AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES	
J	1	2

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO.(If applicable)
0002	15-Apr-2003	W26GLG-2038-3181	5022896

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than item 6)	CODE
CONTRACTING OFFICE (CA/CW) US ARMY ENGR DIST NORFOLK ATTN: CENAO-SS-C 803 FRONT STREET NORFOLK VA 23510-1096	DACA65	**See Item 6**	

8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)			
		X	9A. AMENDMENT OF SOLICITATION NO. DACA65-03-R-0013
		X	9B. DATED (SEE ITEM 11) 07-Feb-2003
			10A. MOD. OF CONTRACT/ORDER NO.
CODE	FACILITY CODE		10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

[X] The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer [X] is extended, [ ] is not extended.

Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS.
IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

[ ] A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.

[ ] B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).

[ ] C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:

[ ] D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor [ ] is not, [ ] is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

AMENDMENT NO. 0002 to DACA65-03-R-0013, Hazardous Waste Tanks, Line C, Radford Army Ammunition Plant, Radford, VA

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) TEL: EMAIL:	
15B. CONTRACTOR/OFFEROR (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY (Signature of Contracting Officer)	16C. DATE SIGNED 15-Apr-2003

SECTION SF 30 BLOCK 14 CONTINUATION PAGE

The following items are applicable to this modification:

CONTINUATION

1. PROPOSAL DUE DATE IS APRIL 29, 2003 at 2:00 pm. Proposals are to be delivered to US Army Engineer District, Norfolk, 803 Front Street, ATTN: CENAO-SS-C, Norfolk, VA 23510-1096.

2. Section 00010: DELETE Bidding Schedule in its entirety and REPLACE with the attached Bidding Schedule.

3. Section 00100: ADD Clause FAR 52.217-0005, Evaluation of Options.

4. Section 00800: ADD Clause FAR 52.217-0007, Option for Increased Quantity—Separately Priced Line Items.

5. Technical plans and specifications are amended. Make appropriate changes in accordance with the attached.

Section 00010 - Solicitation Contract Form

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0001		1	Lump Sum		

SCHEDULE I - BASE (Items 0001-0004)
FFP
All work for replacement of the existing Hazardous Waste Tank with new tank that meets RCRA and State standards, complete, in accordance with the drawings and specifications, excluding items 0002 thru 0004 and Optional Bid Items.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0002		1	Lump Sum	60,000.00	60,000.00

FFP
All work for O&M Manuals as specified from preparation to final excluding items 0001, 0003 and 0004 and Schedule II - Optional Bid Items.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0003		1	Lump Sum	25,000.00	25,000.00

FFP
All work for As-Built drawings as specified from preparation to final excluding items 0001, 0002 and 0004 and Schedule II - Optional Bid Items.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0004		1	Lump Sum	12,000.00	12,000.00

FFP
All work for Form 1354 Checklist and Equipment in place list as specified from preparation to final excluding items 0001 thru 0003 and Schedule II - Optional Bid Items.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0005		50	Cubic Yard		

OPTION

SCHEDULE II - OPTIONAL BID ITEM
FFP
All costs in connection with rock excavation for structures and grading for up to 50 CY complete, including all work thereto as shown on the drawings and as specified, exclusive of items 0001-0004.

52.217-5 EVALUATION OF OPTIONS (JUL 1990)

(a) Except when it is determined in accordance with FAR 17.206(b) not to be in the Government's best interests, the Government will evaluate offers for award purposes by adding the total price for all options to the total price for the basic requirement. Evaluation of options will not obligate the Government to exercise the option(s).

(b) The Government may reject an offer as nonresponsive if it is materially unbalanced as to prices for the basic requirement and the option quantities. An offer is unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated for other work.

(End of provision)

52.217-7 OPTION FOR INCREASED QUANTITY--SEPARATELY PRICED LINE ITEM (MAR 1989)

The Government may require the delivery of the numbered line item, identified in the Schedule as an option item, in the quantity and at the price stated in the Schedule. The Contracting Officer may exercise the option by written notice to the Contractor within 120 calendar days from receipt of Notice to Proceed. Delivery of added items shall continue at the same rate that like items are called for under the contract, unless the parties otherwise agree.

(End of clause)

US ARMY CORPS
OF ENGINEERS
NORFOLK DISTRICT

SPECIFICATIONS

HAZARDOUS WASTE TANK LINE C

APRIL 15, 2003 (REVISED)

PREPARED FOR

RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

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-- End of Project Table of Contents --

SECTION 01005

PROJECT WORK REQUIREMENTS AND RESTRICTIONS
07/00

PART 1 GENERAL

1.1 DEFINITIONS

a. Facility: The facility is Radford Army Ammunition Plant.
b. CO: Contracting Officer or his authorized representative.
c. Operating Contractor: Alliant Tech Systems.
All references to Hercules shall be changed to Alliant Tech Systems

1.2 SPECIAL CONTRACTOR REQUIREMENTS

1.2.1 Performance period

The Contractor shall have 420 calandar days to complete the work.

1.2.2 STRUCTURAL DRAWING DIMENSIONS

The building layout, including both horizontal and vertical dimensions, is shown on the Architectural sheets contained in the contract drawings. The Contractor shall use the dimensions from the Architectural sheets to obtain dimensions for foundation layout and structural members as necessary to prepare all shop drawings and fabricate structural members. There may be some instances where the Contractor shll have to adjust actual dimensions to the submitted items that he will use, to finalize the location of a structural member. Any such adjustments shall be clearly identified on the submitted shop drawings for Government review.

1.3 COOPERATION WITH USING AGENCY AND OTHER CONTRACTORS

During the period of this contract, other contracts may be in force for the construction of other features of work on or adjacent to the site of work being accomplished under this contract. It shall be the responsibility of the Contractor on this contract to be fully informed of the extent of the limits of work to be performed by other Contractors. Should there be any conflict between these limits, it shall be brought to the attention of the Contracting Officer(CO)and the CO's decision shall be final. Also, prior to completion of work under this contract, members of the Using Agency may be performing work or occupying facilities on or adjacent to the area. The Contractor shall arrange his plant and shall schedule and perform this work so as to effectively cooperate with all other Contractors and Government agencies.

1.4 PERSONNEL RESTRICTIONS

Personnel are limited to the immediate site areas and shall not enter buildings or facilities not involved in the work. All employees of the Contractor will be subject to all rules and regulations of the Facility which pertain to personnel. The Contractor shall erect fences and signs as specified and be responsible for the restrictions of all personnel. The Contractor's plans for restricting personnel access to the project site shall be submitted for approval as a part of the Safety Plan (Accident Prevention Plan).

1.5 TRANSPORTATION FACILITIES

The Facility is served by an all weather surfaced road network. Road(s) within the Facility proposed to be used by the Contractor shall be subject to prior approval of the Facility authorities and such roads, if used, shall be maintained throughout construction and shall be restored to as good condition as existed prior to their use. The Contractor shall also construct, subject to approval, such temporary haul roads and bridges as may be necessary for conducting his work. Any such temporary construction shall be removed and the affected area restored to its original condition. All costs for the use of existing transportation facilities, for the construction of temporary facilities, and for maintenance, repair, removal and restoration shall be borne by the Contractor.

1.5.1 Use of Roads

Hard-surfaced roads from U.S. Highways 11 and 460 serve the plant. The movement of all vehicles within the Facility shall be confined to the roads designated and shall comply with traffic regulations within the Facility. The Contractor shall keep all roads clear of all obstructions and free of mud and other foreign materials resulting from operations. The Contractor's vehicles shall at no time follow a vehicle closer than 50 feet, and all vehicles shall pull off the road and come to a complete stop when meeting emergency vehicles, vehicles escorting heavy equipment,or vehicles with flashing lights. When approaching jeep tractor-trailers from the rear, vehicles shall not pass.Facility speed limits and traffic controls shall be observed.

1.5.2 Road Restrictions

The movement of all vehicles within the Facility shall be confined to the roads designated and shall comply with traffic regulations within the Facility. Other roads may be used only with the approval of the CO.

1.5.3 Cleated Vehicles

Cleated vehicles shall not be moved over surfaced roads except at the immediate site of the area where they are to be used.

1.5.4 Road Restrictions

The movement of all vehicles within the Facility shall be confined to the roads designated and shall comply with traffic regulations within the Facility. Other roads may be used only with the approval of the CO.

1.5.5 Rail Service

Railroad shipments may be made by Norfolk Southern Railway directly into Radford Army Ammunition Plant. Such shipments shall be made to Pepper, Virginia.

1.5.5.1 Rail Car Unloading

Contractor may be required to stop work and leave the site due to rail car unloading 2-4 hours a week without notice.

1.5.6 New River Bridge Limitations

The New River bridge in the Facility has an H-20 live load limit as designated by the American Association of State Highway Officials, and this

limit shall not be exceeded. Loads wider than 10-1/2 feet or higher than 16 feet shall not be moved over the bridge without prior approval of the CO.

1.5.7 Loading Limitations

Load limit for all roads within the boundaries of the Facility is 8 tons per axle. The Contractor shall not exceed these limits except by prior written approval of the CO.

1.5.8 Transportation of Personnel Within the Facility

Contractor owned vehicles shall be used to transport workers from the entrance gates to the work sites, be equipped with approved fire extinguisher and first aid kits, and meet all laws and regulations for transporting person(s) on state of Virginia highways. Private owned vehicles shall not be allowed in the Facility area within the security fence. Buses and other approved vehicles used for transport of workers only may be parked overnight inside the gate in the area to be designated at the time of construction.

1.5.9 Vehicle Passes

Only official Contractors' vehicles which are used in the performance of the work will be permitted within the Facility. A vehicle pass will be issued to approved vehicles upon request to the Plant Security Officer. No vehicles shall be allowed to enter the Facility until such permits have been issued.

1.6 COORDINATION IN WORK AREAS

1.6.1 Occupied Work Area

The area where work is to be accomplished will be occupied during the work. Activities of the occupants of the scheduled work area shall not be interrupted or hampered in any way without prior written approval of the Contracting Officer.

1.6.2 Unoccupied Work Area

The area where the Contractor is scheduled to perform the work will not be occupied during the work, however, the Contractors work activities may affect other area(s) that are occupied. All work shall be in accordance with the Contractor's work plan.

1.6.3 Maintenance of Utilities

Any active utilities, including but not limited to electricity, gas, water, sewer, heating, air conditioning, or any like service, that will require interruption or replacement in any occupied area affected as a result of the Contractors scheduled work activities, shall be temporarily provided by the Contractor at his own expense until the affected service is fully and permanently restored. All temporary method(s) of service replacement the Contractor proposes for use on this contract shall be approved by the CO prior to commencing the work.

1.6.4 Hours of Work

The normal work hours for construction shall be from 8:00 a.m. to 4:30 p.m. Monday through Friday of each week. Any request to change these hours

shall be made in writing to the Contracting Officer at least two calendar days prior to the desired day on which the change is to go into effect. The changed hours shall not go into effect until written permission has been received from the Contracting Officer.

1.6.5 Hot Work Permit

Heat or spark producing devices such as welding machines, power actuated anchoring devices, drills, flares, matches, firearms, ammunitions, cameras, and flashlights shall not be used either inside or outside working areas until a hot work permit has been issued by the Operating Contractor. Request for hot work permits shall be made in writing to the Contracting Officer not less than five working days prior to the request of the permit. All heat producing devices shall be attended at all times.

1.6.6 Mobile Radio Equipment

The Contractor shall not use any mobile radio equipment within the fenced area of the Facility.

1.6.7 Contaminated Areas

Notice is hereby given that some of the areas in which the work is to be performed may have been used for the processing of explosive materials. The Government does not in any way warrant that the areas are entirely free of all explosives and no representation of any kind whatsoever is made that all explosives have been removed, nor will the Government be liable for any damage to persons or property should any damage be occasioned as a result of any explosive material that may not have been removed. The Contractor will be held responsible for making these facts known to all personnel during the performance of this work.

1.6.8 Security Badge Requirements

All persons performing work on RFAAP must have a security badge. These badges are either temporary visitor badges (two weeks or less) which require an authorized Contractor escort at all times, or a permanent badge (two weeks for more) which permits the wearer to pass in-and-out of the security gates to-and-from his work area without an authorized Contractor escort. Temporary badges are issued for a one-week period and renewable for another one week period, maximum of two weeks. Badges, regardless of type must be turned in to Security upon completion of the work effort/contract. Failure to turn in badges will result in withholding of the Contractor's final payment until all badges have been accounted.

1.6.8.1 Personnel Escort

An authorized Contractor representative must escort all personnel attempting to obtain a badge to Security. The representative shall sign documentation that the employee meets Security criteria and is suitable for a badge to be issued.

1.6.8.2 Non-US Citizens

All persons who are non-US citizens must provide and carry their Green card and written approval from the RFAAP Commanding Officer or ACO Security Officer before a badge can be issued.

1.6.8.3 Pre-Employment Investigation

On Contracts expected to exceed two weeks, the following Pre-Employment Investigation of all Contractor employees shall be accomplished prior to security badges being issued.

a) Contractor shall perform a Pre-Employment Investigation of all employees and subContractor personnel who will work at RFAAP under this contract. Such investigation shall include as a minimum, the following:

1) Check of prior work record for a period of one year.
2) Check of police records in city or county of residence or with reputable citizens in the community for prior three years (or longer if conditions warrant).
3) Any other source of information when deemed necessary or appropriate to determine the applicant's character and reputation reflecting on his eligibility for employment at RFAAP.

b) An applicant shall not be employed at RFAAP under this order:
1) Who deliberately falsifies, misrepresents, or omits material facts on the job application form;
2) Whose activities indicate he/she is not reliable or trustworthy;
3) Whose actions demonstrate dishonest, immoral, or notoriously disgraceful conduct;
4) Who suffers from chronic alcoholism or habitual of intoxicants;
5) Who suffers from drug addiction or habitual use of drugs;
6) Where the facts provide reason to believe the applicant would be susceptible to coercion, influence, or pressure which could cause him to act contrary to the interests of the national security or the best interest of the United States Government.

c) Upon completion of such investigation, the Contractor shall furnish to Security an executed Form DUP-3871, showing name, address, date, and place of birth, citizenship, Social Security number, confirm whether or not the employee has been convicted of a crime and certify that the application of the employee has been investigated and is acceptable for employment at RFAAP.

d) An applicant who has not received a Pre-Employment Investigation and who is sent to the Security Department for processing will be processed and handled as a visitor. An authorized Contractor escort shall be required for the applicant until the investigation is completed. Upon completion of a favorable investigation, the executed Form DUP 3871 shall be furnished to Security Department for issuance of a permanent badge as noted above. If the investigation report is unfavorable, the Contractor shall deny the temporary employee further access to RFAAP, including temporary badge access.

e)All Contractor personnel shall comply with the provisions of this clause in the employment of persons for work at RFAAP and shall make available the records with respect to such Pre-Employment Investigations upon request. Failure to comply strictly with the requirements of this clause may constitute grounds for termination of this contract.

1.6.4 Area Entry Permit

The Contractor shall sign Form RA-603 before Contractor employees will be allowed to enter the Plant area within the security fence. This form will be completed by the OC and a copy of the signed form furnished to the CO.

1.6.4.1 Notification Letter

Within 5 calendar days after receipt of Notice to Proceed the Contractor shall forward a letter through the Area Engineer, Southwestern Virginia Area Office, Norfolk District, Corps of Engineers, Radford, Virginia 24141, to the plant security officer (Commander, Radford Army Ammunition Plant, ATTN: SARRA-SS, Radford, Virginia 24141) providing general data about the project. Required information is shown in the following "INITIAL CONTRACTOR REPORT". Significant changes will be reported as they occur and documented as a part of the Daily Report.

INITIAL CONTRACTOR REPORT

* ON SITE SUPERINTENDENT

* LOCAL ADDRESS

* LOCAL TELEPHONE NUMBER

* WORK AREA/BUILDING

* BRIEF DESCRIPTION OF WORK

* NUMBER OF PERSONNEL EMPLOYED ON PROJECT (approx.)

* LENGTH OF CONTRACT

* SUBCONTRACTORS

* NORMAL WORKING HOURS

* LOCATION OF OFFICE TRAILER(S) ON PLANT (if any)

* Changes in this information will be reported in the Daily Report of operations as they occur.

1.6.4.2 Daily Report

A daily report shall be provided by the Contractor which shall indicate which employees are working that day and what area/building they will be working in. This report shall be provided to the Security Department, Badge and Decal Section (Building 229), not later than 8:00 a.m. daily. Contractors shall document in the Daily Report and notify the Security Department whenever they have personnel working in an area before or after their regularly established working hours. Any request to work at other than regularly established hours may require using a gate not normally open at that time. The request shall be in writing and will be processed through the plant security office at least 24 hours prior to performance of the work. A copy of the approved request shall be furnished to the Contracting Officer and noted in the Daily Report of operations. The operating Contractor will have its Security Department check work sites periodically to verify the accuracy of the daily reports provided by the Contractor.

1.6.5 Digging Permits

Contractor is responsible for obtaining all digging permits, including associated locating and marking services, in accordance with installation and local requirements, at no additional cost to the Government.

1.7 INTERRUPTIONS OF UTILITIES

1.7.1 Approval

Utility services shall not be interrupted by the Contractor to relocate, make connections, or interrupt for any purpose, without written approval of the CO.

1.7.2 Request

Request for permission to shut down services shall be submitted in writing to the CO not less than 10 calendar days prior to date of proposed interruption. The request shall give the following information:

a. Nature of Utility (Gas, L.P. or H.P., Water, Elec.)

b. Size of line and location of shutoff.

c. Buildings and services affected.

d. Hours and date of shutoff.

e. Estimated length of time service will be interrupted.

1.7.3 Service Interruptions

Services shall not be shut off until receipt of approval of the proposed hours and date from the Contracting Officer.

1.7.4 Timely Disconnections

Shutoffs which will cause interruption of Government work operations as determined by the Contracting Officer shall be accomplished during regular non-work hours or non-work days of the Using Agency without any additional cost to the Government.

1.7.5 Utilities Operation

Operation of valves on water mains will be by Government personnel. Where shutoff of water lines interrupts service to fire hydrants or fire sprinkler systems, the Facility Fire Department shall be notified by the Contractor in writing 72 hours prior to the proposed interruption. The Contractor shall arrange his operations and have sufficient material and personnel available to complete the work without undue delay and shall restore service without delay in event of emergency.

1.7.6 Gas

Flow in gas mains which have been shut off shall not be restored until the Government inspector has determined that all items serviced by the gas line have been shut off.

1.8 PHYSICAL DATA

The physical conditions indicated on the drawings and in the specifications are the result of and borings. See Specification Section 01055 SOIL BORING DATA for boring logs and data.

1.9 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the Contract Clause entitled "Default: (Fixed Price Construction)". In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

a. The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

b. The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.

1.9.1 Schedule

The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY WORK DAYS

BASED ON (5) DAY WORK WEEK

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

1.9.2 Records

Upon acknowledgement of the Notice to Proceed and continuing throughout the contract, the Contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the Contractor's scheduled work day.

1.9.3 Impacted Days

The number of actual adverse weather days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day in each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in the schedule of monthly anticipated adverse weather delays, above, the contracting officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the Contract Clauses entitled "Default (Fixed Price Construction)".

1.10 SITE CONTAMINATION

This site is designated a Category III site and is defined as a site which is located in an area known or suspected to be contaminated.

1.10.1 Contamination Removal

In the event that contamination beyond that shown or specified is encountered, the Contracting Officer shall be advised immediately. The contamination shall be removed as directed and replaced with satisfactory material. Payment therefore will be made in conformance with the CHANGES clause of the CONTRACT CLAUSES.

1.10.2 Compliance Requirements

The Contractor shall comply with applicable Federal, state and local laws, codes, ordinances and regulations (including the obtaining of licenses and permits) in connection with any hazardous material, substance or waste.

1.10.3 Requirements

The requirements of this clause and any act or failure to act by the Government shall not relieve the Contractor of any responsibility or liability for the safety of Government, Contractor or subContractor personnel or property.

1.11 WORK IN QUARANTINED AREA

The work called for by this contract involves activities in counties quarantined by the Department of Agriculture to prevent the spread of certain plant pests which may be present in the soil. The Contractor agrees that all construction equipment and tools to be moved from such counties shall be thoroughly cleaned of all soil residues at the

construction site with water under pressure and that hand tools shall be thoroughly cleaned by brushing or other means to remove all soil. In addition, if this contract involves the identification, shipping, storage, testing, or disposal of soils from such a quarantined area, the Contractor agrees to comply with the provisions of ER 1110-1-5 and attachments, a copy of which will be made available by the Contracting Officer upon request. The Contractor agrees to assure compliance with this obligation by all subContractors.

1.13 HISTORICAL AND ARCHAEOLOGICAL FINDS

Federal legislation provides for the protection, preservation, and collection of scientific, prehistorical, historical, and archaeological data, including relics and specimens which might otherwise be lost due to alteration of the terrain or building features as a result of any Federal construction project. Should the Contractor, or any of the Contractor's employees, or parties operating or associated with the Contractor, in the performance of this contract discover evidence of possible scientific, prehistorical, historical, or archaeological data, the Contractor shall immediately cease work at that location and notify the Contracting Officer, giving the location and nature of the findings. The Contractor shall forward written confirmation to the Contracting Officer as directed. The Contractor shall exercise care so as not to disturb or damage artifacts or fossils uncovered during excavation operations, and shall provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition. Any person who, without permission, injures, destroys, excavates, appropriates, or removes any historical or prehistorical artifact, object of antiquity, or archaeological resource on the public lands of the United States is subject to arrest and penalty of law. Where appropriate by reason of discovery, the Contracting Officer may order delays in the time of performance or changes in the work, or both. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with the applicable clauses of the contract.

1.12 EQUIPMENT-IN-PLACE LIST:

The Contractor shall maintain a list of equipment installed under the terms of the contract. In the event that the contract includes more than one building or facility, a list must be maintained for each and delivered to the Contracting Officer upon acceptance of each building or facility. Forms to be used for this purpose shall be obtained from the Area Engineer's Office. The list shall include the following:

a. Contract number
b. Description of item
c. Model number
d. Serial number
e. Capacity
f. Name of manufacturer
g. Address of manufacturer
h. Condition of item
i. Replacement cost
j. Name of person who checked item

1.13 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE

1.13.1 Allowable Costs

Allowable cost for construction and marine plant and equipment in sound

workable condition owned or controlled and furnished by a Contractor or subContractor at any tier shall be based on actual cost data when the Government can determine both ownership and operating costs for each piece of equipment or equipment groups of similar serial and series from the Contractor's accounting records. When both ownership and operating costs cannot be determined from the Contractor's accounting records, equipment costs shall be based upon the applicable provisions of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense Schedule," Region II. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the Contracting Officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retrospective pricing, the schedule in effect at the time the work was performed shall apply.

1.13.2 Rental Costs

Equipment rental costs are allowable, subject to the applicable provisions of the Federal Acquisition Regulations, and shall be substantiated by certified copies of paid invoices. Rates for equipment rented from an organization under common control, lease-purchase or sale-leaseback arrangements will be determined using the schedule except that rental costs leased form an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees are allowable. Costs for major repairs and overhaul are unallowable.

1.13.3 Equipment Costs

When actual equipment costs are proposed and the total amount of the pricing action is over $25,000, cost or pricing data shall be submitted on the Standard Form 1411, "Contract Pricing Proposal Cover Sheet". By submitting cost or pricing data, the Contractor grants to the Contracting Officer or an authorizing representative the right to examine those books, records, documents and other supporting data that will permit evaluation of the proposed equipment costs. After price agreement the Contractor shall certify that the equipment costs or pricing data submitted are accurate, complete and current.

1.14 SUBCONTRACTS AND WORK COORDINATION

Contract Clauses "SUBCONTRACTS", "PERMITS AND RESPONSIBILITIES", and "MATERIAL AND WORKMANSHIP" are supplemented as follows:

a. Divisions or sections of specifications are not intended to control the Contractor in dividing the work among subContractors, or to limit work performed by any trade.

b. Contractor shall be responsible for coordination of the work of the trades, subContractors, and materials.

c. The Government or its representative will not undertake to settle any difference between the Contractor and Contractor's subContractors, or between subContractors.

d. The Government reserves the right to refuse to permit employment on the work or require dismissal from the work of any subContractor who, by reason of previous unsatisfactory work on Corps of Engineers projects, or for any other reason is considered

by the Contracting Officer to be incompetent or otherwise objectionable.

1.15 CONSTRUCTION MANPOWER AND EQUIPMENT REPORT

The Contractor shall submit executed CENAO Form 987, Construction Manpower and Equipment Report daily. The report shall include manpower and equipment for the general and subContractors. Forms are available from the Contracting Officer.

1.16 PURCHASE ORDERS

To ensure proper expediting of orders the Contractor and his subContractors shall furnish to the Contracting Officer, one copy of each purchase order covering supplies or services required for performance of the work. Each purchase order shall clearly indicate the date of placement, the date delivery is required in order to avoid delay in the scheduled progress of the work, and the date delivery is promised by the supplier or producer. Copies of purchase orders shall be forwarded on the date issued.

1.17 PROFIT

1.17.1 Weighted Guidelines

Weighted guidelines method of determining profit shall be used on any equitable adjustment change order or modification issued under this contract. The profit factors shall be as follows:

Factor	Rate	Weight	Value
Degree of Risk	20		
Relative difficulty of work	15		
Size of Job	15		
Period of performance	15		
Contractor's investment	05		
Assistance by Government	05		
Subcontracting	25		
	100		

1.17.2 Value

Based on the circumstances of each procurement action, each of the above factors shall be weighted from .03 to .12 as indicated below. The value shall be obtained by multiplying the rate by the weight. The value column when totalled indicates the fair and reasonable profit percentage under the circumstances of the particular procurement.

1.17.2.1 Degree of Risk

Where the work involves no risk or the degree of risk is very small, the weighting should be .03; as the degree of risk increases, the weighting should be increased up to a maximum of .12. Lump sum items will have, generally, a higher weighted value than the unit price items for which quantities are provided. Other things to consider: the portion of the work to be done by subContractors, nature of work, where work is to be performed, reasonableness of negotiated costs, amount of labor included in costs, and whether the negotiation is before or after performance of work.

1.17.2.2 Relative Difficulty of Work

It the work is most difficult and complex, the weighting should be .12 and should be proportionately reduced to .03 on the simplest of jobs. This factor is tied in to some extent with the degree of risk. Some things to consider: the nature of the work, by whom it is to be done, where, and what is the time schedule.

1.17.2.3 Size of Job

All work not in excess of $100,000 shall be weighted at .12. Work estimated between $100,000 and $5,000,000 shall be proportionately weighted from .12 to .05.

1.17.2.4 Periods of Performance

Jobs in excess of 24 months are to be weighted at .12. Jobs of lesser duration are to be proportionately weighted to a minimum of .03 for jobs not to exceed 30 days. No weight where additional time not required.

1.17.2.5 Contractor's Investment

To be weighted from .03 to .12 on the basis of below average, average, and above average. Things to consider: amount of subcontracting, mobilization payment item, Government furnished property, equipment and facilities, and expediting assistance.

1.17.2.6 Assistance by Government

To be weighted from .12 to .03 on the basis of average to above average. Things to consider: use of Government owned property, equipment and facilities, and expediting assistance.

1.17.2.7 Subcontracting

To be weighted inversely proportional to the amount of subcontracting. Where 80 percent or more of the work is to be subcontracted, the weighting is to be .03 and such weighting proportionately increased to .12 where all the work is performed by the Contractor's own forces.

1.18 BLASTING

Blasting will not be permitted.

PART 2 PRODUCTS (THIS PART NOT USED)

PART 3 EXECUTION (THIS PART NOT USED)

-- End of Section --

SECTION 01055

SOIL BORING DATA
03/00

PART 1 GENERAL

1.1 GENERAL

The following pages are boring logs representing the subsurface investigations in the project vicinity. The information contained herein represent the basic subsurface conditions at the project site.

1.2 LOCATIONS

Locations are shown on the contract drawings.

1.3 CHARACTER OF MATERIALS

This data is included for information only. Each log is believed to show the nature of the materials encountered at that specific location and to the depth indicated on the log.

1.4 BORING NOTES

1.4.1 Soils

Soils (ML, CL, GP, etc.) are classified in accordance with ASTM D 2487, Classification of Soils for Engineering Purposes. Available lab data is presented on the logs

1.4.2 Elevations

All elevation and locations are approximate, and are based on the elevation of the top of the existing pier.

1.4.3 Dates

Dates shown on logs are completion dates.

1.4.4 Abbreviations

Abbreviation	Meaning	Abbreviation	Meaning
BOH	Bottom of Hole	NP	Nonplastic
brn	Brown	PHI	Friction Angle
cly	Clayey	PI	Plastic Index
CPT	Cone Penetration Testing	Piez	Piezometer
CPTU	CPT w/Pore Pressure Measurements	PL	Plastic Limit
		plast	Plasticity, Plastic
crs, c	Coarse	PP	Pocket Penentrometer
dia	diameter		
do	Ditto	sat	Saturated
dk	Dark	som	Some
fn, f	Fine	SPT	Standard Penetration Testing
gry	Gray		
gvy	Gravelly		

HP	High Plasticity	tr	Trace
lt	Light	v	Very
med, m	Medium	v.f.	Very Fine
MP	Medium Plasticity	vert	Vertical
		w	Moisture Content
		WOR	Weight of Rod
		WOH	Weight of Hammer
		&	and

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

[redacted]

SWMU 6 SAMPLING RESULTS REPORT

RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

Prepared for:

USACE Baltimore District

Delivery Order No. 0018
Contract No. DACA31-00-D-0011

May 2001

PREPARED BY:

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EXECUTIVE SUMMARY

URS/Dames & Moore (URS) conducted Soil Sampling and Reporting at Solid Waste Management Unit (SWMU) 6, Acid Wastewater Lagoon at the Radford Army Ammunition Plant (RFAAP), Radford, Virginia in accordance with Work Plan Addendum No. 11 as approved by USEPA Region III. This effort is critical for the Production Base Support (PBS) project to construct nitrocellulose (NC) settling tanks in an area that includes SWMU 6. It will allow RFAAP to properly manage the excavated material during construction and to prevent future sampling under the tanks once the construction is complete.

The specific objectives of the soil sampling and reporting at SWMU 6 were: (1) to collect and chemically analyze composite and discrete subsurface soil samples from overburden soils; (2) to perform an evaluation of the data with respect to RCRA hazardous waste characteristics; and (3) to provide data that can be used to evaluate residual risk through comparison to USEPA residential and industrial Region III Risk Based Concentrations (RBCs).

To achieve these objectives, twelve soil borings were advanced. One representative composite sample was collected from the overburden soil, and one representative discrete sample of the soils at depth from each of the twelve soil borings. The composite overburden samples were analyzed for full Toxicity Characteristics Leaching Procedure (TCLP) including TCLP metals, TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP pesticides, and TCLP herbicides, plus corrosivity, reactivity (percent nitrocellulose), and paint filter liquids, in accordance with SW-846 Methods. Results were compared to the Regulatory TCLP limits for hazardous waste set forth in 40 CFR 261, to assess the appropriate disposal methods for soil excavated as part of the PBS project.

Discrete samples were collected below the planned excavation depth of 25-feet below ground surface (bgs), or at probe refusal (if less than 25-feet bgs). Each of the twelve discrete samples was analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs), TCL Semi-Volatile Organic Compounds (SVOCs), TCL pesticides/ aroclors, Target Analyte List (TAL) metals, and explosives following SW-846 Methods. Soil analytical results were compared to USEPA Region III Residential and Industrial RBC Tables to evaluate the residual risk of compounds detected in the discrete samples.

The results of the laboratory analysis indicate that several of the TCLP analytes (for evaluation of overburden soils as hazardous waste) were reported at values that are above the laboratory detection limits. However, none of the analytes detected exceeded the Regulatory TCLP limits for hazardous waste. Based on these results, the soil excavated as part of the construction project will likely not have to be disposed of as hazardous waste.

The results of the laboratory analysis indicate that several of the TAL/TCL analytes (for evaluation of discrete samples for residual risk) were reported at concentrations that are above the laboratory detection limits. Four (4) TCL VOCs, one (1) TCL SVOC, seven (7) TCL pesticide/PCBs, one (1) explosive and twenty-two (22) TAL metals were detected in the discrete samples. Of these detections, none of the TCL VOCs or SVOCs were present above the applicable RBC criteria. Detected TCL

Pesticides/PCBs and explosive concentrations were less than applicable RBC criteria. Aluminum (10,200 to 49,600 mg/Kg) detections were above the residential RBC of 7,800; however, these detections were below the industrial RBC of 200,000 mg/Kg. Arsenic detections (3.8 to 7.6 mg/Kg) were above the residential and industrial RBCs of 0.43 and 3.8 mg/kg, respectively. Chromium detections (18.6 to 51.5 mg/Kg) were above the residential RBC of (23 mg/kg); however, these detections were below the industrial RBC of 610 mg/kg. Iron detections (20,500 to 40,400 mg/Kg) were above the residential RBC of 2,300 mg/kg; however, these detections were below the industrial RBC of 61,000 mg/kg. Manganese detections (181 to 1,510 mg/Kg) were above the residential RBC of 160 mg/kg; however, these detections were below the industrial RBC of 4,100 mg/Kg. The thallium detection (1.2 mg/Kg) was above the residential RBC of 0.55 mg/kg; however, these detections were below the industrial RBC of 14 mg/Kg. Vanadium detections of greater than 55 to 89.9 mg/Kg were above the residential RBC of 55 mg/kg; however, these detections were below the industrial RBC of 1,400 mg/Kg.

1.0 INSTALLATION DESCRIPTION AND BACKGROUND

RFAAP is a government-owned, contractor-operated (GOCO) industrial complex located in Radford, Virginia. It is owned by the U.S. Department of the Army and was operated under contract with Hercules, Inc., from 1941 until 1995 when Alliant Techsystems (ATK) became the operating contractor. The installation consists of two noncontiguous areas: the Main Manufacturing Area (MMA) and the New River Unit (NRU). SWMU 6 is located in the MMA of RFAAP.

The MMA contains approximately 1,969 buildings and occupies 6,900 acres. Facility activities include the manufacturing of solid propellants used in small arms, anti-aircraft and anti-tank weapons, rockets, torpedoes, missile systems, igniters, gas generators, and related items.

