shall supply 200 watts of emergency power at 120 volts, 60 Hz sine wave ac for a minimum period of 240 minutes. Sine wave ac system shall have an inverter output distortion of not more than 10 percent at unity power factor. The system shall be designed to handle surges during loss and recovery of power.

2.11.3.1 Operation

With normal power applied, batteries shall be automatically charged. Upon loss of normal power, system shall automatically disengage from the normal input line and switch to a self-contained inverter within 1 second when serving incandescent and fluorescent lamps 2 milliseconds when serving HID lamps. Inverter shall have built-in protection when output is shorted or overloaded. When normal power resumes, the emergency system shall automatically switch back to normal operation before the power loss. Size transfer switch for this function to handle 125 percent of full load.

2.11.3.2 Battery Charger

Provide two-rate charger for lead-calcium batteries. Provide three-rate charger for nickel-cadmium batteries. The charger shall be solid-state, completely automatic, maintaining the batteries in a fully charged condition, and recharging the batteries to full capacity as specified in UL 924.

2.11.3.3 Batteries

Batteries shall be nickel-cadmium type, shall operate unattended, and shall require no maintenance, including no additional water, for a period of not less than 5 years.

2.11.3.4 Accessories

Provide visual indicators to indicate normal power, inverter power, and battery charger operation. Provide test switch to simulate power failure automatic brown-out circuitry to switch to emergency power when input line detector that will activate a visual or audio alarm in the event of a low water condition, time delay feature for areas with HID lighting, and low voltage cutoff to disconnect inverter when battery voltage drops to approximately 80 percent of nominal voltage.

2.11.3.5 Enclosure

Provide a free-standing cabinet with floor stand. Cabinet construction shall be of 14-gauge sheet steel with baked-on enamel finish and locking type latch.

2.12 AUXILIARY INSTANT-ON QUARTZ SYSTEM

UL listed, automatically switched instant-on 250-watt quartz lamp. Quartz lamp shall come on when luminaire is initially energized and following a momentary power outage and shall remain on until HID lamp reaches approximately 60 percent light output. Wiring for quartz lamp shall be internal to the ballast and shall be independent of the incoming line voltage to the ballast. Provide instant-on quartz system for each HPS fixture. Provide instant-on quartz system as indicated.

PART 3 EXECUTION

3.1 EMERGENCY LIGHTS

Wire emergency lights ahead of the switch to the normal lighting circuit located in the same room or area.

3.2 PHOTOCELL SWITCH AIMING

Aim switch according to manufacturer's recommendations. Mount switch on or beside each luminaire when switch is provided in cast weather proof aluminum housing with swivel arm.

3.3 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this Section.

-- End of Section --

SECTION 16530

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS2	1985 Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	1990 National Electrical Safety Code
ANSI C78.1350	1990 Electric Lamps - 400-Watt, 100-Volt, S51 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1351	1989 Electric Lamps - 250-Watt, 100-Volt, S50 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1352	1990 Electric Lamps - 1000-Watt, 250-Volt, S52 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1354	1990 Electric Lamps - 100-Watt, 55-Volt, S54 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1355	1989 Electric Lamps - 150-Watt, 55-Volt, S55 High-Pressure Sodium Lamps
ANSI C78.1375	1990 Electric Lamps - 400-Watt, M59 Single-Ended Metal-Halide Lamps

ANSI C78.1376	1984 Electric Lamps - 1000-Watt, M47 Single-Ended Metal-Halide Lamps
ANSI C78.1377	1987 Electric Lamps - 175-Watt, M57 Single-Ended Metal-Halide Lamps
ANSI C82.4	1985 (Supp. 1988) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C136.3	1989 Roadway Lighting Equipment - Luminaire Attachments
ANSI C136.10	1988 Roadway Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles-Physical and Electrical Interchangeability and Testing
ANSI C136.14	1988 Roadway Lighting Equipment - Enclosed Side-Mounted Luminaires for Horizontal-Burning High-Intensity-Discharge Lamps
ANSI C136.20	1990 Roadway Lighting Equipment - Fiber-Reinforced Plastic (FRP) Lighting Poles
ANSI C136.21	1987 Roadway Lighting - Vertical Tenons Used With Post-Top-Mounted Luminaires