2.1 LOCATION

The RFAAP MMA is located approximately 10 miles west of Blacksburg, Virginia and 47 miles southwest of Roanoke, Virginia (Figure 1). It lies in one of a series of narrow valleys typical of the Appalachian Mountain region. The valley is oriented in a northeast-southwest direction, and is approximately 25 miles long and 8 miles wide at the southwest end, narrowing to 2 miles at its northeast end.

SWMU 6 was historically used as an unlined surface impoundment (i.e., acidic wastewater lagoon). It is located approximately 2,000 feet northwest of the administration area (Figure 2). The lagoon is "tear-dropped" or "triangular" in shape. The boundaries of SWMU 6 were evaluated by reviewing aerial photographs of RFAAP for the period 1937 through 1986 (Figure 3). The earliest presence of SWMU 6 was observed in photographs from 1975 and was also apparent in photographs from 1981 and 1986. Changes in the appearance of SWMU 6 were not observed on the photographs in which it was visible. A copy of the 1986 aerial photograph, which shows the location and boundary of SWMU 6, is provided as Appendix A.

2.2 BACKGROUND INFORMATION

SWMU 6 was used from 1974 to 1980 as an unlined surface impoundment that received overflow and rinse waters from an acid storage tank area in the C-Line nitrocellulose (NC) manufacturing area. During its active life, SWMU 6 received wastewater that typically exhibited the characteristic of a corrosive liquid (RCRA hazardous waste characteristic code D002). There were no overflow controls at the lagoon.

Between 1980 and 1987, the C-Line NC manufacturing area was shut down and no wastewater was introduced to the lagoon. In 1987, the lagoon was filled with soil and replaced by a holding tank.

Dames & Moore (1992) conducted Verification Investigation (VI) sampling at SWMU 6 to assess whether soil contamination existed associated with acidic wastewater that was formerly discharged to the lagoon. Two boreholes (6SB1 and 6SB2) were drilled at SWMU 6 (Figure 4). Boring 6SB1 was advanced to a depth of 21.0 feet bgs in what was thought to be the deepest part of the former lagoon,

which would have likely contained wastewater over the longest time period. Dames & Moore did not observe indications of contamination. Dames & Moore collected two samples from this boring for chemical analysis at depths of 18.0 feet and 20.5 feet below ground surface (bgs). The samples were analyzed for Target Analyte List (TAL) metals and pH.

Dames & Moore drilled boring 6SB2 to a depth of 22.9 feet bgs in what was thought to be a shallower section of the former lagoon. Visual observations of the soil profile indicated the presence of a possible sludge-like material from 14.0 feet to 20.0 feet bgs. Dames & Moore collected two samples from this boring for chemical analysis, 6SB2A and 6SB2B, at depths of 14.0 and 22.0 feet bgs, respectively. The samples were analyzed for TAL metals and pH. Monitoring wells were not installed at SWMU 6 as part of the VI due to the uncertainty that wells would actually intercept groundwater flowing in the karst aquifer beneath the former lagoon area.

Nineteen (19) metals were detected in the four soil samples collected from the former wastewater lagoon. The sample data were compared to Health Based Numbers (HBNs), which were set forth in the installation's first RCRA permit, issued in 1989, which governed activities at the time. Soil sample concentrations of arsenic and cobalt exceeded the HBN criteria in the four samples. Thallium in one sample exceeded the soil HBN criterion in a duplicate analysis; however, the concentration was less than the Practical Quantitation Limit (PQL). No other metal concentrations exceeded HBN criteria.

3.0 ENVIRONMENTAL SETTING

3.1 TOPOGRAPHY

SWMU 6 is a flat grassy level area approximately 1,800 feet above mean sea level (msl), located between two upland ridges. To the north, the ridge rises approximately 6 feet; there are asphalt roads and buildings located on this ridge. The ridge to the south rises approximately 10 feet, where railroad tracks and an asphalt road are present. SWMU 6 is located within an industrial area composed of numerous buildings, overhead pipes, railroad tracks, and asphalt roads.

Based on topography, surface water runoff from these ridges on the northern and southern sides of the SWMU flows into the SWMU 6 area. Surface runoff within SWMU 6 likely flows into storm water catch basins located near the northeast and southeast ends of the SWMU.

3.2 GEOLOGY

The RFAAP is located in a region underlain by carbonate rocks (i.e., limestone and dolomite), and therefore, exhibits prominent karstic features including sinkholes, caves, and caverns. Karst landforms occur in carbonate rock formations as the result of the dissolution of rock by naturally occurring carbonic acid in rainwater.

According to previous studies (Dames & Moore, 1992), subsurface conditions observed in the vicinity of SWMU 6 consist of reddish-brown silty clay present in borings to bedrock or borehole termination. These residual deposits (clays and silts) are a result of chemical and physical weathering of the

underlying Elbrook Formation (limestone and dolomite). At RFAAP the depth to the Elbrook Formation ranges from 21 feet to greater than 45 feet (Dames & Moore, 1992).

3.3 SITE SOILS ENCOUNTERED - LITHOLOGIC DISCUSSION

During this field investigation, site soils encountered were similar to the soils described in previous investigations. Copies of the boring logs from this investigation are included as Appendix B. Figures 5 and 6 present cross-sections of soils encountered during the investigation. In general, soils encountered consisted of a thin surface layer of brown-to reddish-brown clayey silty fine sand, with organic matter and root material, which graded to red or strong brown fine sandy clay at approximately 0.5 feet bgs. From 0.5 feet bgs to depths ranging from 6.5 to 19.0 feet bgs, the soils consisted of red, dark yellowish brown or strong brown silty clay. This stratum is referred to as Stratum 1. Variations in sand and moisture content were observed, as well as plasticity in Stratum 1. In addition, variable amounts of gravel were present. In some borings, the sample recovery was limited at depths of 4.0 to 16.0 feet bgs. This was likely due to the presence of gravels, which prevented the soil from entering the sampling device.

Below Stratum 1, a gradational to sharp change to olive, grayish brown or dark- to very dark-gray silty clay/clayey silt was observed. This Stratum is referred to as Stratum 2. Stratum 2 is characterized by a distinct color change from the overlying soil and the presence small (<1 to 2 inches) pieces of wood chips and woody matter. Texturally, Stratum 2 ranged from soft silty clay (plastic) to sandy wet clay and silt mixtures, to stiff sandy plastic clay. Thin layers (1 to 2 inches) of sand were present in Stratum 2. It should be noted that the texture of Stratum 2 was consistent with that of a soil and did not appear to be sludge. Stratum 2 is therefore considered to be soil and is discussed as soil herein. The distinct color characteristics of Stratum 2 may be indicative of influence from former operations at the SWMU.

Below Stratum 2, the soil was generally stiff to hard silty clay, of medium to high plasticity, and varied in color from yellowish red to red to strong brown. This layer is identified as Stratum 3 in this report. Stratum 3 was observed to be the hardest of the three Strata and may act as a barrier to the downward movement of groundwater.

Geoprobe® refusal, or probe refusal, occurred in three boring locations at bedrock. Boring 6SB3 was terminated at a depth of 27.9 feet bgs. Boring 6SB5 was terminated at a depth of 17.4 feet bgs and boring 6SB10 was terminated at a depth of 20.4 feet bgs. The remainder of the borings were advanced to a depth of 27 feet bgs without probe refusal or indications of bedrock. The observed variations in depth to bedrock are typical of the carbonate rocks present in the region.

4.0 SUMMARY OF FIELD SAMPLING PROGRAM

The purpose of the SWMU 6 sampling program was to collect representative composite samples of the overburden soils and representative discrete samples of the soil at depth (25-feet bgs or at probe refusal) in twelve soil borings advanced in SWMU 6. Each of the twelve composite samples submitted to the laboratory was analyzed for full Toxicity Characteristic Leaching Procedure (TCLP) analysis

including TCLP metals, TCLP VOCs, TCLP SVOCs, TCLP pesticides, and TCLP herbicides, plus ignitability, corrosivity, reactivity (percent nitrocellulose) and paint filter liquids according to SW-846 Method protocols. Each of the 12 discrete samples was analyzed for SW-846 Methods: target compound list (TCL) VOCs; TCL semi-volatile organic compounds; TCL pesticides/aroclors; target analyte list (TAL), metals and explosives.

Figure 7 shows the locations of the 12 soil borings, and Figure 8 shows the approximate locations where the settling tanks will be placed relative to SWMU 6. In selecting the locations of subsurface soil samples to be collected, consideration was given to the size and shape of SWMU 6, as well as the overall project objective of evaluating the overburden soils relative to RCRA waste characteristics and providing the information necessary for evaluating the soils at depth relative to USEPA Region III residential and industrial RBCs.

The investigation activities were conducted in accordance with the EPA approved Work Plan Addendum No. 11.

Components of the investigation included subsurface soil sampling and sample collection by direct push technology (Geoprobe®) methods, boring abandonment, stratigraphic logging of the soil borings, sample management, field screening using a portable photoionization detector (PID), field documentation, laboratory analysis, quality assurance practices, and evaluation of the data relative to RCRA hazardous waste characteristics and USEPA Region III residential and industrial RBCs.

4.1 GEOPROBE® SAMPLING

During WPA development and subsequent USEPA concurrence, the number and locations of soil borings was deemed sufficient to provide an appropriate number of samples to: (1) characterize the volume of soil that will ultimately be excavated from SWMU 6; and (2) evaluate the residual risk, if applicable, of soil that will remain at depth. Given the objectives of the sampling program and the planned excavation of a significant portion of the SWMU 6 area, a distribution of 12 soil borings that provides adequate coverage of the SWMU area and allows for the collection of an appropriate number of samples to characterize soils within the SWMU 6 area was selected. Table 1 provides a summary of the samples collected from each boring. Samples collected for “Overburden Characterization” were composite samples while samples collected for “Residual Risk Screening” were discrete samples.

Boring logs, with information including lithology, boring depth, sample depth, and PID screenings are included in Appendix B. In addition to selecting borings locations that provided geographic coverage of the interior of the SWMU 6 area, borings were placed along the SWMU edges (and in some cases outside the boundaries of the SWMU) to evaluate the potential that constituents may have “leaked” beyond the boundaries of the SWMU.

Prior to the start of the investigation, a meeting was held at the SWMU 6 area to discuss the selected soil boring locations (which were flagged within the SWMU), and to evaluate the locations of underground utilities. Personnel present during this meeting represented RFAAP, URS, USACE and ATK. USACE personnel reviewed utility maps and marked potential underground utilities prior to

drilling. Subsequently, the proposed boring locations were modified (as flagged in the field and identified in the work plan for this investigation) in the field, based on the identification of the locations of potential underground utilities during this meeting. The approximate locations of underground utilities present at SWMU 6 are shown on Figure 9.

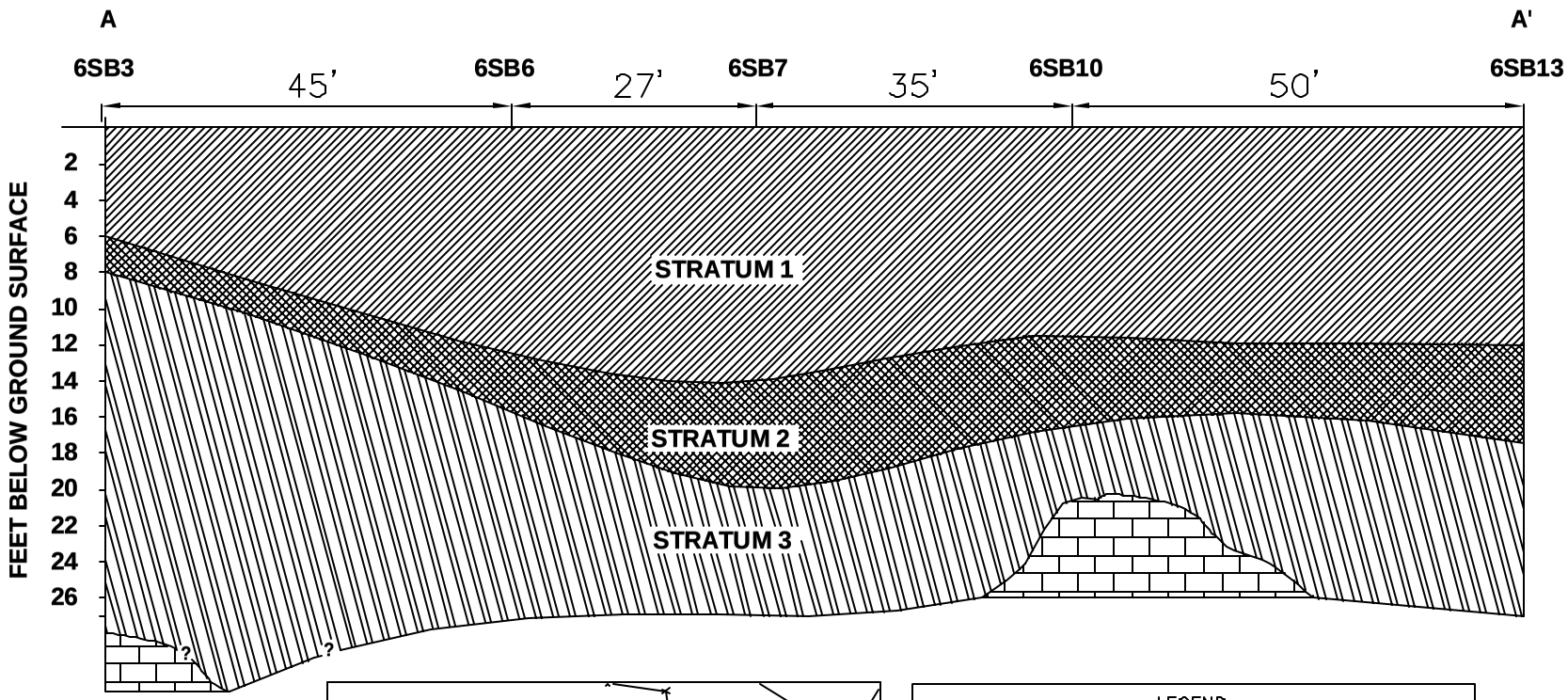
Figure 10 depicts the actual soil boring locations, versus the proposed boring locations identified in the WPA. As shown on Figure 10, borings 6SB3, 6SB5, 6SB9, and 6SB12 were offset to the south. One additional boring was re-positioned from the northern boundary to nearer the center of the SWMU (6SB6). Boring 6SB13 was offset to the east due to the presence of utilities. Boring 6SB12 was offset to the west slightly and boring 6SB10 was offset to the south due to the presence of utilities.

The Geoprobe® is a "direct push" technique, which incorporates a hydraulically powered percussion/probing machine designed specifically for use in the environmental industry. The Geoprobe® uses static force (the truck's weight) and a percussion hammer to advance small diameter sampling tools into the subsurface to collect soil cores. The macro soil core sample is collected inside a dedicated, pre-cleaned acetate liner; each acetate liner is used once, then discarded (handled as IDM).

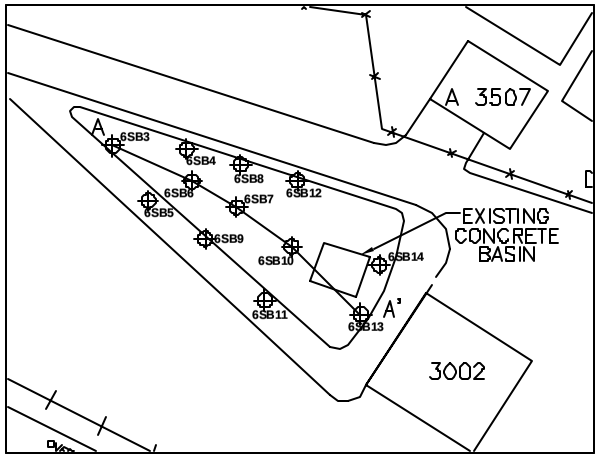
Soil borings were advanced using the direct push technology. A four-foot Macro-Core® device was used to collect the samples. Stratigraphic logs for each boring were prepared. During drilling, subsurface soil samples were screened for the presence of organic compounds using a PID. The PID was calibrated against a 100 ppm isobutylene standard calibration gas (since a single VOC constituent of concern was not previously identified) using a 10.2 eV lamp.

The Geoprobe® and other down hole equipment and tools were steam cleaned daily prior to use at the site. The down-hole equipment and tools were decontaminated on site between each boring location. Following each soil sampling interval (i.e., 4-foot section), the Macro-Core®-cutting shoe (the end of the Macro-Core® that comes in contact with the soil) was decontaminated in accordance with the WPA. Decontamination water was containerized on site.

Soil borings were abandoned (sealed) upon completion by pouring bentonite chips into the borehole in accordance with the WPA. In accordance with the WPA, the chips were not hydrated because the borings were less than three inches in diameter.



Scale
V: 1"=10'
H: 1"=20'
VE: 2x



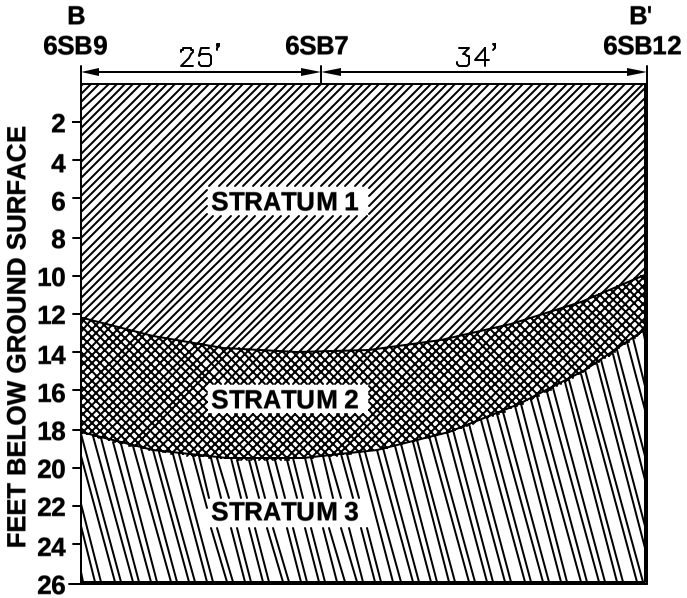
LEGEND

Layer 1 Red, dark yellowish brown or strong brown silty clay.

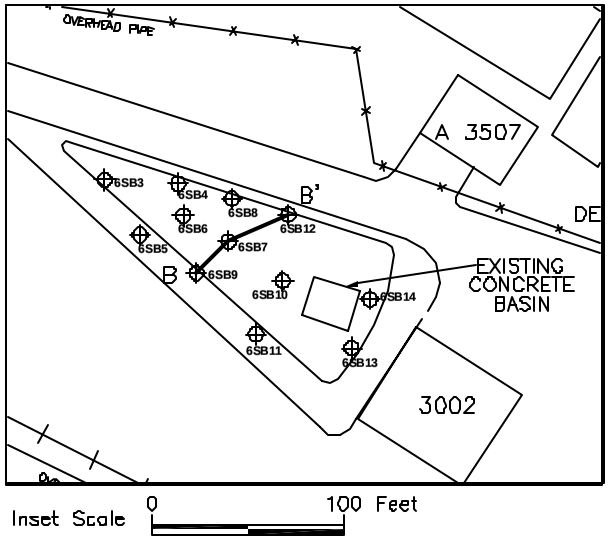
Layer 2 Olive, grayish brown, or dark gray silt and clay mixtures or silty clay mixtures often with the presence of woody matter.

Layer 3 Yellowish red, red to strong brown, stiff to hard plastic silty clay.

Radford Army Ammunition Plant (RFAAP) SWMU 6 Sampling Results Report	
Figure 5	Date/Drawing No. 09604.242.F5.DWG
SWMU 6 Interpreted Cross Section A to A'	Scale: As Shown



Scale
V: 1"=5'
H: 1"=10'
VE: 2x



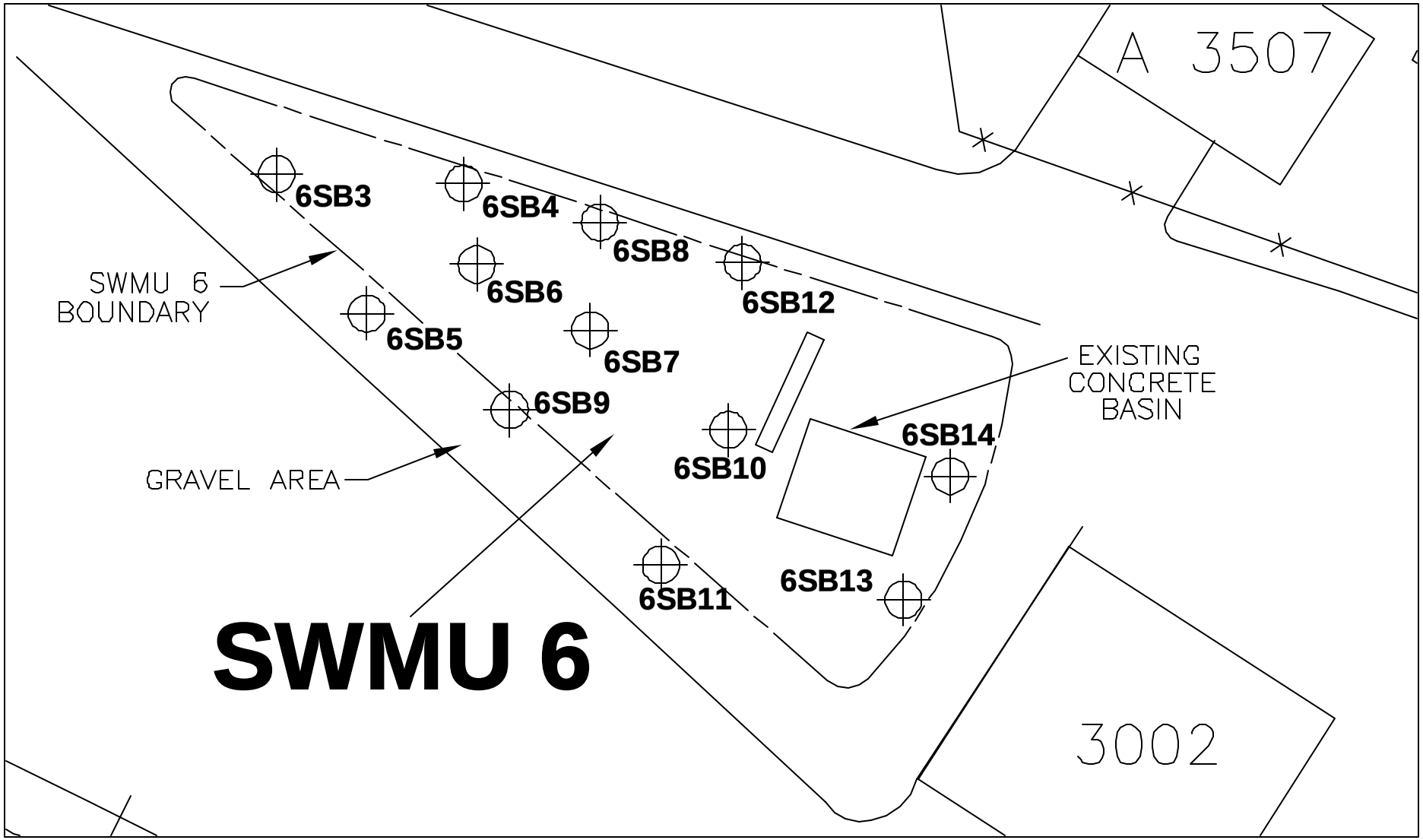
LEGEND

Layer 1 Red, dark yellowish brown or strong brown silty clay.

Layer 2 Olive, grayish brown, or dark gray silt and clay mixtures or silty clay mixtures often with the presence of woody matter.

Layer 3 Yellowish red, red to strong brown, stiff to hard plastic silty clay.

Radford Army Ammunition Plant (RFAAP) SWMU 6 Sampling Results Report	
Figure 6	Date/Drawing. No. 09604.242.F6.DWG
SWMU 6 Interpreted Cross Section B to B'	Scale: As Shown



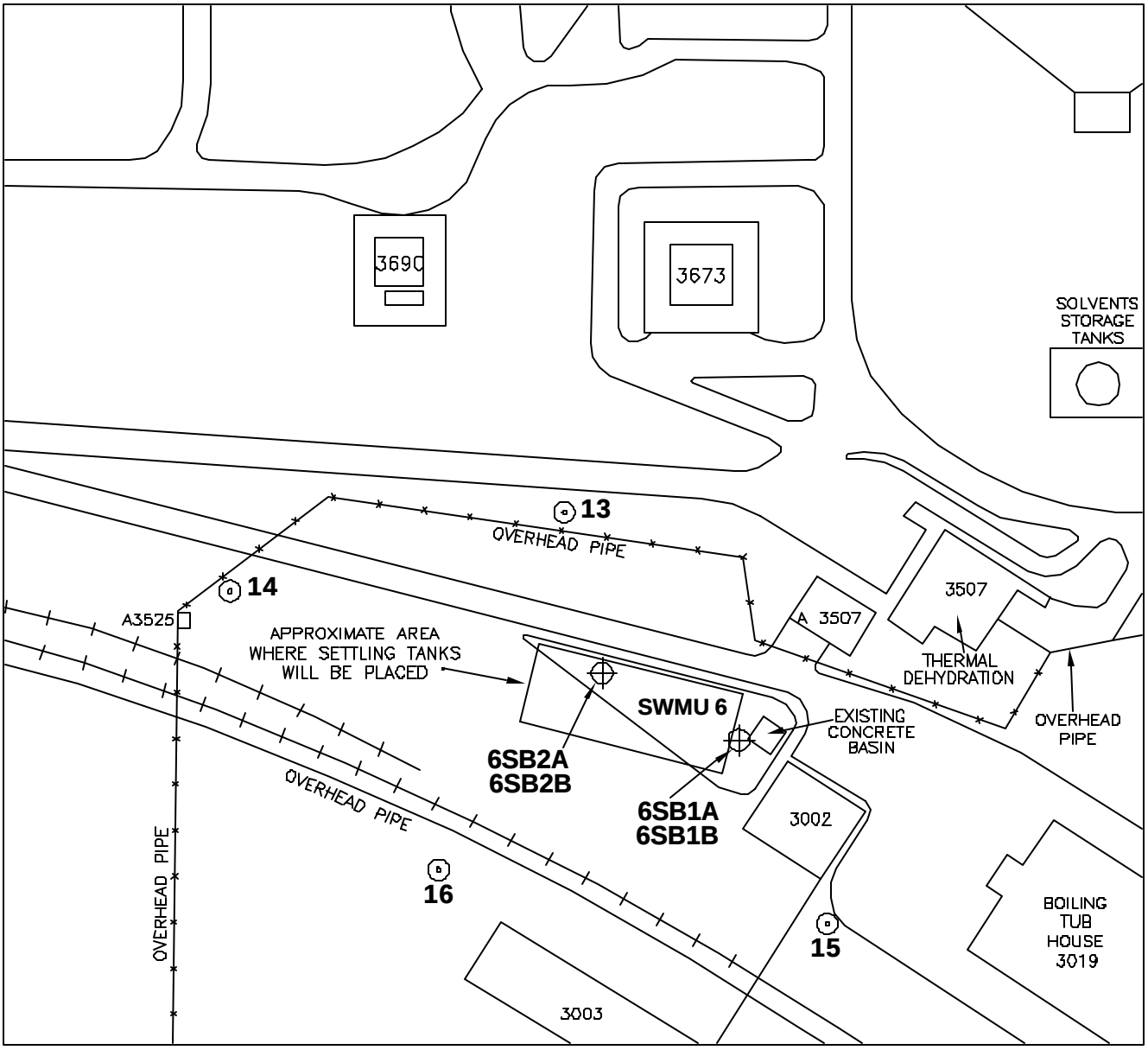
0 30 Feet

SCALE

LEGEND:

6SB3 Boring Location

Radford Army Ammunition Plant (RFAAP) SWMU 6 Sampling Results Report	
Figure 7	Date/Drawing. No. 09604.242.F7.DWG
SWMU 6 Boring Locations	Scale: As Shown



LEGEND:

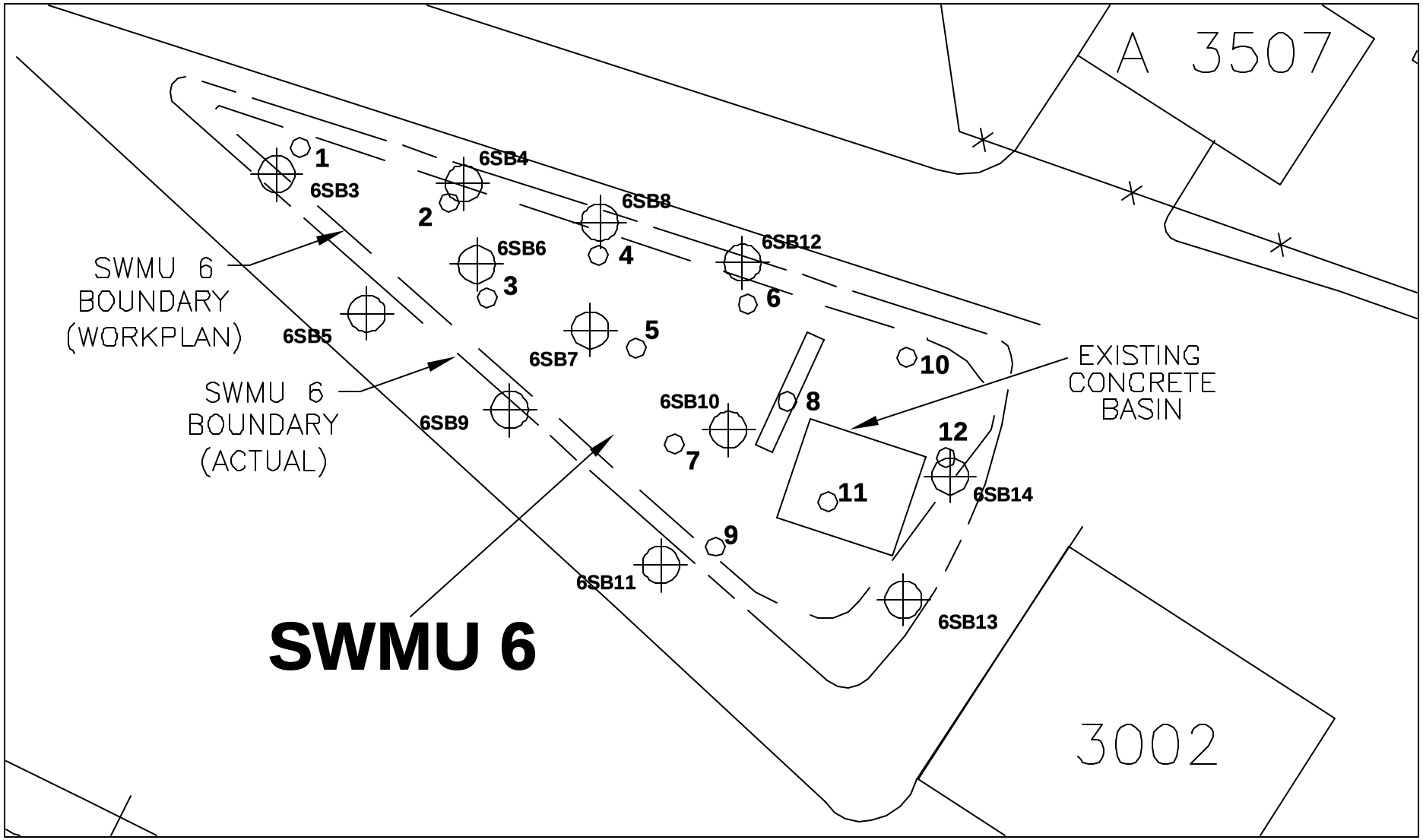
Existing Boring

Existing Monitoring Well/Boring

0 100 Feet

APPROXIMATE SCALE

Radford Army Ammunition Plant (RFAAP) SWMU 6 Sampling Results Report	
Figure 8	Date/Drawing. No. 09604.242.F8.DWG
Approximate Area Where Settling Tanks Will Be Placed	Scale: As Shown



0 30 Feet
SCALE

LEGEND:

6SB3 Actual Boring Location

3 Proposed Boring Location

Radford Army Ammunition Plant (RFAAP) SWMU 6 Sampling Results Report	
Figure 10	Date/Drawing. No. 09604.242.F10.DWG
SWMU 6 Proposed versus actual Boring Locations	Scale As Shown

URS Dames & Moore		Log of:	6SB3
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.9'	Elev GS: / Reference:	Date: Start: 11/14/00	Complete: 11/14/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2	CL	Brown organics/roots/fine sandy clay 0.5': Dark red, (2.5y 3/6), fine sandy clay, moist, low plasticity, trace gravels. 2.5': Dark yellowish brown, (10 yr 5/6), silty clay, moist,medium plasticity some red and black mottling.
ND					4		4.0': Grading yellowish brown (10 yr 5/6), silty clay, wet, moist, trace gravels
ND	4.0' / 4.0'			4-8'	6		
ND					8	CL	6.5': Olive, (2.5 yr 5/4), silty clay, trace gravels
ND	4.0' / 2.2'			8-12'	10		8.0': Reddish yellow (7.5 yr 6/8) silty clay, moist, root material AT 10.9'
0.1					12		
4.0	4.0' / 1.2'			12-16'	14		12.0': Reddish yellow, (7.5 yr 6/8), silty clay, moist, high plasticity
6.0					16		
7.0	4.0' / 1.0'			16-20'	18	CL	Increased sand component
					20		
ND	4.0' / 0.8'			20-24'	22		Increased resistance, hard, at 23'
ND					24		
ND	3.9' / 3.5'			24-27.9'	26		
							27.9': Boring terminated at 27.9'. Refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB4
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/14/00	Complete: 11/14/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 3.4'			0-4'	2	SM	Brown root matter, grading to reddish brown, (2.5 yr 3/3), medium grained clayey sand, slightly micaceous, moist,
						CL	grading red.
						GW	Gravel layer
						CL	Strong brown, (7.5 yr 5/6), medium to coarse sandy clay, soft, high plasticity, moist
	4.0' / 2.8'			4-8'	4, 6		
	4.0' / 1.0'			8-12'	8, 10		Gravel lenses
	4.0' / 3.4'			12-16'	12, 14		Grading softer, increase in moisture
	4.0' / 4.0'			16-20'	16, 18		Grayish brown, (2.5 yr 5/2), stiff, sandy clay, low plasticity, wet
						SM	18.5': Silt/very fine sand mix
						CL	18.7': Yellowish red, (5 yr 5/6) stiff, fine sandy clay, wet with black matter (coal?)
	4.0' / 4.0'			20-24'	20, 22		
	3.0' / 3.0'			24-27'	24, 26		
							Boring terminated at 27' - No refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore		Log of:	6SB5
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 17.4	Elev GS: Reference:	Date: Start: 11/15/00	Complete: 11/15/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4		Brownish red, sandy clay, stiff Strong brown, (7.5 yr 5/6), silty clay, stiff, moist Grading moist with moderate plasticity
	4.0' / 4.0'			4-8'	6, 8		Trace black matter (coal?). Trace fine to coarse sand, trace fine gravels Grading redder; hard at 7.9'
	4.0' / 3.0'			8-12'	10, 12	CL	Red (2.5 yr 4/6) fine to medium sandy clay, moist, grading with soft sandy clay
	4.0' / 0.5'			12-16'	14, 16		
	1.4' / 1.0'						Grading strong brown, soft sandy clay
				16-17.4'	18		Boring terminated at 17.4'. Refusal
				20-24'	20, 22		
				24-27'	24, 26		

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB6
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2	SC	Brown sandy clay, roots, grass Red, (2.5 yr 4/8), fine to medium sandy clay, moist
	4.0' / 4.0'			4-8'	4, 6	CL	5.6' to 5.9': Gravel seam, with strong brown mottlling, moist
	4.0' / 0.8'			8-12'	8, 10	CL/GP	8.0' to 12.0': Red gravelly clay,
	4.0' / 2.0'			12-16'	12, 14	CL/ML	Strong brown (10 yr 5/6), clayey silt to silty clay, wet with trace gravel in lenses 15.5': Very dark gray soft silty clay
	4.0' / 3.0'			16-20'	16, 18	CL	Dark brown, (10 yr 4/2), silty sandy clay, very stiff, moist
	4.0' / 4.0'			20-24'	20, 22		Grading softer, wet, with gravel
	4.0' / 3.0'			24-27'	24, 26		Increasing sand, wet
							Boring terminated at 27'. No refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB7
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/14/00	Complete: 11/14/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4	SM	Brown silty sandy clay with organics
						CL	Red (2.5 yr 4/8) fine to medium sandy clay, slightly micaceous, trace coarse sand , moist
							Red (2.5 yr 4/8) sandy clay, slightly plastic, moist
	4.0' / 4.0'			4-8'	6		Grading stiffer; trace gravels, trace yellow mottles; moist
					8		Increased gravels
0.2	4.0' / 4.0'			8-12'	10		10.0' to 10.8': Increased moisture and plasticity, soft
ND						CH	10.8': Brownish yellow (10 yr 6/6) soft, highly plastic clay trace coarse sand, moist
	4.0' / 3.4'			12-16'	12, 14		Grades to light olive brown (2.5 yr 5/3) soft, clay and silt, wet, with trace decomposed wood fragments
	4.0' / 4.0'			16-20'	16, 18	CL	
					20	CL	20.0': Strong brown (7.5 yr 5/3) soft silty clay, some sand, moist and gravel, moist
	4.0' / 4.0'			20-24'	22	CL/ML	21.0': Becomes brown (10 yr 5/3) soft, silty clay, some sand and gravel moist
	4.0' / 3.0'			24-27'	24, 26	CL	Red sandy clay, moist
							Boring terminated at 27'. No refusal.