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	1989 (Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	1982 (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 108	1987 Aluminum-Alloy Permanent Mold Castings
ASTM C 1089	1988 Spun Cast Prestressed Concrete Poles

ASTM G 53	1988 Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES LHBK	Lighting Handbook, Reference (1984) and Application (1987) Volumes

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	1988 Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	1989 (Rev. 1) Enclosures for Industrial Controls and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1990 National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 773	1987 Plug-In, Locking Type Photocontrols for Use With Area Lighting, Third Edition
UL 773A	1989 Nonindustrial Photoelectric Switches for Lighting Control, Third Edition
UL 1029	1986 (R 1990) (Bul. 1990) High-Intensity-Discharge Lamp Ballasts, Fourth Edition
UL 1572	1984 (Errata 1990) (Bul. 1991) (R 1991) High Intensity Discharge Lighting Fixtures, Second Edition

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.3.2 Groundline Section

That portion between one foot above and 2 feet below the groundline.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals". Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES LHBK, as applicable, for the lighting system specified.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Luminaires

b. Lamps

c. Ballasts

d. Poles

e. Brackets

f. Photocell switch

g. Time switch

h. Lighting contactor

1.4.2 SD-04, Drawings

a. Luminaires

b. Poles

1.4.2.1 Luminaires

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

1.4.2.2 Poles

Include dimensions, wind load determined in accordance with AASHTO LTS2, pole deflection, pole class, and other applicable information. For concrete poles, include: section and details to indicate quantities and position of prestressing steel, spiral steel, inserts, and through holes; initial prestressing steel tension; and concrete strengths at release and at 28 days.

1.4.3 SD-12, Field Test Reports

a. Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

1.5 QUALITY ASSURANCE

1.5.1 Pressure-Treated Wood Pole Quality

Ensure the quality of pressure-treated wood poles. Each pole shall be permanently marked or branded by the producer, in accordance with AWPA M6, and REA 50-18.

1.5.2 Tests for Fiberglass Poles

a. Ultraviolet resistance tests: Perform according to ASTM G 53 using a UV-B lamp having a 313 nanometer wavelength, operated at 130 degrees F, cycling the lamp on for 4 hours and off for 4 hours for a total test period of 1500 hours minimum with the following results:

Fiber Exposure:	None
Crazing:	None
Checking:	None
Chalking:	None
Color:	May dull slightly

b. Flexural strength and deflection test: Test loading shall be as a cantilever beam with pole butt as fixed end and a force simulating wind load at the free end.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Fiberglass Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.6.2 Aluminum Steel Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16375, "Underground Electrical Work", Section 16370, "Overhead Electrical Work," and Section 16402, "Interior Wiring Systems." Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in Section 16510, "Interior Lighting."

2.2 LUMINAIRES

ANSI C136.14 or UL 1572. Provide luminaires as indicated. Provide luminaires complete with 400 watt, 240 volt lamps of number and type indicated. Details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaires of a particular manufacturer.

Luminaire housings shall be corrosive-resistant, chemically treated plated steel. Sockets for the 400 watt super metal halide lamps shall be porcelain sockets incorporating spring-reinforced contacts. Lens shall be molded, dropped prismatic polycarbonate, to resist potential damage. Each lens shall be sealed with silicone sealant.

Ballast shall be high power factor type CWA ballast, designed for minus 20 degrees F operations, mounted to a housing reinforcing plate to ensure long heat sink life. Reflector shall be a one-piece, symmetrical reflector. Door assembly shall be utilized single, captive door fastener for readily accessible maintenance. Provide a one-piece EPDM plastic gasket for positive sealing. Housing finish shall be powder type finishing process for resistance to peeling or cracking. Luminaire shall be guaranteed for not less than five (5) years.

2.2.1 Lamps

2.2.1.1 High-Pressure Sodium (HPS) Lamps

35-watt conforming to ANSI C78.1358 50-watt conforming to ANSI C78.1359 70-watt conforming to ANSI C78.1353 100-watt conforming to ANSI C78.1354 150-watt, 55-volt conforming to ANSI C78.1355 250-watt conforming to ANSI C78.1351 400-watt conforming to ANSI C78.1350 1000-watt conforming to ANSI C78.1352.

2.2.1.3 Metal-Halide Lamps and Super Metal Halide Lamps

175-watt conforming to ANSI C78.1377 400-watt conforming to ANSI C78.1375 1000-watt conforming to ANSI C78.1376. Provide luminaires with tempered glass lens, especially for use in overhead canopies at fueling stations. For the 400 watt super metal halide lamps, voltage shall be 240 volts.

2.2.2 Ballasts for High-Intensity-Discharge (HID) Luminaires

UL 1029 and ANSI C82.4, and shall be constant wattage autotransformer (CWA) or regulator, high power-factor type unless otherwise indicated. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on voltage system to which they are connected.

b. Constructed so that open circuit operation will not reduce the average life. HPS ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C.

2.3 LIGHTING CONTRACTOR

NEMA ICS 2, mechanically held contactor. Contacts shall be rated 220 volts, 60 amperes, and 3 poles. Coils shall be rated 440 volts. Rate contactor as indicated. Provide in NEMA 7 enclosure conforming to NEMA ICS 6. Contractor shall have silver alloy double-break contacts and coil clearing contacts and shall require no arcing contacts. Provide contactor with on-off selector switch. Contactor shall be hermetically sealed.

2.4 TIME SWITCH

Astronomic dial type arranged to turn "ON" at sunset, and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch rated 440 volts, having automatically wound spring mechanism to maintain accurate time for a minimum of 7 hours following power failure. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface mounted, NEMA 7 enclosure conforming to NEMA ICS 6.

2.5 PHOTOCELL SWITCH

UL 733 or UL 773A, hermetically sealed cadmium-sulfide cell rated 220 volts ac, 60 Hz with single pole double-throw (spdt) contacts for mechanically held contactors rated 400 watts, and 220 volts. Provide switch in a cast

weatherproof aluminum housing with swivel arm integral to the luminaire in a high-impact-resistant, noncorroding and nonconductive molded plastic housing with a locking-type receptacle conforming to ANSI C136.10. Switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition.

2.6 POLES

Provide poles designed for wind loading of 150 miles per hour determined in accordance with AASHTO LTS2 while supporting luminaires having effective projected areas indicated. Poles shall be embedded anchor-base type designed for use with underground overhead supply conductors. Poles shall have oval-shaped handhole having a minimum clear opening of 2.5 by 5 inches. Handhole cover shall be secured by stainless steel captive screw.

2.6.1 Aluminum Poles

Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to AASHTO LTS2 for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys. Poles shall be seamless extruded or spun seamless type. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Base covers for aluminum poles shall be cast from 356-T6 aluminum alloy in accordance with ASTM B 108.

2.6.2 Steel Poles

AASHTO LTS2. Provide steel poles having minimum 11-gage steel with minimum yield/strength of 48,000 psi and hot-dipped galvanized in accordance with ASTM A 123 iron-oxide primed factory finish. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Base covers for steel poles shall be structural quality hot-rolled carbon steel plate having a minimum yield of 36,000 psi.

2.6.4 Fiberglass Poles

ANSI C136.20. Designed specifically for supporting luminaires and having factory-formed cable entrance and handhole. Resin color shall be dark bronze and pigment shall provide uniform coloration throughout entire wall thickness. Finish surface shall be pigmented polyurethane having a minimum dry film thickness of 1.5 mils. Polyurethane may be omitted if the surface layer of the pole is inherently ultraviolet inhibited. Minimum fiberglass content shall be 65 percent with resin and pigment comprising the other 35 percent material content.