Note:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore		Log of:	6SB8
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/2000

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2	CL	Red sandy clay, with grass and roots, micaceous, stiff Reddish yellow (7.5 yr 6/6) silty clay, moist grading harder with depth, trace rounded gravels
	4.0' / 4.0'			4-8'	4, 6	CL	6.0': Increased moisture with wood chips
	4.0' / 2.0'			8-12'	8, 10	CL	8.0' to 15.5': No wood chips
	4.0' / 4.0'			12-16'	12, 14	CL/CH	12.4': Dark grayish brown (10 yr 4/2) soft, sandy clay, plastic, moist 13.7': Stiffer 15.5': Wood chips present with yellowish brown mottles, increasing sand and moisture
	4.0' / 4.0'			16-20'	16, 18	GW / CL/CH	Gravel seam Yellowish red (5 yr 5/6) clay, very stiff to hard, moist, trace fine black matter (coal?)
	4.0' / 4.0'			20-24'	20, 22	CL/CH	
	3.0' / 3.0'			24-27'	24, 26	CL/CH	
							Boring terminated at 27'. No refusal.

Note:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore		Log of:	6SB9
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4	GM	Silty gravels to 0.3'
						CL	Red (2.5 yr 4/6) sandy clay, medium plasticity
						CL	Yellowish brown (10 yr 5/8) soft clayey silt/silty clay, moist
	4.0' / 0.5'			4-8'	6, 8		4.8': Gravel seam
	4.0' / 2.3'			8-12'	10, 12		Very soft yellowish brown silty clay, moist
	4.0' / 1.0'			12-16'	14, 16		Strong brown (7.5 yr 5/6) very soft, silty clay, low plasticity trace fine sand, wet
	4.0' / 4.0'			16-20'	18		18.0': Brown (7.5 yr 4/4)
						CH	19.0': Brown (7.5 yr 4/4) stiff, sandy plastic clay with wood fragments
	4.0' / 4.0'			20-24'	20, 22		
						SC	22.5' to 22.8': Zone of wood fragments, underlain by brown (7.5 yr 4/4) fine to medium clayey sand, trace rounded gravels
	3.0' / 4.0'			24-27'	24, 26	ML	24.0' to 27.0': Brown (7.5 yr 4/4) sandy clayey silt, saturated
							Boring terminated at 27'. No refusal.

Note:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore		Log of:	6SB10
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 20.4'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
						SC	Brown silty clayey sand, grass and roots
ND	4.0' / 4.0'			0-4'	2	CL	Red, (2.5y 4/6), sandy clay, trace gravels, with yellowish brown mottles, moist
ND							
ND					4		
ND	4.0' / 4.0'			4-8'	6		Red, (2.5y 4/6), sandy clay, trace gravels, with yellowish brown mottles; moist
0.2							
ND					8		
ND	4.0' / 4.0'			8-12'	10		Grading stiffer.
0.1							
ND						CL/GP	11.0': Yellowish brown, (10 yr 5/4), hard gravelly clay, trace wood fragments, moist
ND	4.0' / 4.0'			12-16'	12		
0.6							
ND					14	CL	13.5': Brown, (7.5 yr 5/3), sandy clay with some red mottling.
ND							
						SM	15.2': Brown, (7.5 yr 5/3), soft silty sand, with wood fragments
ND	4.0' / 4.0'			16-20'	16	CL	16.0': Yellowish brown, (10 yr 5/6), hard sandy clay, moist
ND							
ND					18		
ND						SC	Grading to reddish brown, clayey silty fine sand, moist
ND	0.4' / 0.4'				20		Boring terminated at 20.4'. Refusal.
				20-24'	22		
					24		
				24-27'	26		

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB11
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0'			0-4'		SC	Reddish brown, (2.5 yr 3/4), clayey silty sand becoming red (2.5 yr 4/8) softer, plastic sandy clay
ND						CL	1.5': Becomes brownish yellow, (10 yr 6/8), silty sandy clay, moist with strong brown, (7.5 yr 5/6), mottling, plasticity increasing.
ND					2		
ND	4.0'						
					4		
ND	4.0'			4-8'		GC	5.0' - 5.5': Gravel lense
ND					6	CH	Highly plastic brownish yellow, (10 yr 6/8), clay; moist, trace sand, trace black matter (coal?)
ND	3.0'						
ND					8		
ND	4.0'			8-12'			
ND					10		
ND	4.0'					CL	10.5': Becomes reddish brown, (5 yr 4/6), soft fine to medium sandy silty clay, trace gravel, moist
ND					12		11.5': Dark brown (7.5 yr 3/3) silty sand, moist, with root material
ND	4.0'			12-16'		SM	
0.1'					14		14.2': Dark grayish brown, (2.5 yr 4/2), sandy clay, plastic, trace gravel, trace dark yellow brown, sandy clay, moist
ND	3.5'					CL	
ND					16		grading softer with gray and red mottles
ND	4.0'			16-20'			
ND					18		Brownish yellow, (10 yr 6/8), hard silty clayey gravelly sand, red mottles, moist
ND	4.0'						
					20	SP	
ND	4.0'			20-24'			
ND					22		
ND	4.0'						
ND					24	GC	Brownish yellow, (10 yr 6/8), clayey sandy gravel, moist
ND	4.0'			24-27'			
ND					26	CL	Strong brown, (7.5 yr 5/6), slightly sandy clay, plastic, moist, trace black matter (coal?)
ND	3.0'						
							Boring terminated at 27' - No refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB12
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/15/00	Complete: 11/15/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4	CL	Grass and root matter, becoming red (2.5 yr 4/6) hard sandy clay, 1.5' - 3.0' Micaceous sandy clay with gravel lense, moist
	4.0' / 2.8'			4-8'	6	ML	Yellow (10 yr 8/8) soft silt, dry
	4.0' / 1.5'			8-12'	8, 10	CL	7.0': Yellowish red (5 yr 5/6) sandy clay, soft, plastic, moist
	4.0' / 1.5'			12-16'	12, 14	CL	13.0': Stiff dark brown (7.5 yr 4/3) fine to coarse sandy clay, moist
	4.0' / 4.0'			16-20'	16, 18	CL	grading redder and gravelly
						GC	18.7' to 19.1': Sandy clayey gravel
	4.0' / 4.0'			20-24'	20, 22	CM	Yellowish red (5 yr 5/8) highly plastic stiff clay with strong brown and yellow mottles , moist
	4.0' / 3.0'			24-27'	24, 26	CL	Yellowish red (5 yr 5/8) medium stiff silty clay, trace sand lenses moist
							Boring terminated at 27'. No refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore			
		Log of:	6SB13
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/16/00	Complete: 11/16/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4	GM, CL	0' to 1.0': Surface gravel 1.0': Red (2.5 yr 4/6) clay, soft sandy (micaceous) silty, moist
	4.0' / 0.4'			4-8'	6, 8		
	4.0' / 2.0'			8-12'	10, 12	GC, CL	8.4' to 8.7' Gravel lense *8.7' to 8.8': Black tar-like matter with fiber-like matting attached to it (Resembles tar/matting of adjacent concrete basins) 8.8' to 12.0': Red clay, trace gravel, moist
	4.0' / 3.5'			12-16'	14, 16	SP	Dark grayish brown (2.5 yr 4/2) clayey silty fine sand, moist
	4.0' / 4.0'			16-20'	18, 20	CL, SC	Grades to soft silty clay 17.4': Yellowish brown (7.5 yr 5/4) soft, very silty clay, saturated 18.5' to 20.0': Strong brown (7.5 yr 5/8) soft sandy clay with fine gravel moist
	4.0' / 4.0'			20-24'	22, 24	CL/GP	Strong brown (7.5 yr 5/8) gravelly sandy plastic clay, trace silt moist
	3.0' / 3.0'			24-27'	26		Increased plasticity
							Boring terminated at 27'. No refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

URS Dames & Moore		Log of:	6SB14
		Project Number:	09604-242
Client:	U.S. Army Corps of Engineers	Drilling Company:	Marshall Miller & Assoc.
Project:	SWMU 6 Sampling and Reporting	Driller:	Keith Carr
Location:	Radford Army Ammunition Plant, Radford, VA	Boring Method:	Geoprobe
North:	East:	Logged by:	John H. Spangler
Total Depth: 27.0'	Elev GS: / Reference:	Date: Start: 11/16/00	Complete: 11/16/00

PID	Ft. Driven / Ft. Recovered	Composite Sample Collection Depth	VOC Sample Depth	Sample Interval	Depth (Ft.)	Symbol	Description
ND	4.0' / 4.0'			0-4'	2, 4	GM	Surface gravel/silt/clay
						CL	0.75': Red (2.5 yr 4/6) sandy clay, medium plasticity, with yellowish brown mottling, moist
	4.0' / 0.3'			4-8'	6, 8		4.0': Increasing yellowish brown mottles
	4.0' / 3.2'			8-12'	10, 12	GM	9.3' to 9.5': Gravel lense
						CL	9.5' to 10.0': Stiff red (2.5 yr 4/6) sandy clay, moist 10.0' - 12.0': Grading soft , with increasing gravels
	4.0' / 4.0'			12-16'	14, 16	SC/SM	14.7': Olive brown (2.5 yr 4/3) silty, trace clay, clayey fine sand, with occassional wood fragments, moist
	4.0' / 4.0'			16-20'	18, 20		Grading to dark brown (10 yr 4/3), trace wood fragments or sticks
	4.0' / 4.0'			20-24'	22, 24	CH	21.5': Strong brown (7.5 yr 5/6) highly plastic clay, trace reddish yellow mottles
						CL	23.0': Strong brown (7.5 yr 5/6) slightly silty, slightly gravelly clay occasional reddish yellow mottles.
	3.0' / 3.0'			24-27'	26		
							Boring terminated at 27' - No probe refusal.

Notes:
ND = Not Detected
PID = Photo Ionization Detector

SECTION 01111
SAFETY AND HEALTH REQUIREMENTS
03/98

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 basic designation only.

CORPS OF ENGINEERS (COE)

EM 385-1-1	Safety and Health Requirements Manual (September 1996)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; All other submittals are submitted for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Preconstruction Submittals

Safety and Health Plan; G.

1.3 SAFETY REQUIREMENTS AND ACCIDENT PREVENTION

1.3.1 Standards

The Contractor shall comply with Occupational Safety and Health Act (OSHA) Standards, the Corps of Engineers Manual EM 385-1-1, "Safety and Health Requirements Manual," NFPA 101, and state, local, and facility safety requirements.

1.3.2 SAFETY AND HEALTH PLAN

1.3.2.1 Preparation and Implementation

An Accident Prevention Plan (APP) shall be prepared covering onsite work to be performed by the Contractor and all subcontractors, and shall at a minimum address the requirements for an Accident Prevention Plan (APP), as contained in Appendix A, EM 385-1-1. The Safety and Health Manager shall be responsible for the development, implementation and oversight of the APP. The APP shall establish, in detail, the protocols necessary for the anticipation, recognition, evaluation, and control of hazards associated with each task performed. The APP shall address general safety and health requirements and procedures. The level of detail provided in the APP shall be tailored to the type of work, complexity of operations to be performed, and hazards anticipated. Details about some activities may not be available when the initial APP is prepared and submitted. Therefore, the APP shall address, in as much detail as possible, anticipated tasks, their related hazards and anticipated control measures.

1.3.2.2 Acceptance and Modifications

Prior to submittal, the APP shall be signed and dated by the Contractor's Safety and Health Manager and the Site Superintendent. The APP shall be submitted for review at least days prior to the Prework Safety Conference. Deficiencies in the APP will be discussed at the Prework Safety Conference, and the APP shall be revised to correct the deficiencies and resubmitted for acceptance. Onsite work shall not begin until the plan has been accepted. A copy of the written APP shall be maintained onsite. As work proceeds, the APP shall be adapted to new situations and new conditions. Changes and modifications to the accepted APP shall be made with the knowledge and concurrence of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer. Should any unforeseen hazard become evident during the performance of the work, shall bring such hazard to the attention of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, necessary action shall be taken to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted APP shall be cause for stopping of work until the matter has been rectified to the satisfaction of the Contracting Officer.

1.3.3 Corps of Engineers Standards

Corps of Engineers Manual EM 385-1-1, referred to in "ACCIDENT PREVENTION" article of Contract Clauses, is hereby supplemented or revised as follows:

1.3.3.1 Conflicts

When a conflict exists between the Corps of Engineers Safety and Health Requirements Manual, other safety requirements, or the contract plans and/or specifications, the most stringent requirement shall prevail. (NAOSA 5 FEB 87).

1.3.3.2 Front End Loader - Backhoe Machines

1.3.3.2.# Non-compliance Safety Check

All front end loader-backhoe machines and other machines, such as tractors that utilize a backhoe attachment, shall be checked for:

a. Exposed backhoe boom swing foot pedals.

b. Backhoe boom swing lever which can be reached by a man standing on the ground or on the outrigger support bracket.

1.3.3.2.# Correction and Fabrication of Non-compliance Safety Items

Where these conditions exist, guards shall be fabricated to:

a. Cover over exposed foot pedals to prevent someone from accidentally stepping on them.

b. Inclose the swing lever so as to preclude operation from the ground or from the outrigger support bracket.

1.3.3.3 Attendance at Safety Meetings

In order to allow for maximum attendance at weekly tool box meetings and monthly supervisor meetings by Corps of Engineers personnel, the Contractor

shall advise the CO's Office, a minimum of 48 hours before the start of each meeting, of the date, time and location of Safety Meetings.

1.3.3.4 Minutes of Safety Meetings

Minutes shall be prepared by the Contractor and forwarded to the Contracting Officer by close of business the next work day.

1.3.3.5 Protective Footwear

Protective footwear as defined by American National Standards Institute Z41 shall be worn by all working personnel on site.

1.3.3.6 Ground Fault Circuit Interrupters (GFCI)

GFCI's are required for work on this contract in accordance with EM 385-1-1. GFCI's are also required when using electric power extension cords.

1.3.3.7 Crawler-, Truck-, and Wheel-Mounted Cranes

Implementation of paragraph 16.D.05 shall include the following:

a. When a crane is performing duty cycle work (such as clamshell, dragline, grapple, or pile driving) it does not require anti-two block equipment. If the crane is required to make a non-duty cycle lift (for example, to lift a piece of equipment, a tool box, or supplies), it will be exempt from the anti-two block equipment requirements if the following procedures are implemented:

(1) an international orange warning device (warning flag, warning tape, or warning ball) is properly secured to the hoist line at a distance of 8 to 10 feet above the hoist rigging;

(2) the signalperson (or an individual designated as the signalperson) acts as a spotter to alert the crane operator with a "STOP" signal when the warning device approaches the boom tip and the crane operator ceases hoisting functions when alerted of this; and

(3) while the non-duty cycle lift is underway, the signal person shall not stand under the load, shall have no duties other than signalperson, and shall comply with the signaling requirements of EM 385-1-1;

b. Anti-two block devices are always required when hoisting personnel by crane or derrick.

PART 2 PRODUCTS (This Part Not Used)

PART 3 EXECUTION (This Part Not Used)

-- End of Section --

SECTION 01312

QUALITY CONTROL SYSTEM (QCS)
08/01

1.1 GENERAL

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor shall use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

Administration
Finances
Quality Control
Submittal Monitoring
Scheduling
Import/Export of Data

1.1.1 Correspondence and Electronic Communications

For ease and speed of communications, both Government and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.1.2 Other Factors

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01320, PROJECT SCHEDULE, Section 01330, SUBMITTAL PROCEDURES, and Section 01451, CONTRACTOR QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

1.2 QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request by the Contractor, the Government can provide QCS on 3-1/2 inch high-density diskettes or CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government RMS Website as they become available.

1.3 SYSTEM REQUIREMENTS

The following listed hardware and software is the minimum system configuration that the Contractor shall have to run QCS:

Hardware

IBM-compatible PC with 200 MHz Pentium or higher processor

32+ MB RAM

4 GB hard drive disk space for sole use by the QCS system

3 1/2 inch high-density floppy drive

Compact disk (CD) Reader

Color monitor

Laser printer compatible with HP LaserJet III or better, with minimum 4 MB installed memory.

Connection to the Internet, minimum 28 BPS

Software

MS Windows 95 or newer version operating system (MS Windows NT 4.0 or newer is recommended)

Word Processing software compatible with MS Word 97 or newer

Internet browser

The Contractor's computer system shall be protected by virus protection software that is regularly upgraded with all issued manufacturer's updates throughout the life of the contract.

Electronic mail (E-mail) compatible with MS Outlook

1.4 RELATED INFORMATION

1.4.1 QCS User Guide

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government RMS Internet Website; the Contractor can obtain the current address from the Government. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

1.4.2 Contractor Quality Control(CQC) Training

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

1.5 CONTRACT DATABASE

Prior to the pre-construction conference, the Government shall provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by files attached to E-mail. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.6 DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database throughout the duration of the contract. The Contractor shall establish and maintain the QCS database at the Contractor's site office. Data updates to the Government shall be submitted by E-mail with file attachments, e.g., daily reports, schedule updates, payment requests. If permitted by the Contracting Officer, a data diskette or CD-ROM may be used instead of E-mail (see Paragraph DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM). The QCS database typically shall include current data on the following items:

1.6.1 Administration

1.6.1.1 Contractor Information

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver Contractor administrative data in electronic format via E-mail.

1.6.1.2 Subcontractor Information

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Each subcontractor/trade shall be assigned a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver subcontractor administrative data in electronic format via E-mail.

1.6.1.3 Correspondence

All Contractor correspondence to the Government shall be identified with a serial number. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Letters initiated by the Contractor's home (main) office shall be prefixed with "H". Letters shall be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

1.6.1.4 Equipment

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.6.1.5 Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC

comments, Submittal Register Status, Three-Phase Inspection checklists.

1.6.2 Finances

1.6.2.1 Pay Activity Data

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the construction schedule. The sum of all pay activities shall be equal to the total contract amount, including modifications. Pay activities shall be grouped by Contract Line Item Number (CLIN), and the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

1.6.2.2 Payment Requests

All progress payment requests shall be prepared using QCS. The Contractor shall complete the payment request worksheet and include it with the payment request. The work completed under the contract, measured as percent or as specific quantities, shall be updated at least monthly. After the update, the Contractor shall generate a payment request report using QCS. The Contractor shall submit the payment requests with supporting data by E-mail with file attachment(s). If permitted by the Contracting Officer, a data diskette may be used instead of E-mail. A signed paper copy of the approved payment request is also required, which shall govern in the event of discrepancy with the electronic version.

1.6.3 Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other contractor QC requirements. The Contractor shall maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. The Contractor shall provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01451, CONTRACTOR QUALITY CONTROL. Within seven calendar days of Government acceptance, the Contractor shall submit a data diskette or CD-ROM reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.6.3.1 Daily Contractor Quality Control (CQC) Reports.

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS shall be the Contractor's official report. Data from any supplemental reports by the Contractor shall be summarized and consolidated onto the QCS-generated Daily CQC Report. Daily CQC Reports shall be submitted as required by Section 01451, CONTRACTOR QUALITY CONTROL. Reports shall be submitted electronically to the Government using E-mail or diskette within 24 hours after the date covered by the report. Use of either mode of submittal shall be coordinated with the Government representative. The Contractor shall also provide the Government a signed, printed copy of the daily CQC report.

1.6.3.2 Deficiency Tracking.

The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch

list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.6.3.3 Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

1.6.3.4 Accident/Safety Tracking.

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of the safety comments. In addition, the Contractor shall utilize QCS to advise the Government of any accidents occurring on the jobsite. This brief supplemental entry is not to be considered as a substitute for completion of mandatory reports, e.g., ENG Form 3394 and OSHA Form 200.

1.6.3.5 Features of Work

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.6.3.6 QC Requirements

The Contractor shall develop and maintain a complete list of QC testing, transferred and installed property, and user training requirements in QCS. The Contractor shall update all data on these QC requirements as work progresses, and shall promptly provide this information to the Government via QCS.

1.6.4 Submittal Management

The Government will provide the initial submittal register, ENG Form 4288, SUBMITTAL REGISTER, in electronic format. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update, ENG Form 4288, shall be produced using QCS. RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

1.6.5 Schedule

The Contractor shall develop a construction schedule consisting of pay activities, in accordance with Contract Clause "Schedules for Construction Contracts", or Section 01320, PROJECT SCHEDULE, as applicable. This schedule shall be input and maintained in the QCS database either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01320 PROJECT SCHEDULE). The updated schedule data shall be included with each

pay request submitted by the Contractor.

1.6.6 Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data, and schedule data using SDEF.

1.7 IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. The Contractor shall ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

1.8 DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

The Government-preferred method for Contractor's submission of updates, payment requests, correspondence and other data is by E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of computer diskettes or CD-ROM for data transfer. Data on the disks or CDs shall be exported using the QCS built-in export function. If used, diskettes and CD-ROMs will be submitted in accordance with the following:

1.8.1 File Medium

The Contractor shall submit required data on 3-1/2 inch double-sided high-density diskettes formatted to hold 1.44 MB of data, capable of running under Microsoft Windows 95 or newer. Alternatively, CD-ROMs may be used. They shall conform to industry standards used in the United States. All data shall be provided in English.

1.8.2 Disk or CD-ROM Labels

The Contractor shall affix a permanent exterior label to each diskette and CD-ROM submitted. The label shall indicate in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

1.8.3 File Names

The Government will provide the file names to be used by the Contractor with the QCS software.

1.9 MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the Contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions. The Contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

-- End of Section --

SECTION 01320

PROJECT SCHEDULE
06/97

PART 1 GENERAL

1.1 REFERENCES

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

ENGINEERING REGULATIONS (ER)

ER 1-1-11	(1995) Progress, Schedules, and Network Analysis Systems

1.2 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS, a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of all progress payments.

3.2 BASIS FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel will result in an inability of the Contracting Officer to evaluate Contractor's progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the case where Project Schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the Project Schedule, the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have been made.

3.3 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manual methods used to produce any required information shall require approval by the Contracting Officer.

3.3.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in the Precedence Diagram Method (PDM).

3.3.2 Level of Detail Required

The Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule:

3.3.2.1 Activity Durations

Contractor submissions shall follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods (usually less than 2 percent of all non-procurement activities' Original Durations are greater than 20 days).

3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, and delivery.

3.3.2.3 Government Activities

Government and other agency activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.

3.3.2.4 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, contractor work force, or government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

3.3.2.5 Work Areas

All activities shall be identified in the project schedule by the work area

in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

3.3.2.6 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a mod or claim code that changed the activity. Activities shall not belong to more than one modification or claim item. The modification or claim number of each activity shall be identified by the Mod or Claim Number. Whenever possible, changes shall be added to the schedule by adding new activities. Existing activities shall not normally be changed to reflect modifications.

3.3.2.7 Bid Item

All activities shall be identified in the project schedule by the Bid Item to which the activity belongs. An activity shall not contain work in more than one bid item. The bid item for each appropriate activity shall be identified by the Bid Item Code.

3.3.2.8 Phase of Work

All activities shall be identified in the project schedule by the phases of work in which the activity occurs. Activities shall not contain work in more than one phase of work. The project phase of each activity shall be by the unique Phase of Work Code.

3.3.2.9 Category of Work

All Activities shall be identified in the project schedule according to the category of work which best describes the activity. Category of work refers, but is not limited, to the procurement chain of activities including such items as submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing. The category of work for each activity shall be identified by the Category of Work Code.

3.3.2.10 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to, a work breakdown structure for the project. The feature of work for each activity shall be identified by the Feature of Work Code.

3.3.3 Scheduled Project Completion

The schedule interval shall extend from NTP to the contract completion date.

3.3.3.1 Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project". The "Start Project" activity shall have an "ES" constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.3.2 Constraint of Last Activity

Completion of the last activity in the schedule shall be constrained by the

contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path. The Contractor shall include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the completion date for the project, and a zero day duration.

3.3.3.3 Early Project Completion

In the event the project schedule shows completion of the project prior to the contract completion date, the Contractor shall identify those activities that have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. Contractor shall specifically address each of the activities noted in the narrative report at every project schedule update period to assist the Contracting Officer in evaluating the Contractor's ability to actually complete prior to the contract period.

3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

3.3.4.1 Start Phase

The Contractor shall include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

3.3.4.2 End Phase

The Contractor shall include as the last activity in a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the completion date for the project, and a zero day duration.

3.3.4.3 Phase X

The Contractor shall include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" activity shall be logically tied to the earliest and latest activities in the phase.

3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the Actual Start and Finish dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent

functions. Program features which calculate one of these parameters from the other shall be disabled.

3.3.6 Out-of-Sequence Progress

Activities that have posted progress without all preceding logic being satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case approval of the Contracting Officer. The Contractor shall propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule.

3.3.7 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data disk, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the Contractor's planned operations for the first 60 calendar days shall be submitted for approval within 20 calendar days after the NTP is acknowledged. The approved preliminary schedule shall be used for payment purposes not to exceed 60 calendar days after NTP.

3.4.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 40 calendar days after NTP. The schedule shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail.

3.4.3 Periodic Schedule Updates

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor shall submit periodic schedule updates. These submissions shall enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgement of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

3.4.4 Standard Activity Coding Dictionary

The Contractor shall use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used.

3.5 SUBMISSION REQUIREMENTS

The following items shall be submitted by the Contractor for the preliminary submission, initial submission, and every periodic project

schedule update throughout the life of the project:

3.5.1 Data Disks

Two data disks containing the project schedule shall be provided. Data on the disks shall adhere to the SDEF format specified in ER 1-1-11, Appendix A.

3.5.1.1 File Medium

Required data shall be submitted on 3.5 disks, formatted to hold 1.44 MB of data, under the MS-DOS Version 5. or 6.x, unless otherwise approved by the Contracting Officer.

3.5.1.2 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The label shall indicate the type of schedule (Preliminary, Initial, Update, or Change), full contract number, project name, project location, data date, name and telephone number or person responsible for the schedule, and the MS-DOS version used to format the disk.

3.5.1.3 File Name

Each file submitted shall have a name related to either the schedule data date, project name, or contract number. The Contractor shall develop a naming convention that will ensure that the names of the files submitted are unique. The Contractor shall submit the file naming convention to the Contracting Officer for approval.

3.5.2 Narrative Report

A Narrative Report shall be provided with the preliminary, initial, and each update of the project schedule. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to relay to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through that analysis.

3.5.3 Approved Changes Verification

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in progress or completed.

3.5.4.1 Activity Report

A list of all activities sorted according to activity number.

3.5.4.2 Logic Report

A list of Preceding and Succeeding activities for every activity in ascending order by activity number. Preceeding and succeeding activities shall include all information listed above in paragraph Schedule Reports. A blank line shall be left between each activity grouping.

3.5.4.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates. Completed activities shall not be shown on this report.

3.5.4.4 Earnings Report

A compilation of the Contractor's Total Earnings on the project from the NTP until the most recent Monthly Progress Meeting. This report shall reflect the Earnings of specific activities based on the agreements made in the field and approved between the Contractor and Contracting Officer at the most recent Monthly Progress Meeting. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining Contractor Payment. Activities shall be grouped by bid item and sorted by activity numbers. This report shall: sum all activities in a bid item and provide a bid item percent; and complete and sum all bid items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), and Earnings to Date.

3.5.5 Network Diagram

The network diagram shall be required on the initial schedule submission and on monthly schedule update submissions. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity number, description, duration, and estimated earned value shall be shown on the diagram.

3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3 Critical Path

The critical path shall be clearly shown.

3.5.5.4 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly onsite meeting or other regular intervals mutually agreed to at the preconstruction conference. During this meeting the Contractor shall describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. The Contracting Officer will approve activity progress, proposed revisions, and adjustments as appropriate.

3.6.1 Meeting Attendance

The Contractor's Project Manager and Scheduler shall attend the regular progress meeting.

3.6.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than 4 working days after the monthly progress meeting.

3.6.3 Progress Meeting Contents

Update information, including Actual Start Dates, Actual Finish Dates, Remaining Durations, and Cost-to-Date shall be subject to the approval of the Contracting Officer. As a minimum, the Contractor shall address the following items on an activity by activity basis during each progress meeting.

3.6.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently in-progress or completed .

3.6.3.2 Time Completion

The estimated Remaining Duration for each activity in-progress. Time-based progress calculations shall be based on Remaining Duration for each activity.

3.6.3.3 Cost Completion

The earnings for each activity started. Payment will be based on earnings for each in-progress or completed activity. Payment for individual activities will not be made for work that contains quality defects. A portion of the overall project amount may be retained based on delays of activities.

3.6.3.4 Logic Changes

All logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, lag durations, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

3.6.3.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule which does not represent the actual or planned prosecution and progress of the work.

3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, or any interim milestone date, the Contractor shall furnish the following for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

3.7.1 Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, will not be a cause for a time extension to the contract completion date.

3.7.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date of under 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

a. A list of affected activities, with their associated project schedule activity number.

b. A brief explanation of the causes of the change.

c. An analysis of the overall impact of the changes proposed.

d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

3.7.3 Additional Submission Requirements

For any requested time extension of over 2 weeks, the Contracting Officer may request an interim update with revised activities for a specific change request. The Contractor shall provide this disk within 4 days of the Contracting Officer's request.

3.8 DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, the Contractor shall advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

-- End of Section --

SECTION 01330

SUBMITTAL PROCEDURES
09/97

PART 1 GENERAL

1.1 SUBMITTAL IDENTIFICATION

Submittals required are identified by SD numbers as follows:

SD-01 Preconstruction Submittals

SD-02 Shop Drawings

SD-03 Product Data

SD-04 Samples

SD-05 Design Data

SD-06 Test Reports

SD-07 Certificates

SD-08 Manufacturer's Instructions

SD-09 Manufacturer's Field Reports

SD-10 Operation and Maintenance Data

SD-11 Closeout Submittals

1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.2.1 Government Approved

Governmental approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.2.2 For Information Only

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.3 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any

error which may exist, as the Contractor under the CQC requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

1.5 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

1.5.1 As-Built Drawings

Payment will be made for as-built drawings required under this contract at the rate established in the bidding schedule. No progress payments will be made on this line item. The full amount of the line item for as-built drawings will be paid upon satisfactory completion and acceptance of the as-built drawings.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

As required by paragraph 3.7.1, all submittals designated for Government Approval shall be submitted within 63 calendar days of notice to proceed. The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) representative and each item shall be stamped, signed, and dated by the CQC representative indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

3.2 SUBMITTAL REGISTER (ENG FORM 4288)

At the end of this section is one set of ENG Form 4288 listing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required.

3.2.1 Submittal Register File

The Contractor will also be given the submittal register files, containing the computerized ENG Form 4288. These submittal register files will be furnished on a separate diskette.