2.7 BRACKETS AND SUPPORTS

ANSI C136.3, ANSI C136.13, and ANSI C136.21, as applicable. Pole brackets shall be not less than 1 1/4-inch galvanized steel pipe aluminum secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 24 feet above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

2.8 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of 50,000 psi, the top 12 inches of the rod shall be galvanized in accordance with ASTM A 153. Concrete shall be as specified in Section 03300, "Cast-in-Place Concrete." Section 03302, "Cast-in-Place Concrete (Minor Construction)."

2.9 AUXILIARY INSTANT-ON QUARTZ SYSTEM

UL listed, automatically switched instant-on 250-watt quartz lamp. Quartz lamp shall come on when the luminaire is initially energized and immediately after a momentary power outage, and remain on until HID lamp reaches approximately 60 percent light output. Wiring for quartz lamp shall be internal to ballast and independent of incoming line voltage to the ballast. Provide instant-on quartz system for each HPS fixture. Provide instant-on quartz system as indicated.

PART 3 EXECUTION

3.1 INSTALLATION OF POLES

ANSI C2, NFPA 70, and to the requirements specified herein.

a. Setting depth: Pole setting depths shall be as follows:

Length of Pole (feet)	Setting in Soil (feet)
25	5.5
30	6.0
35	7.0
40	8.0

b. Soil setting: "Setting in Soil" depths shall apply where pole holes are in soil, sand, or gravel or any combination of these. At corners, dead ends and other points of extra strain, poles 40 feet long or more shall be set 6 inches deeper.

c. Setting on sloping ground: On sloping ground, measure the depth of the hole from the low side of the hole.

d. Backfill: Tamp pole backfill for the full depth of the hole and mound the excess fill around the pole.

3.1.1 Fiberglass

Install according to pole manufacturer's instructions.

3.1.2 Aluminum Steel

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit ells, and ground rods shall be as specified in Section 16375, "Underground Electrical Work." Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location. After installation, paint exposed surfaces of steel poles with two finish coats of exterior oil paint of a color as indicated aluminum paint.

3.1.3 Pole Setting

Depth shall be as indicated. Poles in straight runs shall be in a straight line. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 6-inch maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.

3.1.4 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations. Mount switch on or beside each luminaire when switch is provided in cast weatherproof aluminum housing with swivel arm.

3.2 GROUNDING

Grounding noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 16375, "Underground Electrical Work." Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.3 FIELD QUALITY CONTROL

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

-- End of Section --

SECTION 16852

ELECTRIC SPACE HEATING EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA DC 3	1989 Residential Controls - Electrical Wall-Mounted Room Thermostats
NEMA ICS 2	1988 Industrial Control Devices, Controllers and Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1990 National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 1025	1980 (R 1990) (Bul. 1991) Electric Air Heaters
UL 1042	1987 Electric Baseboard Heating Equipment

1.2 GENERAL REQUIREMENTS

Section 16011, "Electrical General Requirements" applies to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Electric unit and cabinet heaters

b. Electric baseboard sill pedestal units

c. Electric infrared heater

d. Thermostat

e. Unit thermostat

f. Infrared heater thermostat

1.3.2 SD-04, Drawings

a. Heater installation drawing

1.4.3 SD-19, Operation and Maintenance Manuals

a. Electric unit and cabinet heaters, Data Package 5

b. Electric baseboard sill pedestal units, Data Package 5

c. Electric infrared heater, Data Package 5

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

PART 2 PRODUCTS

2.1 ELECTRIC CABINET HEATERS

UL 1025; wattage, voltage, phase, number of steps, Btu/hr and CFM as indicated. Provide control-circuit terminals and single source of power supply. Heaters 5 Kw and larger shall be 3-phase, with load balanced on each of the three phases. Limit leaving air temperature to 140 degrees F with entering air of 60 degrees F.