3.2.2 Submittal Register (RMS)

Upon award, this data will be provided to the contractor on a RMS data disk. Items of information relative to each submittal not included in the draft, and additional submittals not included, shall be supplied by the Contractor using the RMS system. The dates required for the submittal shall be provided through the contractors performance schedule, and entered into RMS using the SDEF disks. Updated submittal register information shall be provided to the Contracting Officer after each schedule update. This information shall be provided via RMS update disks.

3.2.3 Submittal Register Updating

Contractor shall complete the remaining columns and submit the forms (hard copy plus associated electronic file) to the Contracting Officer for approval with the initial project schedule. The Contractor shall keep the submittal register up-to-date and shall submit it to the Government together with the monthly payment request. The approved submittal register will become the scheduling document and will be used to control submittals throughout the life of the contract. The submittal register and the progress schedules shall be coordinated.

3.3 SCHEDULING

The scheduled need dates must be recorded on the document for each item for control purposes and all submittals must be tied to the contractor's approved schedule.

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled.

No delay damages or time extensions will be allowed for time lost in late submittals.

For information only submittals shall be furnished to the Government not less than 2 weeks prior to procurement of the material or service and prior to scheduling the quality control preparatory inspection.

Submittals requiring government approval shall be furnished to the Government within 63 days of the contract notice to proceed, except for the submittals, which require on-site construction progress before completion such as SD-06 (Test Reports), SD-09 (Manufacturers Field Reports), SD-10 (Operations and Maintenance Data), and SD-11 (Closeout Submittals). The exceptions shall be identified in the quality control plan and progress

schedule for approval by the Government. Allow 28 calendar days for Government review and approval after receipt of the submittal.

3.4 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached to this section shall be used for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

3.5 SUBMITTAL PROCEDURE

Submittals shall be made as follows:

3.5.1 Procedures

Procedures shall be incorporated into the Quality Control Plan required in section 01451.

The Contractor will submit to the Contracting Officer for approval a minimum of six copies of all GA level submittals. One copy of an FIO submittal will be furnished to the Government. The number of copies of submittals specified in this portion of the contract shall be complied with in lieu of four copies as specified by FAR 52.236?21.

For those contracts requiring Network Analysis System (NAS), the Contractor will schedule on the NAS critical items of equipment submittals and procurement activities which will, or have the potential to, significantly impact project completion. The inclusion or exclusion of critical items shall be subject to the approval of the Contracting Officer. Furnishing the schedule shall not be interpreted as relieving the Contractor of his obligation to comply with all the specification requirements for the items on the schedule. Contractor's Quality Control representative shall review the listing at least every 30 days and take appropriate action to maintain an effective system. The Contractor shall furnish a list each 30 days of all submittals on which either Government or Contractor's action is past due. He shall also furnish revised due dates in those cases when the original submittal schedule is no longer realistic. This monthly list of delayed items shall also be annotated by the Contractor to show what corrective action he is taking with regard to slippages in submittal schedule which are attributable to actions by him, his subcontractors, or suppliers.

The Contractor shall provide a complete updated submittal register indicating the current status of all submittals when requested by the Contracting Officer in order to assure himself the schedule is being maintained.

The Contractor shall certify that each submittal is correct and in strict conformance with the contract drawings and specifications.

Submittals For Information Only (FIO). All submittals not subject to the approval of the Contracting Officer will be submitted for information purposes only. Where the review authority is designated to the Contractor,

the Contractor is required to sign the certification on ENG Form 4025 in the box beside the remarks block in Section I and sign the approval action block in Section II as the approving authority. These Contractor approved submittals will be used to verify that material received and used in the job is the same as that described and approved and will be used as record copies. All samples of materials submitted as required by these specifications shall be properly identified and labeled for ready identification, and upon being certified by the Contractor and reviewed by the Contracting officer, shall be stored at the site of the work for job site use until all work has been completed and accepted by the Contracting officer. Delegation of this approval authority to Contractor Quality Control does not relieve the Contractor from the obligation to conform to any contract requirement and will not prevent the Contracting Officer from requiring removal and replacement of construction not in contract conformance; nor does it relieve the Contractor from the requirement to furnish "samples" for testing by the Government Laboratory or check testing by the Government in those instances where the technical specifications so prescribe.

Contractor certified drawings would be subject to quality assurance review by the Government at any time during the duration of the contract. No adjustment for time or money will be allowed for corrections required as a result of noncompliance with plans and specifications.

Submittals Requiring Government Approval (GA). Where the review authority is designated to the Government, the Contractor is required to sign the certification on ENG Form 4025 in the box beside the remarks block in Section I. The Government will code the items in block h and sign the approval action block in Section II as the approving authority.

Operating and Maintenance Instructions. Six complete sets of instructions containing the manufacturers operating and maintenance instructions for each piece of equipment shall be furnished. Each set shall be permanently bound and shall have a hard cover. One complete set shall be furnished at the time test procedures are submitted. Remaining sets shall be furnished before the contract is completed. The following identification shall be inscribed on the covers: The words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the facility, name of the Contractor, and contract number. Flysheets shall be placed before instructions covering each subject. Instruction sheets shall be approximately 8?1/2 by 11 inches, with large sheets of drawings folded in. Instructions shall include but are not limited to:

(1) System layout showing piping, valves and controls;

(2) Approved wiring and control diagrams;

(3) A control sequence describing startup, operation and shutdown;

(4) Operating and maintenance instructions for each piece of equipment, including lubrication instructions and troubleshooting guide; and

(5) Manufacturer's bulletins, cuts and descriptive data; parts lists and recommended parts.

The Government will further discuss the submittal procedures at the Pre-Construction Conference.

3.5.2 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

3.6 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

3.7 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Four copies of the submittal will be retained by the Contracting Officer and two copies of the submittal will be returned to the Contractor.

3.7.1 Submission of Government Approved Submittals

As soon as practicable after notice to proceed, but not later than 63 calendar days after notice to proceed, the Contractor shall forward to the Contacting Officer all copies of submittals designated for Government approval(G). Submittals shall be as required in the technical sections of this specification, including shop drawings, product data, and samples. Submittal types SD-06 (test Reports), SD-09 (Manufacturers Field Reports), SD-10 (Operations and Maintenance Data), and SD-11 (Closeout Submittals) need not be submitted within this 63 day limit; These submittal types shall be submied by the dates/times established in the specifications.

3.8 FOR INFORMATION ONLY SUBMITTALS

Submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

3.9 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR

(Firm Name)

_____ Approved

_____ Approved with corrections as noted on submittal data and/or attached sheets(s).

SIGNATURE: _____

TITLE: _____

DATE: _____

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.
NA

TITLE AND LOCATION
Hazardous Waste Tanks/C Line

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01111	SD-01 Preconstruction Submittals															
			Safety and Health Plan	1.3.2	G													
		01355	SD-01 Preconstruction Submittals															
			Environmental Protection Plan	1.7	G													
		01780	SD-02 Shop Drawings															
			As-Built Drawings	1.2.1	G													
			SD-03 Product Data															
			As-Built Record of Equipment and	1.2.2	G													
			Materials															
			Warranty Management Plan	1.3.1	G													
			Warranty Tags	1.3.5														
			Final Cleaning	1.6														
		02220	SD-03 Product Data															
			Work Plan		G													
		02222	SD-09 Manufacturer's Field															
			Reports															
			Soils Tests	3.5.1														
			Displacement of Sewers Tests	3.5.2														
		03301	SD-03 Product Data															
			Mixture Proportions		G													
			SD-06 Test Reports															
			Strength	2.1.1														
			Slump	2.1.5														
			Air Content	2.1.6														
			Temperature Tests															
		05090	SD-03 Product Data															

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							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05090	Welding Procedure Qualifications	1.5	G													
			Welder, Welding Operator, and	1.6														
			Tacker Qualification															
			Inspector Qualification	1.7	G													
			Previous Qualifications		G													
			Prequalified Procedures	1.5.1														
			SD-06 Test Reports															
			Quality Control	3.2														
		05093	SD-02 Shop Drawings															
			Pressure and Acid Piping		G													
			SD-03 Product Data															
			Qualifications	1.6	G													
			Welding Operations	3.1														
					03													
			SD-07 Certificates															
			Qualifications	1.6	G													
		10430	SD-04 Samples															
			Exterior signs		G													
		11211	SD-02 Shop Drawings															
			Installation	3.1	G													
			SD-03 Product Data															
			Materials and Equipment	2.1	G													
			Instructions	3.5	G													
			Training Period	3.5	G													
			SD-06 Test Reports															
			Tests	3.2	G													

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		11211	SD-07 Certificates															
			Manufacturer's Representative	3.4	G													
			SD-10 Operation and Maintenance															
			Data															
			Centrifugal Pump System		G													
		13850	SD-02 Shop Drawings															
			Fire Alarm Reporting System	1.4.1														
			SD-03 Product Data															
			Storage Batteries	2.2														
			Voltage Drop															
			Spare Parts	2.7.3	G													
			Technical Data and Computer	1.5	G													
			Software															
			Training	3.5	G													
			Testing	3.4	G													
			SD-06 Test Reports															
			Testing	3.4	G													
			SD-07 Certificates															
			Equipment		G													
			Qualifications	1.3.7	G													
		13852	SD-03 Product Data															
			Battery	2.1.2.1	G													
			Qualifications		G													
			Fire Alarm Reporting System		G													
			Test Procedures		G													
			SD-06 Test Reports															

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		13852	Testing	3.3	G													
		15080	SD-03 Product Data															
			General Materials	2.1	G													
		15200	SD-02 Shop Drawings															
			Pipe and Equipment;	3.2.1														
			Stainless Steel Pipe		G													
			Expansion Joints	2.7.1.3	G													
			SD-03 Product Data															
			Qualifications;															
			Welders;															
			Waste Water Disposal;															
			Assistance and Training;															
			Delivery, Storage and Handling;															
			Material safety data sheets															
			Materials and Equipment;															
			Installation	3.1														
			Pipe Schedule:															
			Valve Schedule:															
			SD-06 Test Reports															
			Pipe Leakage Tests;															
			Hydrostatic Tests;															
			Pneumatic Tests;															
			SD-07 Certificates															
			Contractor's Installation;															
			SD-10 Operation and Maintenance															
			Data															

SUBMITTAL REGISTER

CONTRACT NO.
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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
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		15200	Piping and Appurtenances;	3.3														
		16263	SD-02 Shop Drawings															
			Layout	3.6	G													
			General Installation	3.1	G													
			Acceptance	3.8	G													
			SD-03 Product Data															
			Performance Criteria		G													
			Sound Limitations	2.6	G													
			Harmonic Requiremants															
			Engine-Generator Parameter	1.3.1														
			Schedule															
			Integral Main Fuel Storage Tank															
			Day Tank															
			Power Factor	3.5.1.2	G													
			Heat Rejected To															
			Engine-Generator Space															
			Cooling System	2.5														
			Time-Delay on Alarms	2.17.5														
			Generator	2.13														
			Manufacturer's Catalog	2.2	G													
			Site Welding	1.4.6														
			Spare Parts															
			Onsite Training	3.7	G													
			Battery Charger	2.11.3.2														
			Vibration-Isolation															
			Posted Data and Instructions	3.6	G													

SUBMITTAL REGISTER

CONTRACT NO.
NA

TITLE AND LOCATION
Hazardous Waste Tanks/C Line

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		16263	Instructions															
			Experience	1.4.10	G													
			Field Engineer	1.4.11	G													
			General Installation	3.1	G													
			SD-06 Test Reports															
			Factory Inspection and Tests	2.25														
			Factory Tests	2.25.2														
			Onsite Inspection and Tests	3.5	G													
			SD-07 Certificates															
			Prototype Test															
			Reliability and Durability	1.3.4														
			Emissions	2.10														
			Sound Limitations	2.6														
			Site Visit															
			Flywheel Balance		G													
			Materials and Equipment	2.1														
			Inspections	3.5.3														
			Cooling System	2.5														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.7	G													
			Manuals															
			Maintenance Procedures	3.7	G													
			Special Tools	2.12														
			Filters	2.4.2														
		16375	SD-02 Shop Drawings															

SUBMITTAL REGISTER

CONTRACT NO.
NA

TITLE AND LOCATION
Hazardous Waste Tanks/C Line

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		16375	Electrical Distribution System	3.11.3	G													
			As-Built Drawings		G													
			SD-03 Product Data															
			Nameplates	2.2	G													
			Material and Equipment	2.1	G													
			General Installation Requirements	3.1	G													
			SD-06 Test Reports															
			Factory Tests	2.15	G													
			Field Testing	3.11	G													
			Operating Tests	3.11.8	G													
			Cable Installation	3.2.1.4	G													
			SD-07 Certificates															
			Material and Equipment	2.1	G													
			Cable Joints	3.3	G													
			Cable Installer Qualifications		G													
			SD-10 Operation and Maintenance															
			Data															
			Electrical Distribution System	3.11.3	G													
		16403	SD-02 Shop Drawings															
			Drawings	2.4.2	G													
			Shop Drawings	2.2.1	G													
			Motor Control Centers	2.5	G													
			Switchboards	2.6	G													
			Panelboards	2.7	G													
			SD-03 Product Data															
			Equipment		G													

SUBMITTAL REGISTER

CONTRACT NO.
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TITLE AND LOCATION
Hazardous Waste Tanks/C Line

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		16403	Factory Tests	2.9														
			SD-06 Test Reports															
			Factory Tests	2.9														
			SD-07 Certificates															
			Motor Control Centers	2.5														
		16410	SD-02 Shop Drawings															
			Automatic Transfer Switch	2.1	G													
			Equipment	1.3.1														
			Installation	3.1														
			SD-03 Product Data															
			Material	1.3.1	G													
			Equipment	1.3.1	G													
			SD-06 Test Reports															
			Testing	2.3	G													
			SD-07 Certificates															
			Equipment	1.3.1	G													
			Material	1.3.1	G													
			Switching Equipment															
			SD-10 Operation and Maintenance															
			Data															
			Switching Equipment															
			Instructions	3.2														
		16415	SD-02 Shop Drawings															
			Interior Electrical Equipment		G													
			Manufacturer's Catalog		G													

SUBMITTAL REGISTER

CONTRACT NO.
NA

TITLE AND LOCATION
Hazardous Waste Tanks/C Line

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		16415	Material, Equipment, and Fixture		G													
			Lists															
			Installation Procedures		G													
			As-Built Drawings	1.2.6	G													
			Onsite Tests		G													
			SD-06 Test Reports															
			Factory Test Reports		G													
			Field Test Plan		G													
			Field Test Reports	3.17	G													
			SD-07 Certificates															
			Materials and Equipment	1.4	G													
		16900	SD-08 Manufacturer’s Instructions															
			Manufacturers' Recommendations		G													
			Operation and Maintenance		G													
			Instructions															
			Components with Technical Data		G													
			Sheets (Appendix A);															
		16902	SD-01 Preconstruction Submittals															
			Documents to be Furnished with		G													
			Proposal															
			Documents to be Furnished after															
			Purchase															

SECTION 01355

ENVIRONMENTAL PROTECTION
10/00

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 basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

33 CFR 328	Definitions
40 CFR 260	Hazardous Waste Management System: General
40 CFR 279	Standards for the Management of Used Oil
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
40 CFR 68	Chemical Accident Prevention Provisions

CORPS OF ENGINEERS (COE)

EM 385-1-1	Safety and Health Requirements Manual (September 1996)

US ARMY CORPS OF ENGINEERS TECHNICAL REPORT

WETLAND MANUAL	Corps of Engineers Wetlands Delineation Manual Technical Report Y-87-1

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other

pollutants.

1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners,excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.2.4 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor shall discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" shall occur. Land Application shall be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.5 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

1.2.6 Pests

The term "pests" means arthropods, birds, rodents, nematodes, fungi, bacteria, viruses, algae, snails, marine borers, snakes, weeds and other organisms (except for human or animal disease-causing organisms) that adversely affect readiness, military operations, or the well-being of personnel and animals; attack or damage real property, supplies, equipment, or vegetation; or are otherwise undesirable.

1.2.7 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers,creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.2.8 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.9 Wetlands

Wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with WETLAND MANUAL.

1.3 GENERAL REQUIREMENTS

The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations.

1.4 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors.

1.5 PAYMENT

No separate payment will be made for work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. All costs associated with this section shall be included in the contract price. The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G,

The environmental protection plan.

1.7 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, the Contractor shall meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental

Protection Plan shall be current and maintained onsite by the Contractor.

1.7.1 Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.7.2 Contents

The environmental protection plan shall include, but shall not be limited to, the following:

a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan shall include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

i. Drawing showing the location of borrow areas.

j. The Spill Control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Control

Plan supplements the requirements of EM 385-1-1 . This plan shall include as a minimum:

1. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Contracting Officer and Facility Environmental Office in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.

2. The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.

3. Training requirements for Contractor's personnel and methods of accomplishing the training.

4. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

5. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

6. The methods and procedures to be used for expeditious contaminant cleanup.

k. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction. The Contractor shall attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. The report shall be submitted on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and shall be for the previous quarter (e.g. the first working day of January, April, July, and October). The report shall indicate the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.

l. A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. The plan shall detail the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

m. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

n. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time shall be included in the contaminant prevention plan. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.

o. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan shall include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan shall include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, a copy of the permit and associated documents shall be included as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan shall include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

p. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. The plan shall include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Contracting Officer.

q. A pesticide treatment plan shall be included and updated, as information becomes available. The plan shall include: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. The Contractor is responsible for Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional specific requirements.

1.7.3 Appendix

Copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents shall be attached,as an appendix, to the Environmental Protection Plan.

1.8 PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.9 SPECIAL ENVIRONMENTAL REQUIREMENTS

The Contractor shall comply with the special environmental requirements listed here and included at the end of this section.

1.10 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings,plans and specifications which may have an environmental impact will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.11 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

The Contractor shall be responsible for obtaining and complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations.

3.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

3.2.1 Work Area Limits

Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.2.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs) . BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. Any temporary measures shall be removed after the area has been stabilized.

3.2.4 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect

adjacent areas.

3.3 WATER RESOURCES

The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.3.1 Cofferdams, Diversions, and Dewatering Operations

Construction operations for dewatering, removal of cofferdams, tailrace excavation, and tunnel closure shall be controlled at all times to maintain compliance with existing State water quality standards and designated uses of the surface water body. The Contractor shall comply with the State of Virginia water quality standards and anti-degradation provisions.

3.4 AIR RESOURCES

Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all Federal and State air emission and performance laws and standards.

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants; shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. The Contractor shall comply with all State and local visibility regulations.

3.4.2 Odors

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

3.4.3 Burning

Burning shall be prohibited on the Government premises.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.5.1 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. There shall be no storage of fuel on the project site. Fuel must be brought to the project site each day that work is performed.

3.5.2 Waste Water

Disposal of waste water shall be as specified below.

a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water off-Government property in accordance with all Federal, State, Regional and Local laws and regulations.

b. For discharge of ground water, the Contractor shall obtain a State or Federal permit specific for pumping and discharging ground water prior to surface discharging.

c. Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing shall be discharged into the sanitary sewer with prior approval and/or notification to the Waste Water Treatment Plant's Operator.

3.6 RECYCLING AND WASTE MINIMIZATION

The Contractor shall participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project. .

3.7 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

The Contractor shall maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. The Contractor shall submit a report to through the Contracting Officer on the first working day after each fiscal year quarter, starting the first quarter that non-hazardous solid waste has been generated. The following shall be included in the report:

a. Construction and Demolition (C&D) Debris Disposed = in cubic yards or tons, as appropriate.

b. Construction and Demolition (C&D) Debris Recycled = in cubic yards or tons, as appropriate.

c. Total C&D Debris Generated = in cubic yards or tons, as appropriate.

d. Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount) = in cubic yards or tons, as appropriate.

3.8 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.9 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations.

3.10 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. The Contractor shall consult with the USDA jurisdictional office for additional cleaning requirements.

3.11 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.12 MILITARY MUNITIONS

In the event the Contractor discovers or uncovers military munitions as defined in 40 CFR 260, the Contractor shall immediately stop work in that area and immediately inform the Contracting Officer.

3.13 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and

avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.14 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --

SECTION 01420

SOURCES FOR REFERENCE PUBLICATIONS
03/03

PART 1 GENERAL

0.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

ACI INTERNATIONAL (ACI)
P.O. Box 9094
Farmington Hills, MI 48333-9094
Ph: 248-848-3700
Fax: 248-848-3701
Internet: http://www.aci-int.org

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)
4100 North Fairfax Dr., Suite 200
ATTN: Pubs Dept.
Arlington, VA 22203
Ph: 703-524-8800
Fax: 703-528-3816
E-mail: ari@ari.org
Internet: http://www.ari.org

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)
2800 Shirlington Road, Suite 300
Arlington, VA 22206
Ph: 703-575-4477
FAX: 703-575-4449
Internet: http://www.acca.org

AIR DIFFUSION COUNCIL (ADC)
1000 East Woodfield Road, Suite 102
Shaumburg, IL 60173-5921
Ph: 847-706-6750

Fax: 847-706-6751
Internet: http://www.flexibleduct.org

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL(AMCA)
30 W. University Dr.
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
Internet: http://www.amca.org

ALUMINUM ASSOCIATION (AA)
900 19th Street N.W., Ste 300
Washington, DC 20006
Ph: 202-862-5100
Fax: 202-862-5164
Internet: http://www.aluminum.org

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1827 Walden Ofc. Sq.
Suite 104
Schaumburg, IL 60173-4268
Ph: 847-303-5664
Fax: 847-303-5774
Internet: http://www.aamanet.org

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 N. Capital St., NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806
Internet: http://www.aashto.org

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)
P.O. Box 12215
Research Triangle Park, NC 27709-2215
Ph: 919-549-8141
Fax: 919-549-8933
Internet: http://www.aatcc.org

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
2025 M Street, NW, Suite 800
Washington, DC 20036
Ph: 202-367-1155
Fax: 202-367-2155
Internet: http://www.abma-dc.org

AMERICAN BOILER MANUFACTURERS ASSOCIATION (ABMA)
4001 North 9th Street, Suite 226
Arlington, VA 22203-1900
Ph: 703-522-7350
Fax: 703-522-2665

Internet: http://www.abma.com

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)
222 West Las Colinas Blvd., Suite 641
Irving, TX 75039-5423
Ph: 972-506-7216 or 800-290-2272
Fax: 972-506-7682
Internet: http://www.concrete-pipe.org
e-mail: info@concrete-pipe.org

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Dr.

Cincinnati, OH 45240
Ph: 513-742-2020
Fax: 513-742-3355
Internet: http://www.acgih.org
E-mail: mail@acgih.org

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)
American Wood Council
ATTN: Publications Dept.
1111 Nineteenth St. NW, Suite 800
Washington, DC 20036
Ph: 800-878-8878 or 202-463-2700
Fax: 202-463-2785
Internet: http://www.afandpa.org/

AMERICAN GAS ASSOCIATION (AGA)
400 N. Capitol St. N.W.Suite 450
Washington, D.C. 20001
Ph: 202-824-7000
Fax: 202-824-7115
Internet: http://www.aga.org

AMERICAN GAS ASSOCIATION LABORATORIES (AGAL)
400 N. Capitol St. N.W.Suite 450
Washington, D.C. 20001
Ph: 202-824-7000
Fax: 202-824-7115
Internet: http://www.aga.org

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)
1500 King St., Suite 201
Alexandria, VA 22314-2730
Ph: 703-684-0211
Fax: 703-684-0242
Internet: http://www.agma.org

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Dr., Suite 3100
Chicago, IL 60601-2001

Ph: 312-670-2400
Publications: 800-644-2400
Fax: 312-670-5403
Internet: http://www.aisc.org

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)
7012 So. Revere Parkway, Suite 140
Englewood, CO 80112
Ph: 303-792-9559
Fax: 303-792-0669
Internet: http://www.aitc-glulam.org

AMERICAN IRON AND STEEL INSTITUTE (AISI)
1140 Connecticut Avenue, NW, Suite 705
Washington, DC 20036
Ph: 202-452-7100
FX: 202-463-6573
Internet: http://www.steel.org

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1819 L Street, NW, 6th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
Internet: http://www.ansi.org/

Note --- Documents beginning with the letter "S" can be ordered from:

Acoustical Society of America
2 Huntington Quadrangle, Suite 1NO1
Melville, NY 11747-4502
Ph: 516-576-2360
Fax: 516-576-2377
Internet: http://asa.aip.org
General e-mail: asa@aip.org

AMERICAN NURSERY AND LANDSCAPE ASSOCIATION (ANLA)
1000 Vermont Avenue, NW, Suite 300
Washington, DC 20005-4914
Ph: 202-789-2900
FAX: 202-789-1893
Internet: http://www.anla.org

AMERICAN PETROLEUM INSTITUTE (API)
1220 L St., NW
Washington, DC 20005-4070
Ph: 202-682-8000
Fax: 202-682-8223
Internet: http://www.api.org

AMERICAN PUBLIC HEALTH ASSOCIATION (APHA)
800 I Street, NW
Washington, DC 20001

PH: 202-777-2742
FAX: 202-777-2534
Internet: http://www.apha.org

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)
8201 Corporate Dr., Suite 1125
Landover, MD 20785-2230
Ph: 301-459-3200
Fax: 301-459-8077
Internet: http://www.arema.org

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)
1711 Arlingate Lane
P.O. Box 28518
Columbus, OH 43228-0518
Ph: 800-222-2768; 614-274-6003
Fax: 614-274-6899
Internet: http://www.asnt.org

AMERICAN SOCIETY FOR QUALITY (ASQ)
600 North Plankinton Avenue
Milwaukee, WI 53203
Ph: 800-248-1946; 414-272-8575
Fax: 414-272-1734
Internet: http://www.asq.org

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191-4400
Ph: 703-295-6300 - 800-548-2723
Fax: 703-295-6222
Internet: http://www.asce.org
e-mail: marketing@asce.org

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329
Ph: 800-527-4723 or 404-636-8400
Fax: 404-321-5478
Internet: http://www.ashrae.org

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)
901 Canterbury, Suite A
Westlake, OH 44145
Ph: 440-835-3040
Fax: 440-835-3488
E-mail: info@asse-plumbing.org
Internet: http://www.asse-plumbing.org

AMERICAN WATER WORKS ASSOCIATION(AWWA)

6666 West Quincy Avenue
Denver, CO 80235
Ph: 303-794-7711
Fax: 303-794-3951
Internet: http://www.awwa.org

AMERICAN WELDING SOCIETY (AWS)
550 N.W. LeJeune Road
Miami, FL 33126
Ph: 800-443-9353 - 305-443-9353
Fax: 305-443-7559
Internet: http://www.aws.org

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)
P.O. Box 5690
Grandbury, TX 76049-0690
Ph: 817-326-6300
Fax: 817-326-6306
Internet: http://www.awpa.com

APA - THE ENGINEERED WOOD ASSOCIATION (APA)
P.O.Box 11700
Tacoma, WA 98411-0700
Ph: 253-565-6600
Fax: 253-565-7265
Internet: http://www.apawood.org

ARCHITECTURAL WOODWORK INSTITUTE (AWI)
1952 Isaac Newton Square West
Reston, VA 20190
Ph: 703-733-0600
Fax: 703-733-0584
Internet: http://www.awinet.org

ASBESTOS CEMENT PRODUCT PRODUCERS ASSOCIATION (ACPPA)
PMB114-1745 Jefferson Davis Highway
Arlington, VA 22202
Ph: 514-861-1153
Fax: 514-861-1152
Internet: www.asbestos-institute.ca

ASM INTERNATIONAL (ASM)
9639 Kinsman Road
Materials Park, OH 44073-0002
Ph: 440-338-5151
Fax: 440-338-4634
Internet: http://www.asm-intl.org

ASME INTERNATIONAL (ASME)
Three Park Avenue
New York, NY 10016-5990

Ph: 212-591-7722
Fax: 212-591-7674
Internet: http://www.asme.org

ASPHALT INSTITUTE (AI)
Research Park Dr.
P.O. Box 14052
Lexington, KY 40512-4052
Ph: 859-288-4960
Fax: 859-288-4999
Internet: http://www.asphaltinstitute.org

ASSOCIATED AIR BALANCE COUNCIL (AABC)
1518 K St., NW
Washington, DC 20005
Ph: 202-737-0202
Fax: 202-638-4833
Internet: http://www.aabchq.com
E-mail: aabchq@aol.com

ASSOCIATION FOR THE ADVANCEMENT OF MEDICAL INSTRUMENTATION (AAMI)
1110 N. Glebe Rd., Suite 220
Arlington, VA 22201-4795
Ph: 1-800-332-2264 or 703-525-4890
Fax: 703-276-0793
Internet: http://www.aami.org

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
600 No. 18th St.
P.O. Box 2641
Birmingham, AL 35291
Ph: 205-257-2530
Fax: 205-257-2540
Internet: http://www.aeic.org

ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)
1111 19th St. NW., Suite 402
Washington, DC 20036
Ph: 202-872-5955
Fax: 202-872-9354
Internet: http://www.aham.org

ASSOCIATION OF THE WALL AND CEILING INDUSTRIES - INTERNATIONAL (AWCI)
803 West Broad Street
Falls Church, VA 22046
PH: 703-534-8300
FAX: 703-534-8307
Internet: http://www.awci.org

ASTM INTERNATIONAL (ASTM)

100 Barr Harbor Drive, PO Box C700
West Conshohocken, PA 19428-2959
Ph: 610-832-9500
Fax: 610-832-9555
Internet: http://www.astm.org

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)
1200 G Street NW, Suite 500
Washington, D.C. 20005
Ph: 202-628-6380
Fax: 202-393-5453
Internet: Unknown
E-mail: Unknown

BIFMA INTERNATIONAL (BIFMA)
2680 Horizon Drive SE, Suite A-1
Grand Rapids, MI 49546-7500
Ph: 616-285-3963
Fax: 616-285-3765
Internet: http://www.bifma.org
E-mail: email@bifma.org

BIOCYCLE, JOURNAL OF COMPOSTING AND RECYCLING (BIOCYCLE)
The JG Press Inc.
419 State Avenue
Emmaus PA. 18049
Ph: 610-967-4135
Internet: http://www.biocycle.net
E-mail: jgpress@jgpress.com

BRICK INDUSTRY ASSOCIATION (BIA)
11490 Commerce Park Dr.
Reston, VA 22091-1525
Ph: 703-620-0010
Fax: 703-620-3928
Internet: http://www.bia.org

BRITISH STANDARDS INSTITUTE (BSI)
389 Chiswick High Road
London W4 4AL
United Kingdom
Phone: +44 (0)20 8996 9000
Fax: +44 (0)20 8996 7001
Email: cservices@bsi-global.com
Website: http://www.bsi-global.com

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)
355 Lexington Ave.
17th floor
New York, NY 10017
Ph: 212-297-2122
Fax: 212-370-9047
Internet: http://www.buildershardware.com

CARPET AND RUG INSTITUTE (CRI)

P.O. Box 2048
Dalton, GA 30722-2048
Ph: 1-800-882-8846 or 706-278-3176
Fax: 706-278-8835
Internet: http://www.carpet-rug.com

CAST IRON SOIL PIPE INSTITUTE (CISPI)
5959 Shallowford Rd., Suite 419
Chattanooga, TN 37421
Ph: 423-892-0137
Fax: 423-892-0817
Internet: http://www.cispi.org

CEILINGS & INTERIOR SYSTEMS CONSTRUCTION ASSOCIATION (CISCA)
1500 Lincoln Highway, Suite 202
St. Charles, IL 60174
Ph: 630-584-1919
Fax: 630-584-2003
Internet: http://www.cisca.org

CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)
1600 Clifton Road
Atlanta, GA 30333
PH: 404-639-3311

Internet: http://www.cdc.gov

CHEMICAL FABRICS & FILM ASSOCIATION (CFFA)
1300 Sumner Ave.
Cleveland OH 44115-2851
PH: 216-241-7333
FAX: 216-241-0105
Internet: http://www.chemicalfabricsandfilm.com/
OK 2/03

CHLORINE INSTITUTE (CI)
1300 Wilson Boulevard
Rosslyn, VA 22209
Ph: 703-741-5760
Fax: 703-741-6068
Internet: http://www.cl2.com

COMPRESSED AIR AND GAS INSTITUTE (CAGI)
1300 Sumner Ave.
Cleveland OH 44115-2851
PH: 216-241-7333
FAX: 216-241-0105
Internet: http://www.cagi.org/

COMPRESSED GAS ASSOCIATION (CGA)
4221 Walney Road, 5th Floor
Chantilly, VA 20151-2923
Ph: 703-788-2700
Fax: 703-961-1831
Internet: http://www.cganet.com
e-mail: cga@cganet.com

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)
933 N. Plum Grove Rd.
Schaumburg, IL 60173-4758
Ph: 847-517-1200
Fax: 847-517-1206
Internet: http://www.crsi.org/

CONSUMER PRODUCT SAFETY COMMISSION (CPSC)
4330 East-West Highway
Bethesda, MD 20814-4408
Ph: 301-504-6816
Fx: 301-504-0124 and 301-504-0025
Internet: http://www.cpsc.gov

CONVEYOR EQUIPMENT MANUFACTURERS ASSOCIATION (CEMA)
6724 Lone Oak Blvd.
Naples, FL 34109
Ph: 239-514-3441
Fax: 239-514-3470
Internet: http://www.cemanet.org

COOLING TECHNOLOGY INSTITUTE (CTI)
2611 FM 1960 West
Suite H-200
Houston, TX 77068-3730
Ph: 281-583-4087
Fax: 281-537-1721
Internet: http://www.cti.org

COPPER DEVELOPMENT ASSOCIATION (CDA)
260 Madison Ave.
New York, NY 10016
Ph: 212-251-7200
Fax: 212-251-7234
Internet: http://www.copper.org
E-mail: staff@cda.copper.org

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)
8720 Red Oak Blvd., Ste, 201
Charlotte, NC 28217
Ph: 704-676-1190 or 800-722-6832
Fx: 704-676-1199
Internet: http://www.mhia.org/psc/psc_products_cranes.cfm

DISTRICT OF COLUMBIA MUNICIPAL REGULATIONS (DCMR)
441 4th Street NW, Suite 520
Washington DC 20001
PH: 202-727-5090
Internet: http://www.abfa.com/dcdocs/dcmrlist.htm

DOOR AND ACCESS SYSTEM MANUFACTURERS ASSOCIATION (DASMA)
1300 Sumner Avenue
Cleveland, OH 44115-2851
Ph: 216-241-7333
Fax: 216-241-0105
Internet: http://www.dasma.com
e-mail: dasma@dasma.com

DOOR AND HARDWARE INSTITUTE (DHI)
14150 Newbrook Dr.Suite 200
Chantilly, VA 20151-2223
Ph: 703-222-2010
Fax: 703-222-2410
Internet: http://www.dhi.org
e-mail: info@dhi.org

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)
245 Riverchase Parkway East, Suite O
Birmingham, AL 35244
Ph: 205-402-8700
Fax: 205-402-8730
Internet: http://www.dipra.org
E-mail: info@dipra.org

EIFS INDUSTRY MEMBERS ASSOCIATION (EIMA)
3000 Corporate Center Drive, Suite 270
Morrow, GA 30260
Ph: 800-294-3462
Fax: 770-968-5818
Internet: http://www.eima.com

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)
1650 South Dixie Highway, Ste. 500
Boca Raton, FL 33432-7462
Ph: 561-750-5575
Fax: 561-395-8557
Internet: http://www.egsa.org

ELECTRONIC INDUSTRIES ALLIANCE (EIA)
2500 Wilson Blvd.
Arlington, VA 22201-3834
Ph: 703-907-7500
Fax: 703-907-7501
Internet: http://www.eia.org

ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION (ERDA)
Organization abolished by Dept of Energy Act
(91 Stat 577)4 Aug 1977
Successor Organization is Department of Energy
Forrestal 4B-222
Washington, DC, 202-586-4716
PH: 202-586-4716
FAX: 202-586-1972
Internet: http://www.directives.doe.gov/

ENGINE MANUFACTURERS ASSOCIATION (EMA)
Two North LaSalle Street, Suite 2200
Chicago, Il 60602
PH: 312-827-8700
FAX: 312-827-8737
Internet: http://www.engine-manufacturers.org/

ETL TESTING LABORATORIES (ETL)
Intertek Testing Services, ETL SEMKO
70 Codman Hill Road
Boxborough, MA 01719
PH: 978-263-2662
FAX: 978-263-7086
Internet: http://www.etlsemko.com
E-mail: info@etlsemko.com

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)
25 N Broadway
Tarrytown, NY 10591
Ph: 914-332-0040
Fax: 914-332-1541
Internet: http://www.ejma.org

FM GLOBAL (FM)
1301 Atwood Avenue
P.O. Box 7500
Johnston, RI 02919
Ph: 401-275-3000
Fax: 401-275-3029
Internet: http://www.fmglobal.com

FLUID SEALING ASSOCIATION (FSA)
994 Old Eagle School Road #1019
Wayne, PA 19087
PH: 610-971-4850
FAX: 610-9971-4859
Internet: http://www.fluidsealing.com
E-mail: info@fluidsealing.com

FORESTRY SUPPLIERS (FSUP)
205 West Rankin St.
P.O. Box 8397
Jackson, MS 39284-8397

Ph: 601-354-3565
Fax: 601-292-0165
Internet: http://www.forestry-suppliers.com

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)
University of South California
Kaprielian Hall 200
Los Angeles, CA 90089-2531
Ph: 213-740-2032
Fax: 213-740-8399
Internet: http://www.usc.edu/dept/fccchr

GEOLOGICAL SOCIETY OF AMERICA (GSA)
P.O. Box 9140
Boulder, CO 80301-9140
Ph: 303-447-2020
Fax: 303-357-1070
Internet: http://www.geosociety.org

GEOSYNTHETIC INSTITUTE (GSI)
475 Kedron Ave.
Folsom, PA 19033
Ph: 610-522-8440
Fax: 610-522-8441
Internet: http://www.geosynthetic-institute.org

GLASS ASSOCIATION OF NORTH AMERICA (GANA)
2945 SW Wanamaker Drive, Suite A
Topeka, KS 66614
Ph: 785-271-0208
Fax: 785-271-0166
Internet: http://www.glasswebsite.com/GANA

GYPSUM ASSOCIATION (GA)
810 First St. NE, Suite 510
Washington, DC 20002
Ph: 202-289-5440
Fax: 202-289-3707
Internet: http://www.gypsum.org

HARDWOOD PLYWOOD & VENEER ASSOCIATION (HPVA)

P.O. Box 2789
Reston, VA 20195-0789
Ph: 703-435-2900
Fax: 703-435-2537
Internet: http://www.hpva.org

HEAT EXCHANGE INSTITUTE (HEI)
1300 Sumner Ave
Cleveland, OH 44115-2851

Ph: 216-241-7333
Fax: 216-241-0105
Internet: http://www.heatexchange.org
email: hei@heatexchange.org

HOIST MANUFACTURERS INSTITUTE (HMI)
8720 Red Oak Blvd., Suite 201
Charlotte, NC 28217
PH: 704-676-1190
FAX: 704-676-1199
Internet: http://www.mhia.org/psc/PSC_Products_Hoists.cfm

H.P. WHITE LABORATORY (HPW)
3114 Scarboro Rd.
Street, MD 21154
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-- End of Section --

SECTION 01451

CONTRACTOR QUALITY CONTROL
04/97

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 basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740	(1999b) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(1998a) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site.

3.2 QUALITY CONTROL PLAN

The Contractor shall furnish for review by the Government, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 60 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.1 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Contracting Officer.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 30 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC System Manager and shall serve as a member of the CQC staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization.The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility

to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, show drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of 5 years construction experience on construction similar to this contract. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: civil,. These individuals shall be directly employed by the prime Contractor and may not be employed by a supplier or sub-contractor on this project; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals shall have no other duties other than quality control.

Experience Matrix

	Area	Qualifications
a.	Civil	Graduate Civil Engineer with 2 years experience in the type of work being performed on this project or technician with 5 yrs related experience
b.	Mechanical	Graduate Mechanical Engineer with 2 yrs experience or person with 5 yrs related experience
c.	Electrical	Graduate Electrical Engineer with 2 yrs related experience or person with 5 yrs related experience

Experience Matrix

	Area	Qualifications
d.	Structural	Graduate Structural Engineer with 2 yrs experience or person with 5 yrs related experience
e.	Architectural	Graduate Architect with 2 yrs experience or person with 5 yrs related experience
f.	Environmental	Graduate Environmental Engineer with 3 yrs experience
g.	Submittals	Submittal Clerk with 1 yr experience
h.	Occupied family housing	Person, customer relations type, coordinator experience
i.	Concrete, Pavements and Soils	Materials Technician with 2 yrs experience for the appropriate area

3.4.4 Additional Requirement

In addition to the above experience and/or education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management For Contractors".

3.4.5 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable

feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.

b. A review of the contract drawings.

c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analysis to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken.

f. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of $450.00 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the Special Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. A punch list of items which do not conform to the approved drawings and specifications shall be prepared and included in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the

deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List

of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.10 SAMPLE FORMS

Sample forms enclosed at the end of this section.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

-- End of Section --

SECTION 01500

TEMPORARY CONSTRUCTION FACILITIES
02/97

1.1 GENERAL REQUIREMENTS

1.1.1 Site Plan

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is desired.

1.1.2 Identification of Employees

The Contractor shall be responsible for furnishing to each employee, and for requiring each employee engaged on the work to display, identification as approved and directed by the Contracting Officer. Prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon release of any employee. When required, the Contractor shall obtain and provide fingerprints of persons employed on the project. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company for whom the employee works.

1.1.3 Employee Parking

Contractor employees shall park privately owned vehicles in an area designated by the Contracting Officer. This area will not be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of the military installation.

1.2 AVAILABILITY AND USE OF UTILITY SERVICES

1.2.1 Payment for Utility Services

The Government will make all reasonably required utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

1.2.2 Meters and Temporary Connections

The Contractor, at its expense and in a manner satisfactory to the Contracting Officer, shall provide and maintain necessary temporary connections, distribution lines, and meter bases (Government will provide meters) required to measure the amount of each utility used for the purpose

of determining charges. The Contractor shall notify the Contracting Officer, in writing, 5 working days before final electrical connection is desired so that a utilities contract can be established. The Government will provide a meter and make the final hot connection after inspection and approval of the Contractor's temporary wiring installation. The Contractor shall not make the final electrical connection.

1.2.3 Advance Deposit

An advance deposit for utilities consisting of an estimated month's usage or a minimum of $50.00 will be required. The last monthly bills for the fiscal year will normally be offset by the deposit and adjustments will be billed or returned as appropriate. Services to be rendered for the next fiscal year, beginning 1 October, will require a new deposit. Notification of the due date for this deposit will be mailed to the Contractor prior to the end of the current fiscal year.

1.2.4 Final Meter Reading

Before completion of the work and final acceptance of the work by the Government, the Contractor shall notify the Contracting Officer, in writing, 5 working days before termination is desired. The Government will take a final meter reading, disconnect service, and remove the meters. The Contractor shall then remove all the temporary distribution lines, meter bases, and associated paraphernalia. The Contractor shall pay all outstanding utility bills before final acceptance of the work by the Government.

1.2.5 Sanitation

The Contractor shall provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer. Government toilet facilities will not be available to Contractor's personnel.

1.2.6 Telephone

The Contractor shall make arrangements and pay all costs for telephone facilities desired.

1.3 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.3.1 Bulletin Board

Immediately upon beginning of work, the Contractor shall provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. The bulletin board shall be located at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work the bulletin board shall be removed by and remain the property of the Contractor.

1.3.2 Project and Safety Signs

The requirements for the signs, their content, and location shall be as shown on the drawings. The signs shall be erected within 15 days after

receipt of the notice to proceed. The data required by the safety sign shall be corrected daily, with light colored metallic or non-metallic numerals. Upon completion of the project, the signs shall be removed from the site.

1.4 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

1.4.1 Haul Roads

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Access and haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. The Contractor shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the Contracting Officer. Lighting shall be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. Upon completion of the work, access and haul roads designated by the Contracting Officer shall be removed.

1.5 CONTRACTOR'S TEMPORARY FACILITIES

1.5.1 Administrative Field Offices

The Contractor shall provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

1.5.2 Storage Area

The Contractor shall construct a temporary 6 foot high chain link fence around trailers and materials. The fence shall include plastic strip inserts, colored brown, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the military boundaries. Trailers, equipment, or materials shall

not be open to public view with the exception of those items which are in support of ongoing work on any given day. Materials shall not be stockpiled outside the fence in preparation for the next day's work. Mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment, shall be parked within the fenced area at the end of each work day.

1.5.3 Supplemental Storage Area

Upon Contractor's request, the Contracting Officer will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but shall be within the military boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor shall be responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

1.5.4 Appearance of Trailers

Trailers utilized by the Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on the military property.

1.5.5 Maintenance of Storage Area

Fencing shall be kept in a state of good repair and proper alignment. Should the Contractor elect to traverse, with construction equipment or other vehicles, grassed or unpaved areas which are not established roadways, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways; gravel gradation shall be at the Contractor's discretion. Grass located within the boundaries of the construction site shall be mowed for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers shall be edged or trimmed neatly.

1.5.6 Security Provisions

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment; in addition, the Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

1.6 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor shall install a satisfactory means of communication, such as telephone or other suitable devices. The devices shall be made available for use by Government personnel.

1.7 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, the Contractor shall furnish and

erect temporary project safety fencing at the work site. The safety fencing shall be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10 foot centers, constructed at the approved location. The safety fencing shall be maintained by the Contractor during the life of the contract and, upon completion and acceptance of the work, shall become the property of the Contractor and shall be removed from the work site.

1.8 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

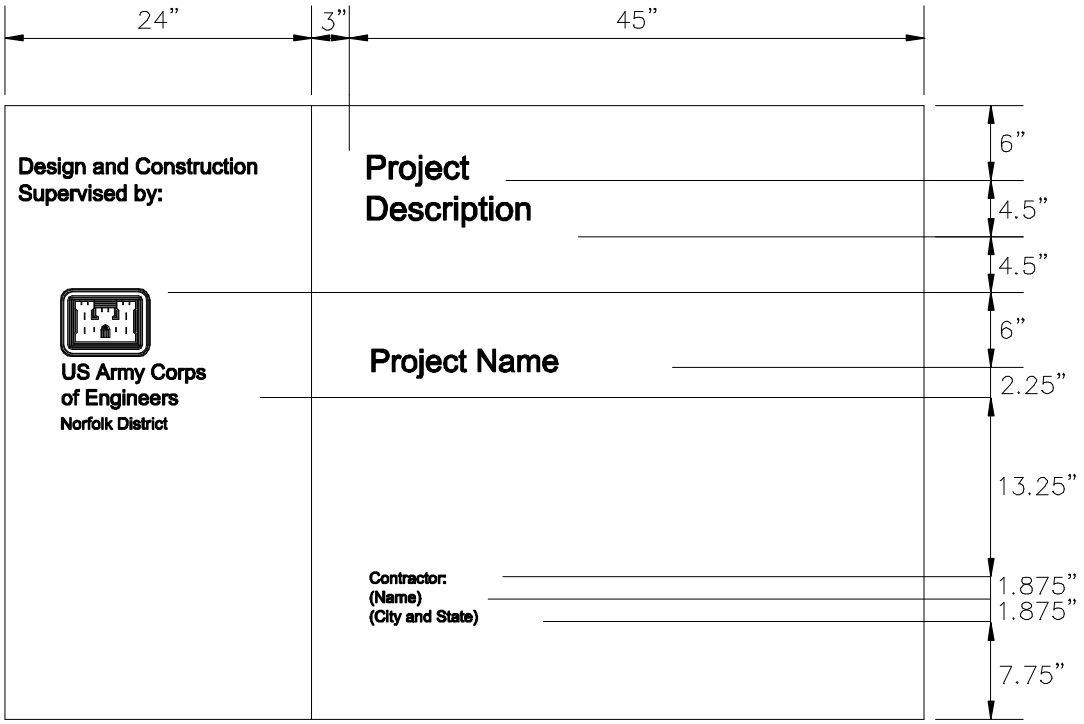
1.9 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary.

-- End of Section --

PROJECT SIGN

The graphic format for this 4'x6' sign panel follows the legend guidelines and layout as specified below. The large 4'x4' section of the panel on the right is to white with black legend. A 2'x4' decal provided by the Corps shall be placed on the left side of the sign panel.



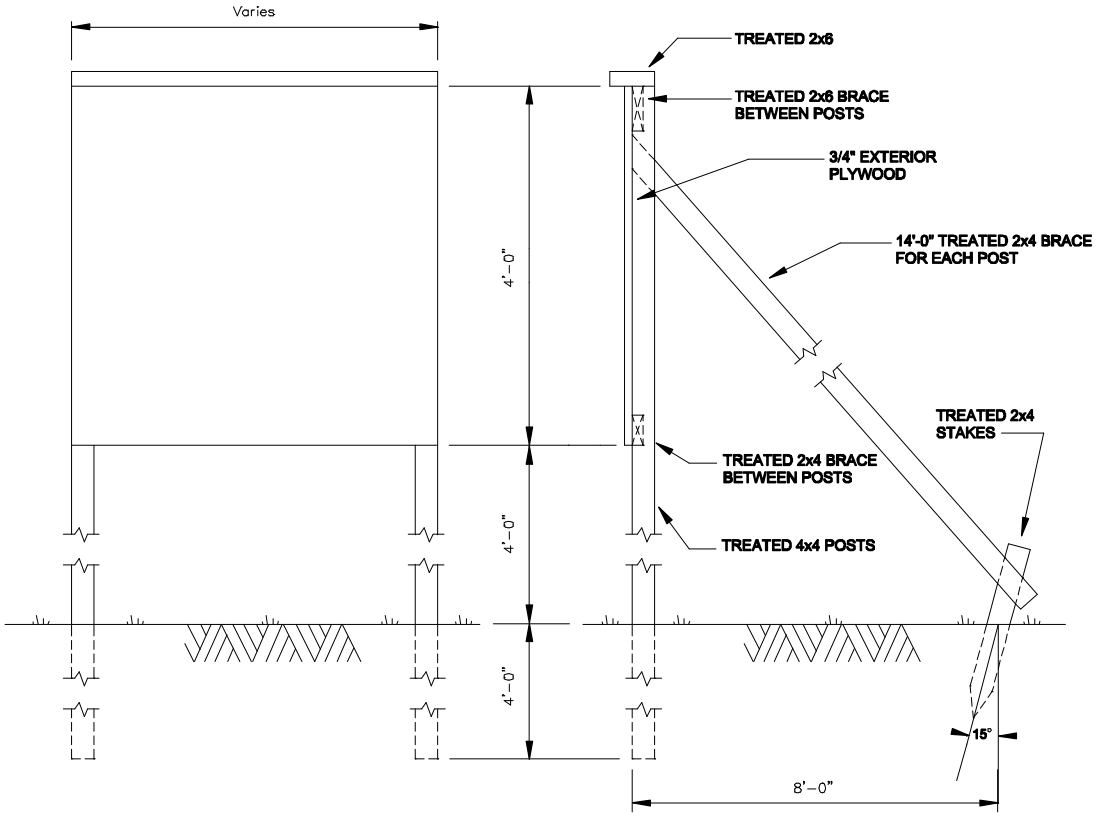
Project Description:
One to three line project title legend describes the work being done under this contract.
Color: Black; Typeface: 3" Helvetica Bold; Maximum line length: 42"

Project Name:
One to three line identification of project or facility.
Color: Black; Typeface 1.5" Helvetica Bold; Maximum line length: 42"
Cross-align the first line of PROJECT NAME with the first line of the Corps Signature as shown.

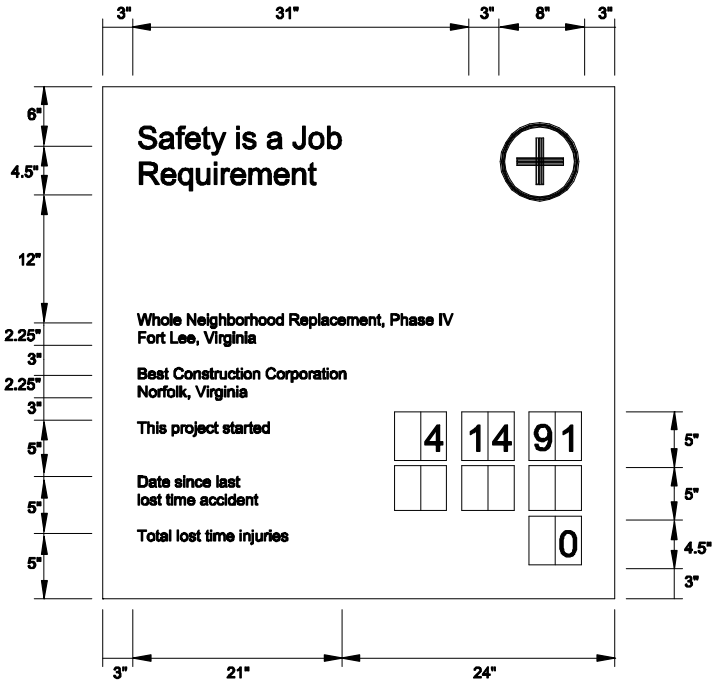
Contractor:
One to five line identification of prime contractors including: type (architect, general contractor, etc.), corporate or firm name, city, state.
Color: Black; Typeface: 1.25" Helvetica Bold; Maximum line length: 21"

All typography is flush left and ragged right, upper and lower case with initial capitals only as shown.
Letter and word spacing to follow Corps Standards (EP 310-1-6a and 6b).

SIGN ERECTION DETAILS



SAFETY SIGN



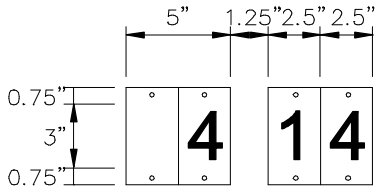
All typography is flush left and rag right, upper and lower case with initial capitals only as shown. Letter and word spacing to follow Corps Standards (EP 310-1-6a and 6b).

Legend Group 1: Standard two-line title "Safety is a Job Requirement" with (8" od.) Safety Green First Aid logo. Typeface: 3" Helvetiva Bold; Color: Black.

Legend Group 2: One to two-line project title legend describes the work being done under this contract and name of host project. Typeface: 1.5" Helvetica Regular; Color: Black; Maximum line length: 42".

Legend Group 3: One to two-line identification: name of prime contractor and city, state address. Typeface: 1.5" Helvetica Regular; Color: Black; Maximum line length: 42".

Legend Group 4: Standard safety record captions as shown. Typeface 1.25" Helvetica Regular; Color: Black.



Replaceable numbers are to be mounted on white 0.060 aluminum plates and screw-mounted to backdrop. Typeface: 3" Helvetica Regular; Color: Black; Plate size: 2.5"x 4.5".

SECTION 01780

CLOSEOUT SUBMITTALS
11/99

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

As-Built Drawings; G

Drawings showing final as-built conditions of the project. The final CADD as-built drawings shall consist of one set of electronic CADD drawing files in the specified format, one set of mylar drawings, 2 sets of blue-line prints of the mylars, and one set of the approved working as-built drawings.

SD-03 Product Data

As-Built Record of Equipment and Materials; G

Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.

Warranty Management Plan; G

Two sets of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. The Contractor shall furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

Warranty Tags;

Two record copies of the warranty tags showing the layout and design.

Final Cleaning;

Two copies of the listing of completed final clean-up items.

1.2 PROJECT RECORD DOCUMENTS

1.2.1 As-Built Drawings

This paragraph covers as-built drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files,"

"working as-built drawings" and "final as-built drawings" refer to contract drawings which are revised to be used for final as-built drawings.

1.2.1.1 Government Furnished Materials

One set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CADD file as-built drawings.

1.2.1.2 Working As-Built and Final As-Built Drawings

The Contractor shall revise two sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. These working as-built marked drawings shall be kept current on a weekly basis and at least one set shall be available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. Final as-built drawings shall be prepared after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final as-built drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as-built drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. The working and final as-built drawings shall show, but shall not be limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (change order price shall include the Contractor's cost to change working and final as-built drawings to reflect modifications) and compliance with the following procedures.

(1) Directions in the modification for posting descriptive changes shall be followed.

(2) A Modification Circle shall be placed at the location of each deletion.

(3) For new details or sections which are added to a drawing, a Modification Circle shall be placed by the detail or section title.

(4) For minor changes, a Modification Circle shall be placed by the area changed on the drawing (each location).

(5) For major changes to a drawing, a Modification Circle shall be placed by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.

(7) The Modification Circle size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.2.1.3 Drawing Preparation

The as-built drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints shall be neat, legible and accurate. These drawings are part of the permanent records of this project and shall be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

1.2.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only personnel proficient in the preparation of CADD drawings shall be employed to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings shall be equal in quality and detail to that of the originals. Line colors, line

weights, lettering, layering conventions, and symbols shall be the same as the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CADD files. The Contractor will be furnished AutoCad latest Release software. The electronic files will be supplied on compact disc, read-only memory (CD-ROM). The Contractor shall be responsible for providing all program files and hardware necessary to prepare final as-built drawings. The Contracting Officer will review final as-built drawings for accuracy and the Contractor shall make required corrections, changes, additions, and deletions.

a. CADD colors shall be the "base" colors of red, green, and blue. Color code for changes shall be as follows:

(1) Deletions (red) - Deleted graphic items (lines) shall be colored red with red lettering in notes and leaders.

(2) Additions (Green) - Added items shall be drawn in green with green lettering in notes and leaders.

(3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes shall be in blue.

b. The Contract Drawing files shall be renamed in a manner related to the contract number (i.e., 98-C-10.DGN) as instructed in the Pre-Construction conference. Marked-up changes shall be made only to those renamed files. All changes shall be made on the layer/level as the original item. There shall be no deletions of existing lines; existing lines shall be over struck in red. Additions shall be in green with line weights the same as the drawing. Special notes shall be in blue on layer #63.

c. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 3/16 inch high. All other contract drawings shall be marked either "AS-Built" drawing denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

d. Within 10 days for contracts less than $5 million after Government approval of all of the working as-built drawings for a phase of work, the Contractor shall prepare the final CADD as-built drawings for that phase of work and submit two sets of blue-lined prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 7 days for contracts less than $5 million the Contractor shall revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 10 days for contracts less than $5 million of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The submittal shall consist of one set of electronic files on compact disc, read-only memory (CD-ROM), one set of mylars, two sets of blue-line prints and one set of the approved working as-built drawings. They shall be complete in all details and identical in form and

function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final as-built drawing files and marked prints as specified shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.2.1.5 Manually Prepared Drawings

Only personnel proficient in the preparation of manually prepared drawings shall be employed to modify the original contract drawing or prepare additional new drawings. Additions and corrections to the contract drawings shall be neat, clean and legible, shall be done to the same level of detail, and shall match the adjacent existing line work, and lettering being annotated in type, density, size and style. Drafting work shall be done using the same medium (pencil, plastic lead or ink) that was employed on the original contract drawings and with graphite lead on paper base material. The Contracting Officer will review as-built drawings for accuracy and conformance to the above specified drafting standards. Corrections, changes, additions, and deletions required shall meet these standards. The title block to be used for any new as-built drawings shall be similar to that used on the original drawings.

a. When final revisions have been completed, each drawing shall be lettered or stamped with the words "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 3/16 inch high. Original contract drawings shall be marked either "As-Built" drawings denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions All original contract drawings shall be dated in the revision block.

b. Within10 days for contracts less than $5 million after Government approval of all of the working as-built drawings for a phase of work, the Contractor shall prepare the final as-built drawings for that phase of work and submit two sets of blue-line prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 7 days for contracts less than $5 million the Contractor shall revise the drawings accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 10 days for contracts less than $5 million of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The submittal shall consist of the completed final as-built drawings, two blue-line prints of these drawings and the return of the approved marked as-built prints. The drawings shall be complete in all details. Paper prints and reproducible drawings will become the property of the Government upon final approval. Failure to submit final as-built drawings and marked prints, as required herein, will be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.2.1.6 Payment

No separate payment will be made for as-built drawings required under this contract, and all costs accrued in connection with such drawings shall be

considered a subsidiary obligation of the Contractor.

1.2.2 As-Built Record of Equipment and Materials

The Contractor shall furnish twocopies of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Two sets of final record of equipment and materials shall be submitted 10 days after final inspection. The designations shall be keyed to the related area depicted on the contract drawings. The record shall list the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.2.3 Final Approved Shop Drawings

The Contractor shall furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.2.4 Construction Contract Specifications

The Contractor shall furnish final as-built construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.2.5 Real Property Equipment

The Contractor shall furnish a list of installed equipment furnished under this contract. The list shall include all information usually listed on manufacturer's name plate. The "EQUIPMENT-IN-PLACE LIST" shall include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. A draft list shall be furnished at time of transfer. The final list shall be furnished 30 days after transfer of the completed facility.

1.3 WARRANTY MANAGEMENT

1.3.1 Warranty Management Plan

The Contractor shall develop a warranty management plan which shall contain information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, the Contractor shall submit the warranty management plan for Government approval. The warranty management plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase shall be submitted to the

Contracting Officer for approval prior to each monthly pay estimate. Approved information shall be assembled in a binder and shall be turned over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. A joint 4 month and 9 month warranty inspection shall be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Information contained in the warranty management plan shall include, but shall not be limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Names, addresses and telephone numbers of sources of spare parts.
6. Warranties and terms of warranty. This shall include one-year overall warranty of construction. Items which have extended warranties shall be indicated with separate warranty expiration dates.
7. Cross-reference to warranty certificates as applicable.
8. Starting point and duration of warranty period.
9. Summary of maintenance procedures required to continue the warranty in force.
10. Cross-reference to specific pertinent Operation and Maintenance manuals.
11. Organization, names and phone numbers of persons to call for warranty service.
12. Typical response time and repair time expected for various warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.3.2 Performance Bond

The Contractor's Performance Bond shall remain effective throughout the construction period.

a. In the event the Contractor fails to commence and diligently

pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.3.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor shall furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, shall be continuously available, and shall be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.3.4 Contractor's Response to Construction Warranty Service Requirements

Following oral or written notification by the Contracting Officer, the Contractor shall respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. The Contractor shall submit a report on any warranty item that has been repaired during the warranty period. The report shall include the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframes specified, the Government will perform the work and backcharge the construction warranty payment item established.

a. First Priority Code 1. Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

b. Second Priority Code 2. Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

c. Third Priority Code 3. All other work to be initiated within 3

work days and work continuously to completion or relief.

d. The "Construction Warranty Service Priority List" is as follows:

Code 1-Air Conditioning Systems
(1) Recreational support.
(2) Air conditioning leak in part of building, if causing damage.
(3) Air conditioning system not cooling properly.

Code 1-Doors
(1) Overhead doors not operational, causing a security, fire, or safety problem.
(2) Interior, exterior personnel doors or hardware, not functioning properly, causing a security, fire, or safety problem.

Code 3-Doors
(1) Overhead doors not operational.
(2) Interior/exterior personnel doors or hardware not functioning properly.

Code 1-Electrical
(1) Power failure (entire area or any building operational after 1600 hours).
(2) Security lights
(3) Smoke detectors

Code 2-Electrical
(1) Power failure (no power to a room or part of building).
(2) Receptacle and lights (in a room or part of building).

Code 3-Electrical
Street lights.

Code 1-Gas
(1) Leaks and breaks.
(2) No gas to family housing unit or cantonment area.

Code 1-Heat
(1). Area power failure affecting heat.
(2). Heater in unit not working.

Code 2-Kitchen Equipment
(1) Dishwasher not operating properly.
(2) All other equipment hampering preparation of a meal.

Code 1-Plumbing
(1) Hot water heater failure.
(2) Leaking water supply pipes.

Code 2-Plumbing
(1) Flush valves not operating properly.
(2) Fixture drain, supply line to commode, or any water pipe leaking.
(3) Commode leaking at base.

Code 3 -Plumbing
Leaky faucets.

Code 3-Interior

(1) Floors damaged.
(2) Paint chipping or peeling.
(3) Casework.

Code 1-Roof Leaks
Temporary repairs will be made where major damage to property is occurring.

Code 2-Roof Leaks
Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

Code 2-Water (Exterior)
No water to facility.

Code 2-Water (Hot)
No hot water in portion of building listed.

Code 3-All other work not listed above.

1.3.5 Warranty Tags

At the time of installation, each warranted item shall be tagged with a durable, oil and water resistant tag approved by the Contracting Officer. Each tag shall be attached with a copper wire and shall be sprayed with a silicone waterproof coating. The date of acceptance and the QC signature shall remain blank until project is accepted for beneficial occupancy. The tag shall show the following information.

a. Type of product/material_____.

b. Model number_____.

c. Serial number_____.

d. Contract number_____.

e. Warranty period_____from_____to_____.

f. Inspector's signature_____.

g. Construction Contractor_____.

Address_____.

Telephone number_____.

h. Warranty contact_____.

Address_____.

Telephone number_____.

i. Warranty response time priority code_____.

j. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

1.4 MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

Prior to final inspection and transfer of the completed facility; all reports, statements, certificates, and completed checklists for testing, adjusting, balancing, and commissioning of mechanical systems shall be submitted to and approved by the Contracting Officer as specified in applicable technical specification sections.

1.5 OPERATION AND MAINTENANCE MANUALS

Operation manuals and maintenance manuals shall be submitted as specified. Operation manuals and maintenance manuals provided in a common volume shall be clearly differentiated and shall be separately indexed.

1.6 FINAL CLEANING

The premises shall be left broom clean. Stains, foreign substances, and temporary labels shall be removed from surfaces. Carpet and soft surfaces shall be vacuumed. Equipment and fixtures shall be cleaned to a sanitary condition. Filters of operating equipment shall be replaced. Debris shall be removed from roofs, drainage systems, gutters, and downspouts. Paved areas shall be swept and landscaped areas shall be raked clean. The site shall have waste, surplus materials, and rubbish removed. The project area shall have temporary structures, barricades, project signs, and construction facilities removed. A list of completed clean-up items shall be submitted on the day of final inspection.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION 01850

CONTRACT DRAWINGS
09/02

PART 1 GENERAL

1.1 AVAILABILITY OF CADD DRAWING FILES

After award and upon request, the electronic "Computer-Aided Drafting and Design (CADD)" drawing files will be provided to the Contractor for use in preparation of construction data related to the referenced contract subject to the following terms and conditions.

Data contained on these electronic files shall not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse shall be at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor shall make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor shall, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic CADD drawing files are not construction documents. Differences may exist between the CADD files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic CADD files, nor does it make representation to the compatibility of these files with the Contractors hardware or software.

If the Contractor uses, duplicates and/or modifies these electronic CADD files for use in producing construction data related to this contract, all previous indicia of ownership (seals, logos, signatures, initials and dates) shall be removed.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

-- End of Section --

SECTION 02220

DEMOLITION
05/01

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 basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Work Plan; G,

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.5.2 Protection of Structures

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, of lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.3 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.4 Protection From the Weather

The interior of buildings to remain; salvageable materials and equipment shall be protected from the weather at all times.

1.5.5 Environmental Protection

The work shall comply with the requirements of Section 01355 ENVIRONMENTAL PROTECTION.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXISTING STRUCTURES

Existing structures indicated shall be entirely removed. Sidewalks, curbs, gutters and street light bases shall be removed as indicated.

3.2 UTILITIES

Disconnection of utility services, with related meters and equipment, are specified in Section 01005. Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.3 FILLING

Holes, open basements and other hazardous openings shall be filled in accordance with Section .

3.4 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.4.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

3.4.1.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

3.4.1.2 Items Salvaged for the Government

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents. The items reserved as property of the Government indicated on the drawings shall be delivered to the areas designated by the Contracting Officer.

3.4.1.3 Historical Items

Historical items shall be removed in a manner to prevent damage. The following historical items shall be delivered to the Government for

disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.4.2 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of off site.

3.5 CLEAN UP

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

3.6 PAVEMENTS

Existing pavements designated for removal shall be saw cut and removed in accordance with the details shown on the drawings and to the limits and to a depth of 18 inches.

-- End of Section --

SECTION 02222
EXCAVATION, TRENCHING, AND BACKFILLING

03/98

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 basic designation only.