2.1.1 Enclosure

Minimum 21 18 gage steel.

2.1.2 Heating Element

Nickel chromium heating wire element, free from expansion noise and 60 Hz hum. Embed element in magnesium-oxide insulating refractory. Seal element in high-mass steel or corrosion-resisting metallic sheath with fins. Enclosed element ends in terminal box. Provide not more than six fins per inch. Limit fin surface temperature 550 degrees F at any point during normal operation.

2.1.3 Controls

Include limit controls for overheat protection of heaters. For remote thermostatic operation, provide contractor rated for 100,000 duty cycles. Provide a control transformer to supply 120-volt thermostat control circuit for each heater.

2.1.4 Wiring

Completely factory-prewired to terminal strips, ready to receive branch circuit and control connections for 60 degrees C copper wiring.

2.1.5 Accessories

Provide fan switching devices to independently operate the fan motor for summer ventilation and winter heat recovery.

2.1.6 Thermostat

Provide tamper resistant space thermostat, adjustable without requiring removal of heater components. Thermostat operating range shall be approximately 50 degrees F to a maximum of 75 degrees F with operating differential of 3 degrees F or less.

2.1.7 Disconnect Means

Provide factory-installed safety disconnect switch in the housing in combination with thermostat with "off" position marking on the face plate.

2.1.8 Outdoor Sensor

Provide outdoor sensor with sunlight-and-rain protection shield. The sensor shall provide a positive heater shut off when outdoor air temperature is 65 degrees F or higher.

2.2 DISCONNECTS

Disconnect. UL listed. Enclosed fused switch, rated 240 volt, 3 phase, 4 wire, NEMA Type 3R enclosure. Enclosed molded case circuit breaker, rated 20 ampere, 240 volt, 3 poles, NEMA Type 3R enclosure. Disconnect shall be capable of being locked in the open position.

PART 3 EXECUTION

3.1 INSTALLATION

Install in conformance with the approved heater installation drawing, NFPA 70, UL listing, and manufacturer's instructions, with necessary clearances for air circulation, maintenance, inspection, service testing and repair. Connect to electrical supply in accordance with Section 16402, "Interior Wiring Systems."

3.1.1 Cabinet Heaters

Where wall mounting is indicated, seal entire wall to cabinet space from exterior wall cavities, and provide a minimum 1/2-inch thick rigid fire resistant insulation on the wall behind the cabinet. Verify manufacturer's clearance requirements from electrical cords, electronic equipment and other furnishings.

3.2 FIELD QUALITY CONTROL

Provide necessary personnel, instruments, and equipment to perform tests. Notify the Contracting Officer 5 working days prior to scheduled testing and locations.

3.2.1 Field Inspection

Prior to initial operation, inspection installed equipment for conformance with drawings and specifications.

3.2.2 Insulation Resistance Tests

Test 600-volt wiring to verify that no short circuits or grounds exist. Tests shall be made using an instrument which applies a voltage of approximately 500 volts and provides a direct reading of resistance in ohms.

3.2.3 Operational Tests

Test equipment circuits and devices to demonstrate proper operation. Test each item of control equipment not less than 5 times.

-- End of Section --

APPENDIX A

DESIGN INFORMATION

ELECTRIC UNIT AND CABINET HEATER

Unit No.	KW	Volts	Phase	No. of Steps	Btu/hr Output	CFM Air	Mounting Height	Remarks

ELECTRIC BASEBOARD, SILL AND PEDESTAL HEATERS

Unit No.	KW	Volts	Phase	Btu/hr Output	Remarks

ELECTRIC INFRARED RADIANT HEATERS

Type Letter	Watts	Volts	No. of Elements Per Fixture	Beam Spread	Fixture	Mounting	Remarks