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu.ft. (2,700 kN-m/cu.m.))
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 2487	(1990) Classification of Soils for Engineering Purposes
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988) Water Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1984) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

U. S. ARMY, CORPS OF ENGINEERS (COE)

EM 385-1-1	(1996) Safety and Health Requirements Manual

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Materials classified by ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, ML, CB, and CH are satisfactory in-situ and as final backfill.

1.2.2 Unsatisfactory Materials

Materials classified by ASTM D 2487 as OL, OH, and Pt are unsatisfactory in-situ and as any kind of fill. Materials classified as OL, MH, and OH are unsatisfactory as final backfill beneath pavement

cuts. Unsatisfactory materials also include those materials containing roots and other organic matter, trash, debris, frozen materials, and stones larger than 3 inches.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

1.2.4 Rock

Rock shall consist of boulders measuring 2-1/2 cubic yards or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 2 1/2 cubic yard in volume, except that pavements will not be considered as rock.

1.2.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension.

1.2.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.7 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the appropriate procedure presented in ASTM D 1557, abbreviated hereinafter as percent maximum density.

1.3 SUBSURFACE DATA

Subsurface soil boring logs are provided in specification section 01055 SOIL BORING DATA. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at the Norfolk District. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Sections 01330 SUBMITTAL PROCEDURES:

SD-09 Manufacturer's Field Reports

Soils Tests; .

Displacement of Sewers Tests; .

Copies of all laboratory and field test reports shall be submitted to the Contracting Officer within 72 hours of the completion of the test.

Required soils tests for fill, backfill, and subgrade materials shall be submitted prior to beginning backfill and compaction operations.

1.5 MEASUREMENT AND PAYMENT

All measurement and payment will be based on completed work performed in accordance with the drawings and specifications.

1.5.1 Trench Excavation

Trench excavation shall be the number of linear feet measured along the centerline of the trench and excavated to the depths and widths specified for the particular size of pipe. No increase shall be made for the extra width required at manholes and similar structures. Payment for trench excavation as so measured shall constitute full payment for excavation and backfilling, including specified overdepth except in rock or unstable trench bottoms. Unstable trench bottoms shall be replaced by select granular material and paid for as specified below. Trench excavation shall also include the additional width at manholes and similar structures, the furnishing, placing and removal of sheeting and bracing, pumping and bailing, and all incidentals necessary to complete the work required by this section.

1.5.2 Rock Excavation

Rock excavation shall be measured and paid for by the number of cubic yards of acceptably excavated rock material. The material shall be measured in place, but volume shall be based on a maximum 30-inch width for pipes 12 inches in diameter or less, and a maximum width of 16 inches greater than the outside diameter of the pipe for pipes over 12 inches in diameter. The measurement shall include all authorized overdepth rock excavation as determined by the Contracting Officer. For manholes and other appurtenances, volumes of rock excavation shall be computed on the basis of 1 foot outside of the wall lines of the structures. Payment for rock excavation shall be made in addition to the price bid for the trench excavation, and shall include all necessary drilling and blasting and all incidentals necessary to excavate and dispose of the rock. Backfill replacing rock excavation shall not be paid for separately, but shall be included in the unit price for rock excavation.

1.5.3 Select Granular Material

Select granular material shall be measured in place as the actual cubic yards replacing wet or unstable material in trench bottoms . The unit price shall
include furnishing and placing the granular material, excavation and disposal of unsatisfactory material, and additional requirements for sheeting and bracing, pumping, bailing, cleaning, and other incidentals necessary to complete the work. Payment for select granular material shall be made in addition to the bid price for trench excavation.

PART 2 PRODUCTS

2.1 SELECT GRANULAR MATERIAL

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing

the 1-inch sieve. Maximum size shall be 3 inches.

2.2 INITIAL BACKFILL MATERIAL

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 1 inch or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller.

2.3 BRIDGING MATERIAL

Bridging material shall be clean gravel or sandy gravel meeting VDOT Size No. 3 or No. 2, or approved equivalent.

2.4 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6-inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

2.5 CAPILLARY WATER BARRIER

2.5.1 Consistency

Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 1-1/2 inches and no more than 3 percent by weight shall pass the No. 8 size sieve.

2.5.2 Substitution

Coarse aggregate conforming to VDOT SPECS Section No.203, Table II-3, aggregate size No.57 is satisfactory as a capillary water barrier.

PART 3 EXECUTION

3.1 DRAINAGE AND DEWATERING

3.1.1 Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion

ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

3.1.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in-situ material. While the excavation is open, the water level shall be maintained continuously below the working level.

3.2 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph "MATERIALS." Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from Government property Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph "BACKFILLING AND COMPACTION" at no additional cost to the Government.

3.2.1 Trench Excavation

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls below the top of pipe shall be made vertical. Trench walls shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in accordance with EM 385-1-1. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.2.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.2.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed as directed to the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.1.3 Removal of Unsatisfactory and Unstable Materials

Where unsatisfactory or unstable materials are encountered in the bottom of the trench, such materials shall be removed to the depth directed and replaced to the proper grade with suitable materials as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to action or inaction of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.2.2 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members Removal of unstable material shall beas specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.2.3 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.3 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Before placing, material shall be moistened or aerated, including material which is unsatisfactory due solely to excess moisture, as necessary to obtain specified compaction. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified. Water flooding or jetting methods of compaction shall not be used.

3.3.1 Trench Backfill

Trenches shall be backfilled to the grade shown.

3.3.1.1 Replacement of Unyielding and Unsatisfactory Materials

Unyielding or unsatisfactory materials removed from the bottom of the trench shall be replaced with satisfactory material or initial backfill material, as directed, and placed as specified for backfill.

3.3.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material or approved bridging material placed in layers between 8 and 12 inches loose thickness and compacted as directed. Care shall be taken not to over compact and pump up moisture, or otherwise weaken the underlying material.

3.3.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown or specified. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.3.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways, : Backfill shall be deposited in layers of a maximum of a 8-inch loose thickness and compacted to 90 percent maximum density for cohesive soils and 95 percent maximum density for cohesionless soils.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12-inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Water flooding or jetting methods of compaction will be permitted for granular noncohesive backfill material. Water jetting shall not be allowed to penetrate the initial backfill. This requirement shall also apply to all other areas not specifically designated above.

3.3.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.4 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.4.1 Water Lines

Trenches shall be of a depth to provide a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.4.2 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.4.3 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown.

3.5 TESTING

3.5.1 Soils Tests

Testing shall be the responsibility of the contractor and shall be performed by an approved commercial testing laboratory or may be performed by the contractor subject to approval. Laboratory tests for moisture-density relations complete with zero air voids curve, gradation, and Atterberg limits shall be made in accordance with the procedures referenced in ASTM D 1557, ASTM D 422, and ASTM D 4318. Field tests for density and moisture content shall be made in accordance with ASTM D 1556 and ASTM D 2216 except that method ASTM D 2922 may be used to supplement tests by method ASTM D 1556. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. When soil conditions exist, such as the presence of mica, which produce inconsistent results by the nuclear gauge method D 2922, only method D 1556 shall be used. Where results by Method D 2922 differ from those by Method D 1556, the results by method D 1556 shall govern for contract compliance.

The following test are required:

a. A minimum of one moisture-density test shall be performed for each classification of fill material, backfill material, and existing subgrade material.

b. One Atterberg limits test and one gradation analysis is required for every six field density tests.

c. A minimum of one sand cone density test is required for every six nuclear gauge field density tests or fraction thereof. Worksheets of sand density and sand cone calibration shall be submitted to the Contracting Officer prior to commencing work and each time a new supply of sand is used.

d. A quart jar sample of each moisture-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

e. A pint jar sample of each field-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

f. Field density tests shall be performed as follows: a minimum of one test per lift per 100 linear feet of trench or fraction thereof is required for fill material. Locations of all tests shall be at the direction of the Contracting Officer.

3.5.2 Displacement of Sewers Tests

After other required tests have been performed and the trench backfill compacted to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

3.6 SHORING

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.7 UTILITY AND DRAIN TRENCHES

Trenches for underground utilities systems and drain lines shall be excavated to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe, and the overdepth shall be backfilled with satisfactory material placed and compacted in conformance with paragraph FILLING AND BACKFILLING.

3.8 BORROW MATERIAL

Borrow materials shall be selected to meet requirements and conditions of the particular fill for which it is to be used. Borrow materials shall be subject to approval. Necessary clearing, grubbing, disposal of debris, and satisfactory drainage of borrow pits shall be performed by the Contractor as incidental operations to the borrow excavation.

3.8.1 Selection

Borrow materials shall be obtained from The source of borrow material shall be the Contractor's responsibility. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, shall pay all royalties and other charges involved, and shall bear all the expense of developing the sources, including rights-of-way for hauling.

3.9 EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of off Government property.

3.10 PREPARATION OF SURFACES FOR FILL

Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. The ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 6 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Aeration shall include disking, harrowing, mixing, and other methods as may be necessary to achieve the

proper moisture content.

3.11 FILLING AND BACKFILLING

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Materials which are unsatisfactory solely due to excess moisture shall be spread, disked, and aerated prior to placing. Satisfactory materials shall be placed in horizontal layers not exceeding 8 inches in loose thickness, or 6 inches when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade and shall include backfill for outside grease interceptors, underground fuel tanks, and appurtenances. Backfill shall not be placed in wet or frozen areas. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall. Recompaction over underground utilities and heating lines shall be by hand tamping.

3.12 COMPACTION

Each layer of fill, backfill, and prepared subgrade shall be compacted to not less than the percentage of maximum density specified below:

	Percent Laboratory maximum density	
	Cohesive material	Cohesionless material
Fill, subgrade, and backfill		
Under structures, paved areas, around footings, and in trenches	90	95
Under sidewalks and grassed areas	85	90
Nonfrost susceptible materials		95
Under structures and paved areas,		

	Percent Laboratory maximum density	
	Cohesive material	Cohesionless material
top 6 inches	95	95
Under sidewalks and exterior slabs, top 6 inches	90	95

Compacted surfaces that are disturbed by the Contractor's operations or adverse weather shall be scarified and recompacted as specified at the Contractor's expense prior to further construction thereon.

3.13 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete or capillary barrier are to be placed. Structures shall bear on undisturbed natural subgrade or on compacted fill. Subgrade which becomes disturbed below indicated grade shall be overexcavated and backfilled, as directed, with VDOT SPECS Size No. 57 or No. 21A Stone at the Contractor's expense.

3.14 SOILS TESTS

Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Laboratory tests for moisture-density relations complete with zero air voids curve, gradation, and Atterberg limits shall be made in accordance with the procedures referenced in ASTM D 1557, ASTM D 422, and ASTM D 4318. Field tests for density and moisture content shall be made in accordance with ASTM D 1556 and ASTM D 2216 except that method ASTM D 2922 may be used to supplement tests by method ASTM D 1556. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. When soil conditions exist, such as the presence of mica, which produce inconsistent results by the nuclear gauge method D 2922, only method D 1556 shall be used. Where results by Method D 2922 differ from those by Method D 1556, the results by method D 1556 shall govern for contract compliance.

The following tests are required:

a. A minimum of one moisture-density test shall be performed for each classification of fill material, backfill material, and existing subgrade material.

b. One Atterberg limits test and one gradation analysis is required for every six field density tests.

c. A minimum of one sand cone density test is required for every six nuclear gauge field density tests or fraction thereof. Worksheets of sand density and sand cone calibration shall be submitted to the Contracting Officer prior to commencing work and each time a new supply of sand is used.

d. A quart jar sample of each moisture-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

e. A pint jar sample of each field-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

f. Field density tests shall be performed as follows: A minimum of one test per lift per 100 feet of wall length or fraction thereof and one test per lift for each column footing is required for fill material; Locations of all tests shall be at the direction of the Contracting Officer.

3.15 CAPILLARY WATER BARRIER

Capillary water barrier under concrete floor and area-way slabs on grade shall be placed directly on the treated, prepared subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.16 GRADING

Areas within 5 feet outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.17 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work shall be repaired and grades reestablished to the required elevations and slopes.

-- End of Section --

SECTION 03301

CONCRETE
09/95

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 basic designation only.

ACI INTERNATIONAL (ACI)

ACI 301	(1989) Structural Concrete for Buildings
ACI 304	Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(1991) Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 315	Details and Detailing of Concrete Reinforcementt
ACI 318R-89	Building Code Requirements for Reinforced Concrete

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT	Road and Bridge Specifications and all supplements thereto

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM A 615	Steel Reinforcement for concrete

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mixture Proportions; G

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be

based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

SD-06 Test Reports

Strength;
Slump;
Air Content;
Temperature Tests;

PART 2 PRODUCTS

2.1 Concrete

CONCRETE for cast-in-place work shall conform to ASTM C94.

2.1.1 Strength

(28-day) shall be 4,000 psi.

2.1.2 Cement shall be Type II

2.1.3 Maximum aggregate size shall be 3/4".

2.1.4 Maximum water to cement ration shall be 0.40.

2.1.5 Slump shall be 3 inches maximum.

2.1.6 Air content shall be 4 to 7 percent.

2.2 REINFORCEMENT

Shall conform to ASTM A 615 Grade 60.

2.3 FORM MATERIAL

Shall conform to ACI 301.

2.4 CURING MATERIAL

Shall conform to ACI 301.

PART 3 EXECUTION

2.5 FORMWORK

Shall conform to ACI 301.

2.6 INSTALLATION OF REINFORCING

Shall conform to ACI 301.

2.7 BATCHING, MIXING AND TRANSPORTING CONCRETE

Shall conform to ACI 301, ACI 304, ACI 305R, AND ACI 306R except as otherwise specified.

2.8 PROTECTION

Shall conform to ACI 301.

2.9 TESTING AND ACCEPTANCE OF CONCRETE

Strength tests, slump test, air content tests, and temperature tests shall be performed at the Contractor's expense in accordance with ACI 301. All tests shall be submitted for approval.

SECTION 05090

WELDING, STRUCTURAL
09/98

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 basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 335	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(1996) Recommended Practice SNT-TC-1A

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(1994) Standard Welding Terms and Definitions
AWS D1.1/D1.1M	(1998) Structural Welding Code - Steel
AWS D1.6	(1998) Structural Welding Code - Stainless Steel
AWS Z49.1	(1999) Safety in Welding and Cutting and Allied Processes

1.2 DEFINITIONS

Definitions of welding terms shall be in accordance with AWS A3.0.

1.3 GENERAL REQUIREMENTS

The design of welded connections shall conform to AISC 335 unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Welding shall not be started until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Qualification testing shall be performed at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding

operator, and tacker performance qualifications. This section pertains to welding for both ferrous and stainless steel. All welding on structural stainless steel items (excluding stainless steel piping)shall conform to the requirements of AWS D1.6.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Welding Procedure Qualifications; G
Welder, Welding Operator, and Tacker Qualification;
Inspector Qualification; G
Previous Qualifications; G
Prequalified Procedures;

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

SD-06 Test Reports

Quality Control;

Records of tests and inspections.

1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1/D1.1M or AWS D1.6) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1/D1.1M or AWS D1.6 and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Appendix E of AWS D1.1/D1.1M or AWS D1.6. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M or AWS D1.6, this specification governs.

1.5.1 Prequalified Procedures

Welding procedures which are considered prequalified as specified in AWS D1.1/D1.1M or AWS D1.6 will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M or AWS D1.6 and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.6.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without requalification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

1.6.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason

to question the tacker's ability. In such a case, the tacker shall be required to pass the prescribed tack welding test.

1.7 INSPECTOR QUALIFICATION

Inspector qualifications shall be in accordance with AWS D1.1/D1.1M or AWS D1.6. Nondestructive testing personnel shall be qualified in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

1.9 SAFETY

Safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M or AWS D1.6.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1/D1.1M or AWS D1.6 and AISC 335. When AWS D1.1/D1.1M or AWS D1.6 and the AISC 335 specification conflict, the requirements of AWS D1.1/D1.1M or AWS D1.6 shall govern.

3.1.2 Identification

Welds shall be identified in one of the following ways:

a. Written records shall be submitted to indicate the location of welds made by each welder, welding operator, or tacker.

b. Each welder, welding operator, or tacker shall be assigned a number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. For seam welds, the identification mark shall be adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers shall not be allowed.

3.2 QUALITY CONTROL

Testing shall be done by an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. The Contractor shall perform visual ultrasonic, inspection to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1/D1.1M or AWS D1.6, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," shall be employed.

3.3 STANDARDS OF ACCEPTANCE

Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1/D1.1M or AWS D1.6 and the contract drawings. Nondestructive testing shall be by visual inspection and ultrasonic methods. The minimum extent of ultrasonic nondestructive testing shall be random 5 percent of welds or joints, or as indicated on the drawings.

3.3.1 Nondestructive Examination

The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

3.3.2 Destructive Tests

When metallographic specimens are removed from any part of a structure, the Contractor shall make repairs. The Contractor shall employ qualified welders or welding operators, and shall use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance with the requirements of AWS D1.1/D1.1M or AWS D1.6 and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a defect is removed and repair by welding is not

required, the affected area shall be blended into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to ensure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless reevaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

SECTION 05093

WELDING PRESSURE PIPING AND ACID PIPING
09/98

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 basic designation only.

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(1996) Recommended Practice SNT-TC-1A
ASNT RP SNT-TC-1A Bk B	(1994) Question and Answers Levels I, II, and III Magnetic Particle Method Book B (Supplement to RP SNT-TC-1A)

ASME INTERNATIONAL (ASME)

ASME B31.1	(1998) Power Piping
ASME B31.3	(1999) Process Piping
ASME B31.4	(1992; B31.4a) Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols
ASME B31.5	(1992; B31.5a) Refrigeration Piping
ASME B31.8	(1995) Gas Transmission and Distribution Piping Systems
ASME BPVC SEC I	(1998) Boiler and Pressure Vessel Code; Section I, Power Boilers
ASME BPVC SEC II-C	(1998) Boiler and Pressure Vessel Code; Section II, Materials, Part C - Specifications for Welding Rods, Electrodes and Filler Metals
ASME BPVC SEC V	(1998) Boiler and Pressure Vessel Code; Section V, Nondestructive Examination
ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(1998) Structural Welding Code - Steel
AWS D1.6	(1998) Structural Welding Code - Stainless

	Steel
AWS D10.4	(1986) Recommended Practice for Welding Austinitic Cromium-Nickel Stainless Steel Piping and Tubing
AWS D10.8	(1996) Recommended Practice for Welding of Chromium-Molybdenum Steel Piping and Tubing
AWS D18.1	(1999) Specification for Welding of Austenitic Stainless Steel Tube and Pipe Systems in Sanitary (Hygenic) Applications
AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(1994) Standard Welding Terms and Definitions
AWS B2.1	(1998) Welding Procedure and Performance Qualification
AWS QC1	(1996) AWS Certification of Welding Inspectors
AWS Z49.1	(1999) Safety in Welding and Cutting and Allied Processes

1.2 DEFINITIONS

Definitions shall be in accordance with AWS A3.0.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pressure and Acid Piping; G,
Detail drawings showing location, length, and type of welds; and indicating postweld heat treatment and NDE as required.

SD-03 Product Data

Qualifications; G,
Welding procedure qualification.

Welding Operations; ,
Detailed procedures which define methods of compliance to contract drawings and specifications. Inspection and material procurement records. System and material testing and certification records. Written records and drawings indicating location of welds made by each welder or welding operator.

SD-07 Certificates

Qualifications; G,
Welder and welding operator performance qualification certificates. Welding inspectors and NDE personnel certificates. Qualifications of testing laboratory or the Contractor's quality assurance organization.

1.4 GENERAL REQUIREMENTS

This section covers the welding of pressure piping and acid piping systems. Deviations from applicable codes, approved procedures, and approved detail drawings will not be permitted without prior written approval. Materials or components with welds made offsite will not be accepted if the welding does not conform to the requirements of this specification, unless otherwise specified. Procedures shall be developed by the Contractor for welding all metals included in the work. Welding shall not be started until welding procedures, welders, and welding operators have been qualified. Qualification testing shall be performed by an approved testing laboratory, or by the Contractor if approved by the Contracting Officer. Costs of such testing shall be borne by the Contractor. The Contracting Officer shall be notified at least 24 hours in advance of the time and place of the tests. When practicable, the qualification tests shall be performed at or near the worksite. The Contractor shall maintain current records of the test results obtained in the welding procedure, welding operator, welder performance qualifications, and nondestructive examination (NDE) procedures readily available at the site for examination by the Contracting Officer. The procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses shall be qualified. ASME B31.1, ASME B31.3, ASME B31.4, ASME B31.5, ASME B31.8 requirements for branch connections may be used in lieu of detailed designs. Unless otherwise specified, all pipe welding shall be accomplished using the GTAW welding process. All Stainless steel pipe welds shall conform to the requirements of AWS D1.6, AWS D10.4, AWS D10.8, and AWS D18.1 as applicable. All ferrous steel pipe welds shall conform to the applicable requirements of AWS D1.1/D1.1M. In all instances, these references shall be applied as applicable to the base material being welded.

1.5 PERFORMANCE

The Contractor shall be responsible for the quality of all joint preparation, welding, and examination. All materials used in the welding operations shall be clearly identified and recorded. The inspection and testing defined in this specification are minimum requirements. Additional inspection and testing shall be the responsibility of the Contractor when he deems it necessary to achieve the quality required.

1.6 QUALIFICATIONS

Welding procedures, welders, and welding operators previously qualified by test may be accepted for the work without requalification, provided that all of the following conditions are fulfilled:

a. Copies of the welding procedures, the procedure qualification test records, and the welder and welding operator performance qualification test records are submitted and approved in accordance with paragraph SUBMITTALS.

b. Testing was performed by an approved testing laboratory or technical consultant or by the Contractor's approved quality

assurance organization.

c. The welding procedures, welders, and welding operators were qualified in accordance with ASME BPVC SEC IX, or AWS B2.1, AR-2 level; and base materials, filler materials, electrodes, equipment, and processes conformed to the applicable requirements of this specification.

d. The requirements of paragraph "Renewal of Qualification" below are met and records showing name of employer and period of employment using the process for which qualified are submitted as evidence of conformance.

1.6.1 Welding Procedures Qualification

The Contractor shall record in detail and shall qualify the Welding Procedure Specifications for every proposed welding procedure. Qualification for each welding procedure shall conform to the requirements of AWS D1.1/D1.1M AWS D1.6, AWS D10.4, AWS D10.8, and AWS D18.1 and to this specification. The welding procedures shall specify end preparation for butt welds including cleaning, alignment, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required by approved welding procedures, unless otherwise indicated or specified. The type of backing rings or consumable inserts, if used, shall be described and if they are to be removed, the removal process shall be described. Copies of the welding procedure specifications and procedure qualification test results for each type of welding required shall be submitted in accordance with paragraph SUBMITTALS. Approval of any procedure does not relieve the Contractor of the sole responsibility for producing acceptable welds. Welding procedures shall be identified individually and shall be referenced on the detail drawings or keyed to the contract drawings.

1.6.2 Welder and Welding Operator Performance

Each welder and welding operator assigned to work shall be qualified in accordance with AWS D1.1/D1.1M AWS D1.6, AWS D10.4, AWS D10.8, and AWS D18.1.

1.6.2.1 Certification

Before assigning welders or welding operators to the work, the Contractor shall provide the Contracting Officer with their names together with certification that each individual is performance-qualified as specified. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

1.6.2.2 Identification

Each particular weld shall be identified with the personal number, letter, or symbol assigned to each welder or welding operator. To identify welds, written records indicating the location of welds made by each welder or welding operator shall be submitted, and each welder or welding operator shall apply the personal mark adjacent to the welds using a rubber stamp or felt-tipped marker with permanent, weatherproof ink or other methods approved by the Contracting Officer that do not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 3 foot intervals. Identification by die stamps or electric etchers will not be

allowed.

1.6.2.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

a. When a welder or welding operator has not used the specific welding process for a period of 3 months; the period may be extended to 6 months if the welder or welding operator has been employed on some other welding process.

b. When a welder or welding operator has not welded with any process during a period of 3 months, all the personal qualifications shall be considered expired, including any extended by virtue of a., above.

c. There is specific reason to question the person's ability to make welds that will meet the requirements of the specifications.

1.6.3 Inspection and NDE Personnel

All inspection and NDE personnel shall be qualified in accordance with the following requirements.

1.6.3.1 Inspector Certification

Welding inspectors shall be qualified in accordance with AWS QC1.

1.6.3.2 NDE Personnel

NDE personnel shall be certified, and a written procedure for the control and administration of NDE personnel training, examination, and certification shall be established. The procedures shall be based on appropriate specific and general guidelines of training and experience recommended by ASNT RP SNT-TC-1A, ASNT RP SNT-TC-1A Bk B.

1.7 DELIVERY, STORAGE, AND HANDLING

All filler metals, electrodes, fluxes, and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to insure safe handling.

1.7.1 Material Control

Materials shall be stored in a controlled access and clean, dry area that is weathertight and is maintained at a temperature recommended by the manufacturer. The materials shall not be in contact with the floor and shall be stored on wooden pallets or cribbing.

1.7.1.1 Damaged Containers

Low-hydrogen steel electrodes shall be stored in their sealed shipping container. If the seal is damaged during shipment or storage, and the damage is not immediately detected, the covered electrodes in that container shall be rebaked in accordance with the manufacturer's instructions prior to issuance or shall be discarded. If a container is damaged in storage and the damage is witnessed, the electrodes from that

container shall be immediately placed in a storage oven. The storage oven temperature shall be as recommended by the manufacturer or the welding material specification.

1.7.1.2 Partial Issues

When a container of covered electrodes is opened and only a portion of the content is issued, the remaining portion shall, within 1/2 hour, be placed in a storage oven.

1.7.2 Damaged Materials

Materials which are damaged shall be discarded. Covered electrodes which are oil or water-soaked, dirty, or on which the flux has separated from the wire shall be discarded.

1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4.

1.9 SAFETY

Safety precautions shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING MATERIALS

Welding materials shall comply with ASME BPVC SEC II-C. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

All welding performed under this specification shall be performed using the Tungsten Inert Gas (GTAW) process in accordance with qualified procedures using qualified welders and welding operators. Welding shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Contracting Officer shall determine when weather or working conditions are unsuitable for welding.

3.1.1 Base Metal Preparation

Oxy-fuel cutting shall not be used on austenitic stainless steel or nonferrous materials.

3.1.2 Weld Joint Fit-Up

Parts that are to be joined by welding shall be fitted, aligned, and retained in position during the welding operation by the use of bars, jacks, clamps, or other mechanical fixtures. Welded temporary attachments shall not be used except when it is impractical to use mechanical fixtures. When temporary attachments are used, they shall be the same material as the base metal, and shall be completely removed by grinding or thermal cutting after the welding operation is completed. If thermal cutting is used, the attachment shall be cut to not less than 1/4 inch from the member

and the balance removed by grinding. After the temporary attachment has been removed, the area shall be visually examined.

3.1.3 Preheat and Interpass Temperatures

Preheat temperatures shall meet the requirements specified by AWS D1.1/D1.1M AWS D1.6, AWS D10.4, AWS D10.8, and AWS D18.1. However, in no case shall the preheat be below 50 degrees F for ferritic steel or austenitic stainless steel, or 32 degrees F for nonferrous alloys. The maximum interpass temperatures shall not exceed 300 degrees F for austenitic stainless steels, nickel alloys, and copper alloys; and 500 degrees F for carbon steels. Preheat techniques shall be such as to ensure that the full thickness of the weld joint preparation and/or adjacent base material, at least 3 inches in all directions, is at the specified temperature. Preheating by induction or resistance methods is preferred. When flame heating is used, only a neutral flame shall be employed. Oxy-fuel heating shall not be used on austenitic stainless steel or nickel-alloy materials; however, air-fuel heating is acceptable if controlled to insure that the surface temperature does not exceed 150 degrees F. Interpass temperatures shall be checked on the surface of the component within 1 inch of the weld groove and at the starting location of the next weld pass, and for a distance of about 6 inches ahead of the weld, but not on the area to be welded.

3.1.4 Production Welding Instructions

a. Welding shall not be done when the ambient temperature is lower than 0 degree F.

b. Welding is not permitted on surfaces that are wet or covered with ice, when snow or rain is falling on the surfaces to be welded, or during periods of high winds, unless the welders and the work are properly protected.

c. Gases for purging and shielding shall be welding grade and shall have a dew point of minus 40 degrees F or lower.

d. Back purges are required for austenitic stainless steels and nonferrous alloys welded from one side and shall be set up such that the flow of gas from the inlet to the outlet orifice passes across the area to be welded. The oxygen content of the gas exiting from the purge vent shall be less than 2 percent prior to welding.

e. The purge on groove welds shall be maintained for at least three layers or 3/16 inch.

f. Removable purge dam materials shall be made of expandable or flexible plugs, such as plexiglass, plywood (which shall be dry when used), etc. Wood dams shall be kiln-dried quality. Nonremovable purge dams and purge dam adhesives shall be made of water soluble materials. Purge dams shall not be made of polyvinyl alcohol.

g. Any welding process which requires the use of external gas shielding shall not be done in a draft or wind unless the weld area is protected by a shelter. This shelter shall be of material and shape appropriate to reduce wind velocity in the vicinity of the weld to a maximum of 5 mph (440 fpm).

h. Welding of low-alloy and hardenable high-alloy steels may be interrupted provided a minimum of at least 3/8 inch thickness of weld deposit or 25 percent of the weld groove is filled, whichever is greater, and the preheat temperature is maintained during the time that welding is interrupted. If the temperature falls below the minimum preheat temperature before all welding has been completed on a joint, or, where required, before post weld heat treatment, a liquid penetrant or magnetic particle examination shall be performed to insure sound deposited metal before reheating. Welding of other materials may be interrupted without restriction provided a visual inspection is performed before welding is resumed.

i. Tack welds to be incorporated in the final welds shall have their ends tapered by grinding or welding technique. Tack welds that are cracked or defective shall be removed and the groove shall be retacked prior to welding. Temporary tack welds shall be removed, the surface ground smooth, and visually inspected. For low-alloy and hardenable high-alloy steels, the area shall be magnetic particle examination inspected.

j. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is required, the following requirements apply:

(1) The weld-end preps of ferritic steel components, which are to be welded to austenitic stainless steel, shall be buttered with one of the following weld filler metals and shall conform to the specified requirements:

ASME BPVC SEC II-C, SFA 5.14, Classification ERNiCr-3.

ASME BPVC SEC II-C, SFA 5.11, Classification ENiCrFe-2.

(2) The ferritic steel weld-end prep shall be buttered, receive a postweld heat treatment as required by AWS D1.1/D1.1M and then be machined with the applicable weld-end preparation. After machining, the buttered layer shall be a minimum of 1/4 inch thick.

(3) Pressure piping transition joints shall be completed using ERNiCr-3 or ENiCrFe-2 weld filler metals. No further postweld heat treatment shall be performed.

k. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is not required, prepare and weld the joint using either ERNiCr-3 or ENiCrFe-2 filler metals. For service temperatures of 200 degrees F or less, stainless filler metal 309 ASME BPVC SEC II-C, SFA 5.4 or 5.9 is permissible in lieu of the nickel-based alloys.

l. Grinding of completed welds is to be performed only to the extent required for NDE, including any inservice examination, and to provide weld reinforcement within the requirements of AWS D1.1/D1.1M AWS D1.6, AWS D10.4, AWS D10.8, and AWS D18.1. If the surface of the weld requires grinding, reducing the weld or base material below the minimum required thickness shall be avoided. Minimum weld external reinforcement shall be flush between external

surfaces.

3.1.5 Postweld Heat Treatment

Postweld heat treatment shall be performed in accordance with AWS D1.1/D1.1M AWS D1.6, AWS D10.4, AWS D10.8, and AWS D18.1. Temperatures for local postweld heat treatment shall be measured continuously by thermocouples in contact with the weldment.

Postweld heat treatment of low-alloy steels, when required, shall be performed immediately upon completion of welding and prior to the temperature of the weld falling below the preheat temperature. However, postweld heat treatment may be postponed after the completion of the weld, if, immediately after the weld is completed, it is maintained at a minimum temperature of 300 degrees F or the preheat temperature, whichever is greater, for 2 hours per inch of weld thickness.

For low-alloy steels, the cooling rates shall be such that temper embrittlement is avoided.

3.2 EXAMINATIONS, INSPECTIONS, AND TESTS

Visual and NDE shall be performed by the Contractor to detect surface and internal discontinuities in completed welds. The services of a qualified commercial inspection or testing laboratory or technical consultant, approved by the Contracting Officer, shall be employed by the Contractor. All tack welds, weld passes, and completed welds shall be visually inspected. In addition, liquid penetrant examination shall be performed on root passes. Radiographic Liquid penetrant Magnetic particle or Ultrasonic examination shall be required as indicated in TABLE I. When inspection and testing indicates defects in a weld joint, the weld shall be repaired by a qualified welder in accordance with paragraph CORRECTIONS AND REPAIRS.

TABLE I. MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS

Type Weld	Piping Service Conditions and Nondestructive Test		
	Temperatures over 750 degrees F and at all pressures.	Temperatures between 350 degrees F and 750 degrees F inclusive and at pressures above 1,025 psig.	All others.
Butt Welds (Girth and Longitudinal)	RT for NPS over 2 inch MT or PT for NPS 2 inches and less.	RT for over 2 inch NPS with thickness over 3/4 inch. Visual for all sizes with thickness 3/4 inch or less.	Visual for all sizes and thicknesses.
Welded Branch Connections (Size indicated is branch size)	RT for NPS over 4 inch MT or PT for NPS 4 inches and less.	RT for branch over 4 inch NPS and thickness of branch over 3/4	Visual for all sizes and thicknesses.

TABLE I. MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS

Type Weld (See Note 7)	Piping Service Conditions and Nondestructive Test		
		inch. Visual for all sizes with branch thickness 3/4 inch or less.	
Fillet, Socket Attachment and Seal Welds	PT or MT for all sizes and thicknesses.	Visual for all sizes and thicknesses.	Visual for all sizes and thicknesses.

NOTES TO TABLE I

(1) All welds must be given a visual examination in addition to type of specific nondestructive examination specified.

(2) NPS - nominal pipe size.

(3) RT - Radiographic examination; MT - magnetic particle examination; PT - liquid penetrant examination.

(4) RT of branch welds shall be performed before any nonintegral reinforcing material is applied.

(5) The thickness of butt welds is defined as the thicker of the two abutting ends after end preparation.

(6) Temperatures and pressures shown are design.

(7) In lieu of radiography of welded branch connections when required above, liquid penetrant or magnetic particle examination is acceptable and, when used, shall be performed at the lesser of one half of the weld thickness or each 1/2 inch of weld thickness and all accessible final weld surfaces.

(8) For nondestructive examination of the pressure retaining component, refer to the standards listed in applicable code or the manufacturing specifications.

(9) Fillet welds not exceeding 1/4 inch throat thickness which are used for the permanent attachment of nonpressure retaining parts are exempt from the PT or MT requirements of the above table.

3.2.1 Random NDE Testing

When random radiographic magnetic particle or ultrasonic examination is required, the Contractor shall test a minimum of 5 percent of the total length or number of piping welds. The welds inspected shall be selected randomly, but the selection shall include an examination of welds made by each welding operator or welder. If the random testing reveals that any welds fail to meet minimum quality requirements, an additional 5 percent of the welds in that same group shall be inspected. If all of the additional welds inspected meet the quality requirements, the entire group of welds represented shall be accepted and the defective welds shall be repaired. If any of the additional welds inspected also fail to meet the quality

requirements, that entire group of welds shall be rejected. The rejected welds shall be removed and rewelded, or the rejected welds shall be 100 percent inspected and all defective weld areas removed and rewelded.

3.2.2 Visual Inspection

Weld joints shall be inspected visually as follows:

a. Before welding - for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.

b. During welding - for cracks and conformance to the qualified welding procedure.

c. After welding - for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

3.2.3 NDE Testing

NDE shall be in accordance with written procedures. Procedures for radiographic magnetic particle or ultrasonic tests and methods shall conform to ASME BPVC SEC V. The approved procedure shall be demonstrated to the satisfaction of the Contracting Officer. In addition to the information required in ASME BPVC SEC V, the written procedures shall include the timing of the NDE in relation to the welding operations and safety precautions.

3.2.4 Inspection and Tests by the Government

The Government will perform inspection and supplemental nondestructive or destructive tests as deemed necessary. The cost of supplemental NDE will be borne by the Government. The correction and repair of defects and the reexamination of weld repairs shall be performed by the Contractor at no additional cost to the Government. Inspection and tests will be performed as required for visual inspection and NDE, except that destructive tests may be required also. When destructive tests are ordered by the Contracting Officer and performed by the Contractor and the specimens or other supplemental examinations indicate that the materials and workmanship do not conform to the contract requirements, the cost of the tests, corrections, and repairs shall be borne by the Contractor. When the specimens or other supplemental examinations of destructive tests indicate that materials or workmanship do conform to the specification requirements, the cost of the tests and repairs will be borne by the Government. When destructive tests are made, repairs shall be made by qualified welders or welding operators using welding procedures which will develop the full strength of the members cut. Welding shall be subject to inspection and tests in the mill, shop, and field. When materials or workmanship do not conform to the specification requirements, the work may be rejected at any time before final acceptance of the system containing the weldment.

3.3 ACCEPTANCE STANDARDS

3.3.1 Visual

The following indications are unacceptable:

a. Cracks.

b. Undercut on surface which is greater than 1/32 inchdeep.

c. Weld reinforcement greater than 3/16 inch.

d. Lack of fusion on surface.

e. Incomplete penetration (applies only when inside surface is readily accessible).

f. Convexity of fillet weld surface greater than 10 percent of longest leg plus 0.03 inch.

g. Concavity in groove welds.

h. Concavity in fillet welds greater than 1/16 inch.

i. Fillet weld size less than indicated or greater than 1-1/4 times the minimum indicated fillet leg length.

3.3.2 Magnetic Particle Examination

The following relevant indications are unacceptable:

a. Any cracks and linear indications.

b. Rounded indications with dimensions greater than 3/16 inch.

c. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.

d. Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6 inches with the area taken in the most unfavorable location relative to the indications being evaluated.

3.3.3 Liquid Penetrant Examination

Indications with major dimensions greater than 1/16 of an inch shall be considered relevant. The following relevant indications are unacceptable:

a. Any cracks or linear indications.

b. Rounded indications with dimensions greater than 3/16 inch.

c. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.

d. Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6 inches with the area taken in the most unfavorable location relative to the indications being evaluated.

3.3.4 Radiography

Welds that are shown by radiography to have any of the following discontinuities are unacceptable:

a. Porosity in excess of that shown as acceptable in ASME BPVC SEC I, Appendix A-250.

b. Any type of crack or zone of incomplete fusion or penetration.

c. Any other elongated indication which has a length greater than:

(1) 1/4 inch for t up to 3/4 inchinclusive, where t is the thickness of the thinner portion of the weld.

(2) 1/3 t for t from 3/4 inch to 2-1/4 inch, inclusive.

(3) 3/4 inch for t over 2-1/4 inch.

d. Any group of indications in line that have an aggregate length greater than t in a length of 12t, except where the distance between the successive indications exceeds 6L where L is the longest indication in the group.

Where t pertains to the thickness of the weld being examined; if a weld joins two members having different thickness at the weld, t is the thinner of these two thicknesses.

3.3.5 Ultrasonic Examination

Linear-type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed the following:

a. 1/4 inch for t up to 3/4 inch.

b. 1/3 inch for t from3/4 to 2-1/4 inch.

c. 3/4 inch for t over 2-1/4 inch.

Where t is the thickness of the weld being examined; if the weld joins two members having different thicknesses at the weld, t is the thinner of these two thicknesses. Where discontinuities are interpreted to be cracks, lack of fusion, and incomplete penetration, they are unacceptable regardless of length.

3.4 CORRECTIONS AND REPAIRS

Defects shall be removed and repaired as specified in AWS D1.1/D1.1M, AWS D1.6, AWS D10.4, AWS D10.8, and AWS D18.1 unless otherwise specified. Disqualifying defects discovered between weld passes shall be repaired before additional weld material is deposited. Wherever a defect is removed, and repair by welding is not required, the affected area shall be blended into the surrounding surface eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, the area shall be examined by the same test method which first revealed the defect to ensure that the defect has been eliminated. After rewelding, the repaired area shall be reexamined by the same test method originally used for that area. Any indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no disqualifying defects are present. The use of any foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

-- End of Section --

SECTION 10430

EXTERIOR SIGNAGE
04/11

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 within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1991) Structural Steel
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 525	(1991b) General Requirement for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 570	(1991) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM D 3841	(1988) Glass-Fiber-Reinforced Polyester Plastic Panels

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1992) Structural Welding Code - Steel

FEDERAL STANDARDS (FED-STD)

FED-STD 795	(Basic) Uniform Federal Accessibility Standards

MILITARY SPECIFICATIONS (MS)

MS MIL-M-43719	(Rev B; Am 1) Marking Materials and Markers, Adhesive, Elastomeric, Pigmented

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 505	(1988) Metal Finishes Manual for Architectural and Metal Products; Section: Applied Coatings

1.2 General Requirements

Exterior signage shall be of the size and type listed in paragraphs 1.2.1 through 1.2.5, shall conform to the requirements specified herein, and shall be provided at the locations identified in paragraphs 1.2.1 through 1.2.5. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Materials and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.2.1 Identification of Exposed Piping Systems

Exposed piping systems shall be identified in accordance with Military Standard 101-B, AR 385-30 and Radford Army Ammunition Plant Paintinq Specifications.

1.2.2 Identification of Underground Piping System

For identification and location of underground piping, signs shall be erected on metal posts along mains at each lateral to a facility and/or at each valve, and where pipeline passes beneath road, walks, fences, etc. Information on signs to consist of pipe content, building number served (for signs located at valves), size of main, and direction of main. (Example: Filtered Water, Bldg. 9500, 611, East-West.) For uniformity throughout the Radford Army Ammunition Plant complex, the signs should be metal, 20 x 10 overall, 1 ½" letters, 111 border with white background and mounted on metal stake with bottom of sign 18" above ground. Colors for letters and border should be as follows:

Filtered Water = Blue
Fire Water = Red
Drinking Water = Green.
Cold Softened Water = Blue
Sanitary Sewer = Black
Acid Sewer = Black

1.2.3 Identification of valves and Controls

All valves and other system components shall be identified as to function. Identification by a metal tag affixed to the component is preferred. Every water outlet which is not connected to a drinking water source shall be equipped with a sign stating "CAUTION: This water is unsafe. Do not use for drinking, washing, or cooking."

1.2.4 Building Signs

All buildings shall be identified by account number and building name, with separate signs installed on corner of building approximately six (6) feet above grade and visible from main road through the area (for earth-mounded buildings, signs to be installed on vertical portions of main portal). For uniformity through the Radford Army Ammunition Plant complex, the sign for account number and the sign for building name should be 6" wide by whatever length is necessary to accommodate the text, white background with black embossed border and black 41, high-embossed letters (or numbers) on 16-gauge metal with rounded corners and a 3/8" diameter hole in each corner.

1.2.5 Fire Hazard Classification Symbol

A fire hazard classification symbol shall be provided on appropriate buildings as per Paragraph 12-21b of AMC-R Safety Manual, AMC-R 385-100.

1.3 Road Signs

Safety and direction signs are to be provided per AR 385-30, and along roads per applicable paragraphs of AMC-R. Safety Manual, AMC-R 385-100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

Exterior signs; G

Drawings including elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location of each sign type shall be included.

SD-06 Test Reports;

Manufacturer's descriptive data, catalog cuts, and installation instructions.

1.5 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area.

PART 2 PRODUCTS

2.1 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B 2-09 for sheet or plate, ASTM B 221 for extrusions and ASTM B 26. Aluminum extrusions shall be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge, 0.0508 inch thick.

2.2 ORGANIC COATING

Surfaces shall be cleaned, primed, and given a semi-gloss baked enamel finish in accordance with NAAMM AMP 505 with total dry film thickness not less than 1.2 mils.

2.3 STEEL PRODUCTS

ASTM A 36 for structural steel, ASTM A 570 for sheet and strip.

2.4 VINYL SHEETING FOR GRAPHICS

MS MIL-M-43719, minimum 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.5 FIBER REINFORCED POLYESTER (FRP)

ASTM D 3841, Type II, Grade 1, Class 124.

2.6 ACRYLIC SHEET

ANSI Z97.1.

2.7 POLYCARBONATE SHEET

SAE AMS 3611.

2.8 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish.

2.9 Workmanship

2.9.1 SHOP FABRICATION AND MANUFACTURE

Work shall be assembled in the shop, insofar as practicable, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Weld to or on structural steel in accordance with AWS D1.1/D1.1M. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable. Items specified to be galvanized shall be by hot-dip process after fabrication if practicable. Galvanization shall be in accordance with ASTM A 123 and ASTM A 525, as applicable. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

2.9.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic

or corrosive action.

2.9.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate primer, or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Do not paint surfaces of items to be embedded in concrete. Upon completion of work, thoroughly recoat: all damaged surfaces.

2.10 STAKE/PANEL TYPE SIGNS

2.10.1 Stakes

Stakes to be galvanized steel 1/2" dia. x 4'0" Lg.

2.11 GRAPHICS FOR PYLON/MONOLITH AND POST/PANEL TYPE SIGNS

2.11.1 Tactile Graphics

Signage that provides emergency information, general circulation directions, or identification of spaces shall be tactile (perceptible to touch) and shall comply with FED-STD 795. Characters, symbols, or pictographs on tactile engraved signs shall be raised or recessed 1/32 inch minimum. Raised letters and numbers shall be sans serif upper case. Raised characters or symbols shall be at least 5/8 inch high, but no higher than a nominal 2 inches. Characters and symbols shall contrast in color with their background.

2.11.2 Graphics

Signage graphics shall conform to the following:

a. Pressure sensitive precision cut vinyl letters with reflecting surface shall be provided UNO in Paragraph 1.2.

2.11.3 Messages

See Paragraph 1.2 for message content. Typeface: Black. Type size as indicated in Paragraph 1.2. Color as indicated in Paragraph 1.2.

2.12 PRESSURE SENSITIVE LETTERS

Precision cut vinyl letters shall be provided. Edges and corners of finished letter forms and graphics shall be true and clean.

2.12.1 Typeface

Bold.

2.12.2 Size

As indicated in Paragraph 1.2.

2.12.3 Color

As indicated in Paragraph 1.2.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed at locations specified in Paragraph 1.2. All signs shall be installed plumb and true at mounting heights specified, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed.

3.1.1 Anchorage

Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned.

-- End of Section --

SECTION 11211

PUMPS: INDUSTRIAL, CENTRIFUGAL
12/88

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 basic designation only.

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5	(1994) Standards for Centrifugal Pumps

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20	(1996; Errata Oct 1996; TIA 96-1) Installation of Centrifugal Fire Pumps
NFPA 70	(1999) National Electrical Code

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory waterworks operation at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the jobsite. Pumps motors of the same types shall each be the product of one manufacturer.

1.2.2 Description

The pumps shall be horizontal centrifugal water pumps of the types indicated and specified. The single driving units for the pumps shall be

electric motors as indicated and specified.

1.2.3 Governing Requirements

Fire pumps and appurtenances shall conform in all respects to NFPA 20.

1.2.4 Safety Requirements

Gears, couplings, projecting set-screws, keys, and other rotating parts, so located that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.

1.2.5 Nameplates

Pumps and motors shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, the nameplate for each pump shall show the capacity in gpm at rated speed in rpm and head in feet of water. Nameplate for each electric motor shall show at least the minimum information required by 10.38 NEMA MG 1. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.2.6 Electrical Work

Electrical motor driven equipment specified herein shall be provided complete with motors, motor starters, and controls. Electric equipment and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical characteristics shall be as indicated. Equipment for control of automatic fire pumps shall be in accordance with NFPA 20. Motor starters shall be provided complete with properly sized thermal overload protection in each phase and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage and frequency. Manual or automatic control and protective or signal devices required for the operation herein specified and any control wiring required for controls and devices but not shown on electrical plans shall be provided under this section of the specifications.

1.2.7 Selection Criteria

Pumps shall be designed using hydraulic criteria based upon actual model developmental test data. Pumps shall be selected at a point within the maximum efficiency for a given impeller casing combination. Deviations within 3 percent of maximum efficiency are permissible, provided the lesser efficiency is not less than the scheduled efficiency. Pumps having impeller diameters larger than 90 percent of the published maximum diameter of the casing or less than 15 percent larger than the published minimum diameter of the casing will be rejected. Acceptable maximum impeller diameter calculations shall not be based on percentage of impeller diameter range for a given casing.

1.2.8 Conformance With Agency Requirements

Where materials or equipment are specified to be an approved type, the seal or label of approval from a nationally recognized testing agency, adequately equipped and competent to perform such services, shall be attached thereto. A written certificate from the testing agency shall

accompany the materials or equipment and shall be submitted to the Contracting Officer stating that the items have been tested and that they conform to the applicable requirements of the specifications and to the standards listed herein. The certificate shall indicate the methods of testing used by the testing agency. In lieu of a certificate from a testing agency, published catalog specification data, accompanied by the manufacturer's certified statement to the effect that the items are in accordance with the applicable requirements of the specifications and the referenced standards, will be considered by the Contracting Officer and may be acceptable as evidence that the items conform with agency requirements.

1.2.9 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.2.10 Factory Tests

Pumps shall be tested by the manufacturer or a nationally recognized testing agency in compliance with Hydraulic Institute Standards. Where two or more identical pumps are specified, only one representative pump shall be tested. Certified test results shall be submitted to the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G

Drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation. A complete listing of equipment and materials shall be provided.

SD-03 Product Data

Materials and Equipment; G

Manufacturer's descriptive data and technical literature, performance charts and curves for all impeller sizes for a given casing, catalog cuts, and installation instructions. Spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Instructions; G

Proposed diagrams, instructions, and other sheets, prior to posting. Approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping valves, and control sequence, framed under glass or in approved laminated plastic, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

Training Period; G

Training course curriculum and training instructions shall be furnished to the Contracting Officer 14 days prior to the start of training.

SD-06 Test Reports

Tests; G

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates

Manufacturer's Representative; G

The names and qualifications of the manufacturer's representative and training engineers and written certification from the manufacturer that the representative and trainers are technically qualified.

SD-10 Operation and Maintenance Data

Centrifugal Pump System; G

Six complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment. One complete set at the time the tests procedure is submitted; remaining sets before the contract is completed. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the building, name of the Contractor, and contract number. Flysheets shall be placed before instructions covering each subject. Instruction sheets shall be approximately 8-1/2 by 11 inches, with large sheets of drawings folded in. Instructions shall include, but not be limited to, the following:

a. System layout showing piping, valves, and controls.

b. Approved wiring and control diagrams.

c. A control sequence describing startup, operation, and shutdown.

d. Operating and maintenance instructions for each piece of equipment, including lubrication instructions and troubleshooting guide.

e. Manufacturer's bulletins, cuts, and descriptive data; and parts list and recommended spare parts.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be as specified below and as shown, and shall be suitable for the service intended. Materials and equipment shall be new and unused, except for tests. Where two or more pieces of equipment performing the same function are required, they shall be duplicate products of the same manufacturer.

2.2 CENTRIFUGAL WATER PUMPS

The pumps shall be as specified on the drawings. Pumps are to be designed for industrial service with all wetted parts manufactured with Carpenter 20 or approved equal.

2.2.1 Pump Service

The pumps shall be utilized for the Acid Waste/Acid Sewer and Nitrocellulose production systems.

2.2.2 Pump Drives

The pumps shall have the following driving units and shall be directly connected to the driving units through solid shafts, flexible couplings, or free wheeling clutches (as appropriate).

2.2.3 Pump Construction

Except as below specified, centrifugal pumps including required priming equipment shall be constructed in accordance with the Hydraulic Institute HI 1.1-1.5.

2.2.4 Pump Characteristics

The pumps shall be capable of discharging quantities at total discharge heads measured at the discharge flange as specified on the drawings.

Pumps shall operate at optimum efficiencies to produce the most economical pumping system under the conditions encountered and shall be sized to make optimum match with the system head curve as shown for Goulds Model 3796 (or approved equal) for Pumps 3058-P1 & P2; Goulds Model 3900 (or approved equal) for Pump 3058 - P3. See Drwgs for TDH and HP requirements. Pumps

shall furnish not less than 150 percent of rated capacity at a total discharge head of not less than 65 percent of total rated head.

2.2.5 Pump Casings

Pump casings shall be high chrome abrasive resistant alloy construction such as Carpenter 20 (or approved equal).

The casings shall be designed to permit replacement of wearing parts. Pump casings shall be of uniform quality and free from blowholes, porosity, hard spots, shrinkage defects, cracks and other injurious defects. Defects in casings shall not be repaired except when such work is approved and is done by or under the supervision of the pump manufacturer, and then only when the defects are small and do not adversely affect the strength or use of the casing. Casings shall be single volute with flanged piping connections conforming to ASME B16.1, Class 125. The direction of shaft rotation shall be conspicuously indicated. The casing shall have tapped openings for air venting, priming, draining, and suction and discharge gauges.

2.2.6 Impellers

Impellers shall be of semi-open, or enclosed design and shall be constructed of high chrome abrasion resistant alloy, carefully finished with smooth water passageways, and shall be dynamically balanced. Impellers shall be securely keyed to the pump shaft and connected through a thrust collar. Provisions shall be made for vertical impeller adjustment at the top of the motor.

2.2.7 Wearing Rings

Wearing rings shall not be provided for impellers.

2.2.8 Shaft

Shaft shall be of 400 series SS compatible with the working fluid, accurately machined, and shall be of sufficient size and strength to perform the work required. Vertical shafts shall be adequately provided with alignment bearings.

2.2.9 Gland

Gland shall be stainless steel with AISI 18-8 stainless steel eyebolts and pins or studs. Hex-nuts shall be nongalling stainless steel.

2.2.10 Mechanical Seals (if required)

Mechanical seals shall be balanced or unbalanced, as necessary to conform to specified service requirements. Mechanical seals shall be constructed in a manner and of materials particularly suitable for the temperature service range and quality of water being pumped. Seal construction shall not require external source cooling for pumped-fluid service temperatures up to 250 degrees F. Seal pressure rating shall be suitable for maximum system hydraulic conditions. Materials of construction shall include AISI 300 series stainless steel, solid tungsten-carbide rotating-seal face, and Buna-N vinylidene-fluoride-hexafluoropropylene, EPT, or tetrafluoroethylene seals. Bypass flushing water supply shall be free of iron rust products and other abrasive materials and shall be directed onto face of seal without dead ending. All piping and accessories shall be provided.

Throttling bushing shall have clearances to minimize leakage in case of complete seal failure without restriction of flushing water. Mechanical seals shall not be subjected to hydrostatic test pressures in excess of the manufacturer's recommendations.

2.2.11 Couplings

Couplings shall be of the heavy-duty flexible type, keyed and locked to the shaft. Couplings for vertical pumps other than close-coupled vertical pumps may be of the universal type. Flexible couplings shall not be used to compensate for misalignment of pump.

2.2.12 Balance

All rotating parts of the equipment shall operate throughout the required range without excessive end thrust, vibration, or noise. Defects of this type that cannot be eliminated by installation adjustments will be sufficient cause for rejection of the equipment. Pump impeller assemblies shall be statically and dynamically balanced to within 4 W/N, where W equals weight and N equals speed. Shaft construction shall be substantial to prevent seal or bearing failure due to vibration. Total shaft peak-to-peak dynamic deflection measured by vibrometer at pump-seal face shall not exceed 2.0 mils under shutoff-head operating conditions. Flow from 1/4 inch iron pipe size (ips) pipe shall be provided during testing.

2.2.13 Bearings

Bearings shall be ball type, and the main bearings shall take all radial and down thrust. Pumps that depend only on hydraulic balance to overcome end thrust will not be acceptable.

2.2.14 Lubrication

Bearings on vertical shaft pumps shall be oil or grease type. Pumps with oil-lubrication systems shall be designed so that all shaft bearings will be isolated from the pumped liquid. An automatic sight feed oiler shall be provided on a suitable mounting bracket with connection to the shaft tube. Grease type bearings shall be provided with fittings for a grease gun and, if the bearings are not easily accessible, with grease tubing extending to convenient locations. The grease fittings shall be of a type that prevent over lubrication and the buildup of pressure injurious to the bearings

2.2.15 Base Plates

The pumps shall be mounted on rigid simplex base/mounting plates. Vertical-shaft pumps shall be provided with complete mounting suitable for the type of pump furnished, with the base for the pump separate from the base of the driving unit. The drainage structure shall collect the packing box leakage and shall have a 15 nun (1/2-inch) 1/2-inch NPT connection to connect it to a drain.

2.2.16 Cocks, Plugs, and Accessories

The pumps shall be equipped with single gauges indicating pressures for all lines where indicated. Gauges, equipped with a shutoff cock and snubber, shall conform to ASME B40.l, and shall be calibrated in kilopascals and pounds per square inch pounds per square inch in not more than 10 kPa and 2 psi 2 psi increments. Gauge ranges shall be appropriate for the particular

installation. Pressure relief valve shall be furnished and installed where indicated.

2.2.17 Piping Connections

The pump suction and discharge shall be provided with flanged connections of suitable size and suitably arranged for piping shown. Pipe flanges shall conform to ASME B16.1 and ASME B16.5. Piping shall be installed to preclude the formation of air pockets.

2.2.18 Finish

Pump shall have painted or enameled finish as is standard with the manufacturer.

2.3 ELECTRICAL EQUIPMENT

Electrical equipment shall conform to Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment herein specified shall be provided complete with motors, motor starters, and controls. Motor controls, equipment, and wiring shall be in accordance with NFPA 70.

2.3.1 Electric Motors

Each electric motor-driven pump shall be driven by an electric motor. In non-hazardous areas the motors shall be totally-enclosed, fan-cooled. continuous-duty electric motors. Motors shall be squirrel-cage induction motors having nonnal starting torque and low starting current characteristics, and shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve.

In hazardous areas the motors shall be rated for a Class 1 and 2, Division I. Groups C, D. E, F, and G areas, continuous duty electric motor. Motors shall be squirrel-cage induction motors having normal starting torque and low starting current characteristics, and shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve.

Motor bearings shall provide smooth operations under the conditions encountered for the life of the motor. Adequate thrust bearing shall be provided in the motor to carry the weight of all -rotating parts plus the hydraulic thrust and shall be capable of withstanding upthrust imposed during pump starting. All motors shall conform to NEMA MG 1. Motors shall have a minimum service factor of 1.15.

All motors over 1 hp shall be rated for 460V, 3 phase operation. All motors shall be high efficiency design E type. Motors 200 hp and over shall be provided with space heaters operating at 120V, 200W maximum

2.3.2 Control Equipment

Manually controlled pumps shall have START-STOP pushbutton in cover. Automatically controlled pumps shall have three-position "MANUAL-OFF-AUTOMATIC" selector switch in cover. Additional controls or protective devices shall be as indicated. A pump low-water cutoff shall be installed in the well or on the suction pipe and shall shut the pump off when the fluid level in the well reaches the level shown.

2.3.3 Variable Speed Controls

The variable speed motor controller shall convert 460 volt plus 15 percent, minus 5 percent, three phase, 60 Hz (plus or minus 2 Hz) utility power to adjustable voltage/frequency, three phase, ac power for stepless motor control from 5 percent to 105 percent of base speed.

2.3.3.1 Description

The variable speed drive shall produce an adjustable ac voltage/frequency output for complete motor speed control. The variable speed drive shall be automatically controlled by a grounded electronic control signal. The variable speed drive shall be self contained, totally enclosed in a NEMA MG 1 ventilated cabinet and capable of operation between 32 and 104 degrees F. The variable speed drive maximum output current rating shall be equal to or exceed the motor nameplate full load. The manufacturer shall advise the maximum recommended motor sine wave current for each controller rating. Variable speed drive multiple motor operation at same frequency/speed shall be possible as long as the sum of connected motor full load sine wave currents are less than or equal to the variable speed drive maximum continuous current rating. Variable speed drive shall be 95 percent efficient at 100 percent rated output power, 60 Hz.

2.3.3.2 Governing Requirements

Variable speed drives shall conform to the following requirements:

a. Variable speed drive shall comply with 47 CFR 15 regulation of RF1/EM1 emission limits for Class A computing devices. The FCC label of compliance shall be displayed on the variable speed drive.

b. The variable speed drive and options shall comply with the applicable requirements and the standards of the American National Standards Institute (ANSI).

c. Variable speed drive and option design and construction thereof shall comply with all applicable provisions of NFPA 70, Article 43D, Sections A-L.

2.3.3.3 Quality Assurance

To ensure quality the variable speed drive shall be subject to the following tests:

a. The integrated circuits shall undergo a 160-hour "burn-in" to test reliability. During the "burn-in" the temperature shall be cycled between 32 and 158 degrees F.

b. The completed unit shall undergo a fully loaded 24-hour "burn-in."

c. The unit shall be subject to a series of in-plant quality controlled inspections before approval for shipment from manufacturer's facilities.

2.3.3.4 Service

The variable speed drive shall be supplied with the following:

a. One-year parts and labor warranty.

b. A troubleshooting guide to help the building operator determine what steps must be taken to correct any problem that may exist in the system.

2.3.3.5 Basic Features

The variable speed drive shall have the following basic features:

a. Hand/Off/Auto Operation.

b. Manual/Auto speed reference switch.

c. Minimum/maximum adjustable speeds.

d. Speed potentiometer.

e. Auto restart.

f. Linear timed acceleration and deceleration for soft starting/stopping.

g. 3-63 Hz controlled speed range. (Factory set at 15 Hz minimum).

h. Terminal connections for time clock control, fire, smoke, freeze detectors, and EP relay pre-set speed override.

i. Output frequency terminals for remote metering.

2.3.3.6 Protective Circuits and Features

The variable speed drive controller shall include the following protective circuits/features:

a. Current limits to 100 percent design by slowing down motor.

b. Instantaneous Electronic Trip - automatically shutdown motor if current exceed 120 percent of design or phase-to-phase output short circuit occurs.

c. The variable speed drive will restart automatically when input line returns to normal in the event of intermittent power outage or phase loss or overvoltage shutdown.

d. Input power protection shuts down the unit if the following faults occur; low input line voltage or loss of an input phase.

e. Insensitive to incoming power phase.

f. Fast acting current limiting input fuses, (Class J) rated with 200,000 interrupting amperes capability.

g. Isolated 115 volt control circuit and dedicated control transformer.

h. Line-to-line fault protection.

i. Line-to-ground short circuiting and accidental motor grounding protection.

j. Output thermal overload relay trip.

2.3.3.7 Adjustments

The variable speed drive has the following adjustments available via potentiometers located on the faceplate of a single, regulator printed circuit board.

a. Minimum speed: 0-75 percent

b. Maximum speed: 100 percent

2.4 EQUIPMENT APPURTENANCES

2.4.1 Attachments

All necessary bolts, nuts. washers, bolt sleeves, and other types of attachments for the installation of the equipment shall be furnished with the equipment. Bolts shall conform to the requirements of ASTM A 307 and nuts shall be hexagonal of the same quality as the bolts used. Threads shall be clean-cut and shall conform to ASME B 1.1. Bolts, nuts. and washers shall be stainless steel type 316.

2.4.2 Equipment Guards

Equipment driven by open shafts, belts, chains, or gears shall be provided with all-metal guards enclosing the drive mechanism. Guard shall be constructed of galvanized sheet steel or galvanized woven wire or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps which will permit easy removal for servicing the equipment. The guards shall conform in all respects to all applicable safety codes and regulations.

2.4.3 Tools

A complete set of all special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment shall be furnished. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment. Special tools shall be high-grade, smooth, forged, alloy, tool steel. One pressure grease gun for each type of grease required for motors shall also be furnished. All tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such tools until completion of the work, at which time they shall be delivered to the Contracting Officer.

2.4.4 Shop Painting

All motors, pump casings, and similar parts of equipment customarily finished in the shop shall be thoroughly cleaned, primed, and given two finish coats of paint at the factory in accordance with the recommendations of the manufacturer. Ferrous surfaces not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.

PART 3 EXECUTION

3.1 INSTALLATION

Each pump and engine shall be installed in accordance with the written instructions of the manufacturer and under the supervision of the manufacturer's representative.

3.1.1 Concrete Foundations

Concrete for equipment foundations and for any required ballast for fuel storage tanks shall be as specified in Section 03301 CONCRETE FOR BUILDING CONSTRUCTION. Concrete foundations shall be integral with and of the same class as that of the building floor unless otherwise indicated. Concrete having a compressive strength of at least 2,500 psi shall be used in foundations that are entirely separated from the surrounding floor. A premolded filler strip shall be installed between the foundation and floor slab as shown. Foundation bolts, as required, shall be furnished for proper positioning during the placement of the concrete.

3.2 TESTS

After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. The Contractor shall make arrangements to have the manufacturer's representatives present when field equipment tests are made. Each pumping unit shall be given a running field test in the presence of the Contracting Officer for a minimum of 2 hours. Each pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the Contracting Officer. The Contractor shall provide an accurate and acceptable method of measuring the discharge flow. Tests shall assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

3.3 FIELD PAINTING

Stainless steel, galvanized steel, and nonferrous surfaces shall not be painted.

3.3.1 Touch-Up Painting

Factory painted items requiring touching up in the field shall be thoroughly cleaned of all foreign material and shall be primed and topcoated with the manufacturer's standard factory finish.

3.3.2 Exposed Ferrous Surfaces

Exposed ferrous surfaces shall be painted with two coats of enamel paint conforming to FS TT - E-489, Class A. Factory primed surfaces shall be solvent-cleaned before painting. Surfaces that have not been factory primed shall be prepared and primed with one coat of FS TT - E-489, Class A or in accordance with the enamel paint manufacturer's recommendations.

3.4 MANUFACTURER'S REPRESENTATIVE

The Contractor shall obtain the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installation, adjustment, and testing of the equipment. Up to 5 days service shall be provided at no expense to the Government.

3.5 DEMONSTRATION

Upon completion of the work and at a time designated by the Contracting Officer, the services of one or more competent engineers shall be provided by the Contractor for a training period of not less than 8 hours to instruct a representative of the Government in the operation and maintenance of equipment furnished under this section of the specifications. These field instructions shall cover all the items contained in the bound instructions.

-- End of Section --

SECTION 13206

STAINLESS STEEL PROCESS 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 basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API 650	(1993) Welded Steel Tanks for Oil Storage

AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

ASTM A 240	(1993b) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

[redacted]

[redacted]

1.2 GENERAL REQUIREMENTS

[redacted]

[redacted]

1.2.2 Design Requirements

The process tank shall have a storage capacity as shown on drawing. Tank details not shown on drawings to be designed accordance with API 650. No additional thickness for corrosion allowance will be required. Allowable stresses shall be per ASME II, Part D, Division 1. The maximum allowable design stress shall not exceed 70% of the materials specified min. yield strength at the design temperature. If the vendor feels that it is necessary or prudent to make additional departures from API 650, in addition to those already allowed on the drawings or in this specification, these exceptions shall be clearly stated in the vendor's bid. Drawing review by RAAP or Stone & Webster Engineering Corporation does not relive the manufacturer of the responsibility to comply with the codes, standards, drawings, process sketches, and specifications. Lifting lugs shall be provided on shop fabricated tanks where necessary for installation, plant operation, or maintenance.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-03 Data

General Requirements; GA.

Design analyses and calculations.

SD-02 Drawings

Stainless Steel Process Tanks; GA.

Detail and erection drawings, before proceeding with any fabrication. The drawings shall be complete with details of all steel, pipe, and concrete work and with details of the assembling of all items required for the complete installation. Standard welding symbols as recommended by the American Welding Society shall be used. Details of all joints referenced on the drawings shall also be included.

SD-06 Reports

Tank Installation; GA. Testing of Valves and Piping; GA; Mill test; GA.

Copies of the following test results:

a. Manufacturer's mill test reports for tank shapes and plate material.

b. Mill and shop inspections by a commercial inspection agency.

c. After acceptance of the structure, the radiographic film and/or test segments.

d. At the conclusion of the work, a written report prepared by the Contractor certifying that each tank was designed, fabricated, erected and tested in accordance with the applicable specifications and drawings.

SD-07 Certificates

General Requirements; GA.

A certificate signed by a registered professional engineer, providing the following information:

a. A statement verifying that the detail drawings have been checked by experienced engineers specializing in hydraulic structures to determine that they agree with the design calculations in member sizes, dimensions, and fabricating process as prescribed by the applicable API 650 standards.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the following requirements:

2.1.1 Steel and Other Tank Materials

? Stainless steel 316L as per ASTM A 240. Materials and allowable stresses shall be from ASME Sec. 8, Division 1.

2.1.2 Shop Fabrication

Fabrication per drawings, specs, and API 650.

2.2 ASSEMBLIES

2.2.1 Tank Accessories

Accessories to be designed and detailed per minimum requirement of API 650, Section 3 and as hereinafter specified. Additional requirements for accessories are as follows:

2.2.1.1 Pipe Connections•

Section 3 of API 650 represents the minimum requirements. Number, type, location, and size of manholes and pipe connections will be as shown on the drawings. Flanges for process connections, which are 24 inches or smaller, shall be according to ANSI B16.5, latest edition. Flanges for process connections, which are within the size range of 26" to 60", inclusive, shall be in accordance with API 650.

2.2.2 Anchors

The following requirements shall be met:

a. An adequate number of anchors designed to prevent overturning of the stainless-steel process tank when empty shall be installed. If anchor bolts are used, the nominal diameter shall not be less than 25 mm (1 inch) 3/4 inch, plus a corrosion allowance of at least 6 mm (1/4 inch) 1/4 inch on the diameter.

b. The anchor bolts shall be a right angle bend, hook, or plate washer. The anchors shall be inserted into the foundation to resist the computed uplift.

c. Attachment of anchors to the shell shall not add significant localized stresses to the shell. The method of attachment shall consider the effects of deflection and rotation of the tank shell. Anchors shall not be attached to the tank bottom. Attachment of the anchor bolts to the shell shall be through stiffened chair-type assemblies or anchor rings of adequate size and height.

PART 3 EXECUTION

3.1 EXCAVATING, FILLING, AND GRADING

Excavating, filling, and grading shall conform to the applicable requirements of Section 02222 [redacted] EXCAVATION, FILLING, AND BACKFILLING [redacted].

3.2 TANK FABRICATION

The fabricator shall locate longitudinal and girth weld seams so they do not interfere with welded attachments such as pipe connections. Location of all weld seams shall be indicated on the fabricator's drawings. A clearance of not less than 1.5 times the plate thickness shall be maintained from the edge of any weld and the toe of any other weld. Weld all clips with fillet welds all around. All interior welds shall be ground smooth. All exterior welds shall be continuous and shall be chipped free of all scale, spatter, and carefully inspected for imperfections. Upon completion, tank shall be broom-cleaned. All rods, stubs, slag, or foreign matter shall be removed, and the interior shall be pickled.

3.3 TANK INSTALLATION

Tank installation shall be in accordance with Attachment 1 and Section 05093 [redacted]

[redacted]

All seams shall be full penetration double-welded butt joints in accordance with paragraph 3.1.1.1 of API 650. Only ASME listed welding rods, wire, and flux shall be used in accordance with the welding procedure specifications. Qualification welders by use of radiographs is not acceptable. All other joints shall be full penetration double-welded joint. Welder qualification must be by samples for mechanical testing in accordance with ASME Code, Section IX.

3.3.1.1 Welding Equipment

All equipment used in welding or welding preparation shall be covered or faced with material, which will prevent mild steel articles from contaminating the stainless steel material. Equipment used to prepare welded joints, such as ground clamps, wire brushes, steel wool, chisels, files, and peen hammers shall be made of stainless steel. Grinding wheels shall be those which have been used solely for stainless steel.

3.3.1.2 Carbon Steel

Carbon steel shall not be welded directly to stainless steel vessels. A stainless steel pad equal to the thickness of the shell shall be welded to the shell and the carbon steel then attached to the pad.

3.3.1.3 Contamination

Every method and technique which will minimize carbon contamination in cutting, fabrication, transportation, storing, and erecting shall be employed. Signs of improper welding, such as rust or other forms of corrosion on stainless vessels, are grounds for rejection.

3.3.1.4 Welding Processes and Rods

Only shielded metal arc welding (SMAW), or automatic submerged arc welding (SAW), or manual and automatic inert gas tungsten arc welding (GTAW-TIG) shall be used. Only low hydrogen welding rods shall be used. Electrodes, filler metals, and flux-wire combinations shall be selected so that the principal elements in the weld metal are of the same nominal composition

[redacted] have as good mechanical properties as the base metal. Electrodes and all filler metals [redacted] be clean and [redacted] of dampness, grease or oxidation. Manufacturer's storage pr[redacted]ures for welding rod and filler w[redacted]hall be followed. When Tungsten Ine[redacted] (TIG) welding is used, shielding gas protection shall be app[redacted] on the underside [redacted] the weld. Welding grade Argon or Helium-Argon mixture shall be used. Elec[redacted]ll be non-consumable tungsten AWS 5.12, type EWTh - 2 for direct curre[redacted] type EWTh-e for alte[redacted] current. Filler metal rods for wall thicknesses ab[redacted].125 inch shall comply to AWS 5.9 as follows: [redacted] Material A151 316L, a[redacted]ode ER 317L. Shielded metal arc welding electrodes shall confo[redacted]WS [redacted].4 as follows: Shell Material AISI 316L and Electrode ER 317L.

3.3.2 Erection

Erection shall be in conformance with applicable specs, drawings, procedures, and API 650.

3.3.3 Inspections and Testing

Tank inspections and testing shall be in accordance with Attachment 1, Class Nitrocellulose (NC) Tank and Tubs-Fabrication, Erection and Testing. The Contractor shall perform the hydrostatic test all of the tank. Weld bevels shall be smooth, without cracks, defects, or uneven edges. As a minimum, all slag or flux shall be removed and the welds be visually inspected for smoothness, undercuts, non-penetration, porosity and, in general, that the weld is a quality weld.

3.3.3.1 Tolerances

Maximum out-of-plumbness, roundness peaking and banding for the shell shall be in strict accordance with API 650, Par. 4.4. Any deviation from these may be cause for tank rejection.

3.3.3.2 Hydrotesting

The method for hydrotesting the tank shell shall be by water filling. Tank shall be successfully hydrotested in the shop before shipment or at the site for field fabricated tanks. Water for testing stainless steel tanks shall have a maximum chloride content of 50 (fifty) ppm. Water with a chloride content not exceeding 200 ppm may be used when treated with 5 pounds of sodium nitrate per 1,000 gallons of water. [redacted]

3.3.3.3 Contamination

Stainless steel tanks shall be inspected for carbon or iron contamination and any affected areas shall be pickled and passivated.

ATTACHMENT 1
Class Nitrocellulose (NC) Tanks and Tubs-Fabrication, Erection and Testing Requirement

-- End of Section --

ATTACHMENT 1

CLASS NITROCELLULOSE (NC) TANKS AND TUBS - FABRICATION, ERECTION AND TESTING REQUIREMENTS

TYPE

CLASS

NO.	TITLE

DO NOT SCALE DRAWING

REFERENCE DRAWINGS

TOLERANCES UNLESS OTHERWISE SPECIFIED

DECIMAL ± _____

FRACTIONAL ± _____

ANGULAR ± _____

RADFORD ARMY AMMUNITION PLANT

U. S. ARMY

RADFORD, VIRGINIA

HERCULES INCORPORATED

APPROVED FOR GENERAL DESIGN AND SPECIFICATIONS

FOR HERCULES INCORPORATED

Logan R. Neel 12/12/89

ENGINEERING DEPT. DATE

FOR U. S. GOVERNMENT

12/18/89

DATE

BUILDING — NO. —

AREA: GPA DEPT.: ACID/NC

TITLE

WELDING & FABRICATION REQUIREMENTS - CLASS "NC"

SCALE: — DATE: DEC. 5, 1989

DRAWN BY: — CHECKED BY: —

APPROVALS

12/8/89

C.L. CAINES DEPT. SUPT.

12/11/89

SAFETY SUPT.

THIS DRAWING SHALL NOT BE USED OR REPRODUCED EITHER WHOLLY OR IN PART EXCEPT WHERE AUTHORIZED IN CONNECTION WITH PROCUREMENT FOR THE UNITED STATES GOVERNMENT.

PROJ: CONTRACT NO. DAAA09-86-Z-0003

ACCOUNT NO.	SERIAL NO.	CLASS. CODE	REV.
000000	424 06	F300	01

CLASS NITROCELLULOSE (NC) TANKS AND TUBS - FABRICATION, ERECTION AND TESTING REQUIREMENTS

1.0 Scope: This drawing lists material, design, fabrication, erection, examination, and testing requirements for vertical cylindrical, aboveground, closed- and open-top welded steel storage tanks and tubs in various sizes and capacities for internal pressures approximating atmospheric pressure. The vessels covered by this drawing are those whose primary function is the processing and storage of nitrocellulose.

2.0 General Requirements for Ferrous and Non-Ferrous Construction and Repairs

[redacted]

2.2 References: The latest edition (or the edition indicated) of the following standards and codes form a part of this specification:

American Petroleum Institute (API) Standard 650, "Welded Steel Tanks for Oil Storage"

American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (hereinafter referred to as the ASME Code)

[redacted]

2.3 In general, design, fabrication, assembly and erection, examination, inspection, and testing shall meet the minimum requirements of the latest applicable edition of the American Petroleum Institute (API) Standard 650. It should be recognized that this standard is for oil storage tanks and some requirements may not apply. Additionally, more stringent requirements specified by Hercules Incorporated must be met.

2.3.1 The term "purchaser" as used throughout API 650 shall be understood as referring to Hercules Incorporated.

2.3.2 The term "manufacturer" as used throughout API 650 and this drawing shall be understood as referring to the vendor(s) or firm(s) subcontracted by Hercules Incorporated to perform their respective work, U.S. Army Corps of Engineers contractor(s), or they may be Hercules Incorporated, RAAP employees performing the work.

[redacted]

4.0 Materials

[redacted]

Incorporated drawings and specifications. Where the materials specified are other than those listed and allowed by API 650, Section 2 - Materials, then alternately the material shall meet the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division I, Subsection C for specification and design stress values.

4.2 Substitution (including thicker wall materials) is not permitted without written authority from Hercules Incorporated.

[redacted]

4.3 All tank or tub materials, nozzle components, flanges, fasteners, etc. shall be marked per their applicable specifications. Traceability by unique markings and supporting Certified Material Test Reports (MTR) or Certificates of Compliance (COC) shall be provided as required by Hercules Incorporated specifications.

[redacted]

Quality Control Plan or Quality Control Manual to Hercules Incorporated for approval, that outlines how the Manufacturer's own Quality Control Function (including both the program and personnel) will perform and document the required examinations and tests that assure that the requirements of drawings and specifications are met. Additionally, the Manufacturer shall submit relevant qualifications and experience information on their designated QC Examination

[redacted]

6.0 Fabrication and Erection

[redacted]

[redacted]

6.3 Dimensional Tolerances: The purpose of the tolerances listed below is to produce a tank or tub of acceptable appearance that will provide a long operating life.

6.3.1 Plumbness: The requirements for plumbness shall be as shown in API 650, Paragraph 5.5.2.

6.3.2 Roundness: The requirements for roundness shall be as shown in API 650, Paragraph 5.5.3

7.0 Welding

7.1 In general, the welding procedures should be designed to produce welds that are of sufficient strength to carry the intended loads, that will offer resistance to corrosion equivalent to that of the base metal, with no cracks or crevices inside or outside the vessel which are detectable using one or more of the Non-Destructive Examination methods listed hereinafter.

7.2 Welding Processes: All welding shall be performed using any of the following welding processes: Shielded Metal Arc Welding (SMAW), Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW), Flux-Cored Arc Welding.

7.3 Joint design: All tank or tub weld seams shall be full penetration, double-welded butt joints as defined in API 650 paragraph 3.1.1.1. Welds for nozzle penetrations shall be in accordance with the applicable drawings.

7.4 Welding procedures and performance qualifications.

7.4.1 All welding (including tack welding) shall be performed in accordance with Welding Procedure Specifications (WPS) qualified by one or more Procedure Qualification Records (PQR) in accordance with API 650 paragraph 7.2.1.1 which references Section IX of the ASME Code.

7.4.2 All persons performing welding (including tack welds) shall be qualified and certified by the Manufacturer in accordance with API 650 Paragraph [illegible] (which also references Section IX of the ASME Code) for the applicable WPS's used in accordance with paragraph 7.4.1 above.

7.4.3 The Manufacturer shall submit copies of all applicable WPS's, PQR's and each Welder or Welding Operator Qualification Records (WPQ) to Hercules Incorporated for approval, prior to any welding. Additionally, the Manufacturer shall submit documented evidence of current qualification, or renewal of qualification for each welder, welding operator.

7.5 Weld seams shall be identified by welder in accordance with API 650 paragraph 7.4.

7.6 Welding electrodes and fillers shall be in accordance with Hercules Incorporated specifications. Only those electrodes and fillers as identified on the approved WPS's shall be used by the Manufacturer. Substitution of electrodes or fillers is prohibited unless the substitution is approved by Hercules Incorporated, the WPS is properly qualified for the substitution, and the WPS is properly revised by the Manufacturer.

[redacted]

recommended by their manufacturers. Electrodes shall be purchased in sealed containers. All electrodes and fillers must be kept clean and dry. Exposed electrodes must be kept dry once the container seals are broken. Portable Storage Ovens shall be at the job site heated to the proper temperature recommended by their manufacturer. At the end of the work day, remaining electrodes shall be removed from portable ovens and returned to their controlled storage ovens which must be kept at the electrode manufacturer's recommended temperatures.

7.8 Base Metal Preparation of the edges of the surfaces to be joined by welding shall be prepared by machining, sawing, plasma cutting or grinding. Surface oxides shall be removed after thermal cutting. The welding grooves shall be smooth, free of notches or harmful irregularities, clean of all oil, grease, cutting fluids or oxides, and shall meet the dimensional requirements of the approved Hercules Incorporated specifications, the drawing, and other applicable drawings.

7.9 Weld Joint alignment, fit-up, preheating and interpass temperature maintenance shall be in accordance with the approved fabrication drawings and applicable WPS's.

7.10 The edges of all welds shall merge with the surface of the plate without a sharp angle. The maximum acceptable undercutting is 1/64 inch in depth for vertical butt joints. For horizontal butt joints, undercutting not exceeding 1/32 inch in depth is acceptable.

7.11 The reinforcement of the welds on all butt joints on either side of the plate shall not exceed 3/32 inch on vertical joints and 1/8 inch on horizontal joints. The reinforcement need not be removed except to [redacted]

7.12 Welding of the bottom and roof plates shall be done in such a sequence that the Manufacturer has found to result in the least distortion from shrinkage and thus to provide as nearly as possible a plane surface.

[redacted]

[redacted]

7.15 Temporary items (lifting lugs, alignment clips, etc.) welded to the tank or tub material shall be of the same material as the base metal. These items shall be completely removed and metal surface left with a smooth surface.

8.0 Inspection, Examination, and Testing

8.1.1 Inspections: All references to "Inspection(s)" shall be understood by the Manufacturer as referring to inspections performed by representatives of Hercules Incorporated.

8.1.2 Examinations: All references to "Examinations(s)" shall be understood by the Manufacturer as being those quality control functions required to be performed by the Manufacturer by this drawing and the applicable Hercules Incorporated drawings and specifications. The person(s) performing these examinations shall be free from production pressure, shall be given the responsibility and authority to perform the required examinations and be free to take corrective action for any non-conformance arising from non-compliance to the approved drawings, specifications, and procedures. Additionally, the QC Examiners are responsible to bring all non-conformances to the attention of the Hercules representative for approval, prior to taking corrective action (including repairs).

8.1.3 Hercules Representative: All references to the "Hercules Representative" shall be understood to mean any employee(s) of Hercules Incorporated that are assigned responsibility for the particular project or subcontract under which the work is being carried out.

8.2 The Hercules Representative shall have access to any place where work concerning tank or tub fabrication or erection is being performed. This includes manufacture, fabrication (including shop fabrication), assembly, erection, examination and testing of the tank or tub. The Hercules Representative shall have the right to inspect the tank or tub using any examination method specified by the design document, review all certifications, records, and test reports to the

8.3 Examination Requirements:

8.3.1 Liquid Penetrant Examination (PT): A minimum of 5% of all fabrication for <u>each</u> welder's and welding operator's work performed by the Manufacturer shall pass a Liquid Penetrant Examination (PT) performed to approved written procedure(s) in accordance with API 650 paragraph 6.4. Personnel qualification and examination procedures shall be in accordance with Section V, Articles 1 and 6, respectively, of the ASME Code. The Hercules Representative shall determine the areas to be examined.

8.3.1.1 If the spot examination reveals that any weld fails to meet the minimum quality requirements, two additional segments of the weld of the same length as the original segment shall be examined by the same procedure in the same weld unit at locations away from the original segment. The locations of these additional segments shall be determined by the Hercules Representative. If the two additional weld segments examined meet the quality requirements, the entire weld unit represented by the three segments is acceptable, provided the defective welding disclosed by the first of the three segment examinations is removed and the area repaired by welding. The repaired weld area shall be re-examined.

8.3.1.2 If either of the two additional segments examined show welding which does not comply with the minimum quality requirements, the entire unit of weld represented shall be rejected. The entire rejected weld shall be removed and the joint shall be re-welded, or at the Manufacturer's option, the entire unit of weld represented shall be completely examined and defective welding only corrected.

8.3.2.1 One hundred percent (100%) of all fabrication by the Manufacturer shall be subjected to visual examination by the Manufacturer. Examination shall be performed to an approved written procedure in accordance with the ASME Code, Section V, Article 9. Qualification of examiner(s) shall be in accordance with one or more of the following:

- ASME Code, Section V, Article 1
- AWS QC1, Standard for Qualification and Certification of Welding Inspectors
- ASNT Recommended Practice No. SNT-TC-IA

8.3.2.2 Acceptance Criteria for Visual Examination: One or more of the following defects if detected by visual examination and/or during hydrostatic testing shall be cause for rejection.

(1) Welding performed by unqualified persons.

(2) Cracks or pinholes.

(3) Evidence of peening.

(4) Oxidation around welds.

(5) Welds not uniform in appearance.

(6) Lack of fusion or incomplete penetration (none

~~(7) [illegible]~~

~~(8) Undercutting adjacent to completed weld or evidence of undercutting by grinding in excess of that stated in paragraph 7.10 of this drawing.~~

~~(9) Misalignment exceeding the requirements listed in 7.13 of this drawing.~~

~~(10) Reinforcement exceeding the requirements listed in paragraph 7.11 of this drawing.~~

~~[illegible]~~

8.3.3 Radiographic Examination: For vessels in which the stressed components have a nominal thickness of 1/2" or greater, welds shall be radiographically examined in accordance with Paragraph 6.1 of API 650. "Stressed components" shall be as defined in API 650, Appendix A, Paragraph 1.1. Personnel qualification and procedures shall be in accordance with Section V, Articles 1 and 2 of the ASME Code.

~~[illegible] the authority of the Hercules Representative. Defects [illegible] to acceptable levels, as verified by approved NDE methods, must provide any allowed repairs. All repairs must be documented, as per the approved Quality Program in Paragraph 5.0 of this drawing. Repairs shall be performed using a qualified procedure. The repaired areas shall be [illegible]~~

8.3.5 Examination to Resolve Uncertainty: Any applicable, recognized NDE method as listed in API 650 may be used to resolve doubtful indications. Acceptance criteria shall be those as listed for the required examination(s).

9.0 <u>Hydrostatic testing</u> shall be performed on each NC tank or tub after completion of other required NDE examinations. The Manufacturer shall blank off all openings so that the tank or tub may be filled with water and allowed to stand for a period of 24 hours. Manufacturer shall furnish blanks and teflon gaskets for testing. If leaks develop, Manufacturer shall drain tank or tub to at least one foot below the defect, repair the defect, and test again. Testing shall be performed until it is ascertained that no leaks are present. After a successful test, Manufacturer shall drain tank or tub.

10.0 Documentation, Records, and Markings

10.1 The Manufacturer shall submit to [redacted] copies of all required Mill Test Reports, Certificates of Compliance, reports of liquid penetrant examinations, all radiographic film, reports of radiographic examinations, and weld maps showing locations of areas examined by both liquid penetrant and radiography (where applicable). (NOTE: This is in addition to the documentation and certifications required hereinbefore.)

10.2 The Manufacturer shall affix a nameplate to each tank or tub in accordance with the specifications.

10.3 Letter of Certification: The Manufacturer shall provide a letter of certification for each tank or tub stating that the vessel was designed, fabricated, erected, and tested in accordance with the applicable Hercules Incorporated specifications and this drawing.

SECTION 13850

FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP
02/02

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 basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41	(1990; R 1996) Audible Emergency Evacuation Signal

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 72	(1999) National Fire Alarm Code
NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1971	(1995; Rev thru Apr 1999) Signaling Devices for the Hearing Impaired
UL 268	(1996; Rev thru Jan 1999) Smoke Detectors for Fire Protective Signaling Systems
UL 268A	(1998) Smoke Detectors for Duct Application
UL 38	(1999) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
UL 464	(1996; Rev thru May 1999) Audible Signal Appliances
UL 521	(1999) Heat Detectors for Fire Protective Signaling Systems
UL 6	(1997) Rigid Metal Conduit

UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 864	(1996; Rev thru Mar 1999) Control Units for Fire Protective Signaling Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire Alarm Reporting System;

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

SD-03 Product Data

Storage Batteries;

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop;

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Spare Parts; G

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced

after 1 year of service.

Technical Data and Computer Software; G

Technical data which relates to computer software.

Training; G

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

Testing; G

Detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

SD-06 Test Reports

Testing; G

Test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. The Contractor shall include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

SD-07 Certificates

Equipment; G

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Qualifications; G

Proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years

prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

1.3.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.3.3 Keys and Locks

Locks shall be keyed alike. Four keys for the system shall be provided.

1.3.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.3.5 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3.6 Compliance

The fire detection and alarm system and the central reporting system shall be configured in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.3.7 Qualifications

1.3.7.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

1.3.7.2 Installer

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 3 4 Fire Alarm Technician shall supervise the installation of the fire alarm system. NICET Level 2 or higher Fire Alarm Technician shall install and terminate fire alarm devices, cabinets and panels. An electrician or NICET Level 1 Fire Alarm Technician shall install conduit for the fire alarm

system. Fire Alarm Technicians to perform the installation of the system. A Fire Alarm Technician with a minimum of 4 years of experience shall perform/supervise the installation of the fire alarm system. Fire Alarm technicians with a minimum of 2 years of experience shall be utilized to assist in the installation and terminate fire alarm devices, cabinets and panels. An electrician shall be allowed to install wire or cable and to install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.4 SYSTEM DESIGN

1.4.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm reporting system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D, in accordance with NFPA 72. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Z in accordance with NFPA 72. Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc.

1.4.2 Operational Features

The system shall have the following operating features:

a. Monitor electrical supervision of alarm IDC and NAC. Smoke detectors shall not have combined alarm initiating and power circuits.

b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.

c. A trouble buzzer and trouble light emitting diode (LED) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.

f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed zone and the NAC devices will be activated.

g. Confirmation or verification modules for smoke detection initiating circuits. The modules shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices, other than smoke detectors, will be prohibited on circuits controlled by confirmation or verification modules.

h. Provide one person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

i. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall.

j. The fire alarm control panel shall provide the required modules to monitor and control the fire sprinkler system, or other fire protection extinguishing system.

m. Zones for alarm IDC and NAC shall be Provide one zone for the whole building.

n. The fire alarm control panel shall be readily capable of future expansion and modification by qualified technicians. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.

1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of a signal over the station radio fire reporting system. The signal shall be common for all zones.

b. Visual indications of the alarmed zone on the fire alarm control panel annunciator .

c. Continuous sounding or operation of alarm notification appliances

throughout the building as required by ANSI S3.41.

1.4.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.5 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

(1) Identification of programmable portions of system equipment and capabilities.

(2) Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.

(3) Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.

(4) Description of Fire Alarm Control Panel equipment operation.

(5) Description of auxiliary and remote equipment operations.

(6) Library of application software.

(7) Operation and maintenance manuals described under SD-19 in the SUBMITTALS paragraph.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection

from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

PART 2 PRODUCTS

2.1 CONTROL PANEL

Control panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LEDs, zones, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble LEDs shall be provided for each zone alarm. These LEDs shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Each IDC shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including batteries, shall not require the reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Visual annunciators shall be provided for each active zone and spare zone. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red.

2.1.1 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

2.1.2 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located at the bottom of the panel. Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery

cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel.

2.3 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

2.4 MANUAL FIRE ALARM STATIONS

Manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on surface mounted outlet boxes. Manual stations shall be mounted at 54 inches. Stations shall be single action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations.

2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed.

2.5.1 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator LED that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections.

2.5.1.1 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268.

2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible

appliances shall be painted red.

2.6.1 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box surface mountedvibrating type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 85 dBA at 10 feet.

2.6.2 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 75 candela. Strobe shall be surface mounted.

2.6.3 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units, except that they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.7.1 Conduit

Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.

2.7.2 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. Wiring for Fire Alarm circuits shall be No. 16 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited.

2.7.3 Special Tools and Spare Parts

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Spare fuses shall be mounted in the fire alarm panel.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown, and in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and

recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor. Manually operable controls shall be between 36 and 42 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location.

3.1.5 Notification Appliances

Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

3.2 OVERVOLTAGE AND SURGE PROTECTION

3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses

shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

3.2.2 Low Voltage DC Circuits Surge Protection

All IDC, NAC, and communication cables/conductors, except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

3.4 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

3.4.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

a. Test of each function of the control panel.

b. Test of each circuit in both trouble and normal modes.

c. Tests of each alarm initiating devices in both normal and trouble conditions.

d. Tests of each control circuit and device.

e. Tests of each alarm notification appliance.

f. Tests of the battery charger and batteries.

g. Complete operational tests under emergency power supply.

h. Visual inspection of wiring connections.

i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.

j. Ground fault.

k. Short circuit faults.

l. Stray voltage.

m. Loop resistance.

3.5 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of 1 hour and shall start after the system is functionally completed but prior to final acceptance tests. The training period for systems maintenance shall consist of 1 hour and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system.

-- End of Section --

SECTION 13852

FIRE ALARM REPORTING SYSTEM, RADIO TYPE
11/97

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 basic designation only.

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/TIA/EIA-222-F	(1996) Structural Standards for Steel Antenna Towers and Antenna Supporting Structures

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(1993) Industrial Control and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 72	(1996; Errata Oct 96, Dec 96; TIA 96-1, 96-2, 96-3) National Fire Alarm Code
NFPA 780	(1997) Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours.

1.2.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.2.3 Tags

Tags with stamped identification numbers shall be furnished for keys and locks.

1.2.4 Keys and Locks

Locks shall be keyed alike.

1.2.5 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.2.6 Compliance

The central reporting system shall comply with NFPA 72. The equipment furnished shall be listed by Underwriters Laboratories, or Factory Mutual Engineering and Research, or be approved or listed by a nationally recognized testing laboratory.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

SD-03 Product Data

Battery; G.

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component, each panel component and the battery recharging period shall be included.

Qualifications; G.

Qualifications, with verification of experience and license number, of a Registered Professional Engineer with at least 4 years of current experience in the design of fire protection and detection systems. This engineer must perform the various specification items required by this section to be performed by a

Registered Professional Engineer.

Fire Alarm Reporting System; G,.

Six complete copies of operating instructions outlining step-by-step procedures required for system startup, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. Instructions shall be approved prior to training.

Test Procedures; G.

Detailed test procedures for the fire alarm reporting system 60 days prior to performing system tests. The test procedures shall be signed by the Registered Professional Engineer.

SD-06 Test Reports

Testing; G.

Test reports in booklet form showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document all readings, test results and indicate the final position of controls.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be protected from the weather, humidity and temperature variations, dirt, dust, and other contaminants.

1.5 ELECTRICAL SUPERVISION

Electrical supervision shall be provided for all circuits and for all positions of interface panel control switches.

PART 2 PRODUCTS

2.1 RADIO FIRE ALARM TRANSMITTER (TRANSCEIVER)

Provide a Monaco Transceiver BT2-7, 4 zones.

2.1.1 Frequency Allocation

The transmitters shall operate on a frequency compatable with the Radford Arsenal-Fire Department-Base Station.

2.1.2 Power Requirements2.1.2.1 Battery Power

The battery package shall be capable of supplying all the power requirements for a given transmitter.

2.1.2.2 Battery Duration

Radio fire alarm transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 60 hours and shall be capable of transmitting alarms during that period. The capacity for battery-only powered transmitters shall be 6 months before recharging is necessary.

2.1.2.3 Battery Supervision

Each radio fire alarm transmitter shall constantly monitor and supervise its own battery powered supply. A low-battery condition shall be reported when battery voltage falls below 85 percent of the rated voltage.

2.1.3 Functional Requirements

2.1.3.1 Interfacing Indicators and Controls

Transmitters shall incorporate the provisions for auxiliary interconnection to existing interior alarm systems.

2.1.3.2 Generation of Signals

Each transmitter shall be a standard design which allows the immediate transmission of all initiated signals.

2.1.4 Transmitter Housings

The housings on transmitters shall be fabricated from corrosion-resistant cast metal or suitable substitute which has the physical strength sufficient to ward off physical damage normally expected to be received by vandalism. The housing shall be sealed against the entry of moisture, dust, dirt, insects, and other foreign objects.

2.1.4.1 Mounting

Transmitter housings shall be designed for mounting on walls, . Mounting shall utilize either lag bolts, or anchor bolts .

2.1.5 Painting

Radio fire alarm transmitter and interface housings shall be factory painted. The finish color shall be fire engine red. Painted surfaces damaged during installation shall be repainted to match existing paint.

2.2 RADIO TRANSMITTER INTERFACE DEVICE

The interface device shall provide a means of converting the signals that are available from the local control equipment into a form that is compatible with the transmitter inputs, while still maintaining electrical supervision of the entire system. Interface devices shall be utilized when direct connection between local control equipment and the transmitter is not possible. Interface devices shall be completely assembled, wired, tested at the factory, and delivered ready for installation and operation.

2.2.1 Enclosure

When furnished as an independent self-contained device, the interface device shall be incorporated into an enclosure conforming to NEMA ICS 1or other national standard as required by its location.

2.2.2 Indicators

Indicators shall be provided to indicate alarm and trouble conditions and shall consist of a red fire alarm and an amber trouble light. The indicators shall be designed to ensure visibility during daylight hours and to indicate the reporting zone.

2.2.3 Access

Switches and other controls shall not be accessible without the use of a key. Access to controls shall be by unlocking and opening a panel or door.

2.2.4 Mounting

Interface housings shall be designed for mounting on walls, . Mounting shall utilize either lag bolts, or anchor bolts.

2.2.5 Inputs/Outputs

Each interface panel shall provide, as a minimum, the number of alarm circuit inputs and outputs indicated. Each input circuit shall be arranged so that the alarm signals shall override the trouble signals.

2.3 FIRE ALARM SYSTEM PERIPHERAL EQUIPMENT

2.3.1 Conduit

Conduit and fittings shall comply with UL 6, UL 1242, and UL 797.

2.3.2 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 5/8 inch in diameter by 8 feet in length.

2.3.3 Antenna

The antenna system shall utilize vertical polarization antennas, and matching networks as needed for the proper coverage. The antenna system shall be either omni-directional or shaped-coveraged as selected by the Contractor based on the topography. The antenna system and cabling shall be furnished to provide adequate system gain. The antennas shall be capable of withstanding the environmental conditions of 125 mph wind and 1/2 inch radial ice without failure. Lightning protection shall comply with NFPA 780. Antenna supporting structures shall comply with EIA ANSI/TIA/EIA-222-F. Antenna grounding conductors shall be minimum 32-strand, No. 17 AWG copper.

2.3.4 Wiring

Wiring shall be in accordance with NFPA 70 and as indicated. Station wiring shall be color coded.

2.3.5 Special Tools and Spare Parts

Special tools necessary for the maintenance of the equipment shall be furnished. One spare set of fuses of each type and size required and 5 spare lamps of each type shall be furnished.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's recommendations, unless otherwise specified. Necessary interconnections, services, and adjustments required for a complete and operational system shall be provided. Electrical work shall be in accordance with NFPA 70.

3.1.1 Wiring

Wiring for systems shall be installed in rigid conduit, intermediate metallic conduit, or electric metallic tubing. The conductors for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. The sum of the cross-sectional areas of individual conductors shall not exceed 40 percent of the interior cross-sectional area of the conduit. Conduit shall comply with NFPA 70. Ample gutter space to accommodate necessary wiring shall be provided.

3.2 GROUNDING

Ground rods shall not protrude more than 6 inches above grade. Noncurrent-carrying metallic parts associated with radio fire alarm equipment shall have a maximum resistance to solid "earth" ground not to exceed 25 ohms.

3.3 TESTING

The Contractor shall notify the Contracting Officer 30 days before the performance and acceptance tests are to be conducted. The tests shall be performed in the presence of the Contracting Officer under the supervision of the fire alarm system manufacturer's qualified representative. The Contractor shall furnish all instruments and personnel required for the tests.

3.3.1 Performance Testing

Upon completion of the installation, the system shall be subjected to a complete functional and operational performance test by the Contractor. Test shall determine that the system is free from grounded, shorted, or open circuits. When all corrections have been made, the system shall be retested to assure that it is functional. Copies of performance test reports shall be submitted in accordance with paragraph SUBMITTALS.

3.3.2 Acceptance Test

The testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that all previous deficiencies have been corrected. The tests shall include the following:

a. Tests to indicate there are no grounded, shorted, or open circuits.

b. Tests of each radio fire alarm transceiver.

c. Tests of radio fire alarm monitoring base station for all required functions.

d. Tests of normal and emergency power supplies.

3.3.3 Training

The Contractor shall conduct a training course for operating staff in the building where the system is installed as designated by the Contracting Officer. The training period shall consist of , 2 hours and shall start after the system is functionally completed but prior to the final acceptance tests. The field instructions shall cover all of the items contained in the approved operating and maintenance instructions.

-- End of Section --

SECTION 15080

THERMAL INSULATION FOR MECHANICAL SYSTEMS
07/02

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 basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM B 209M	(2001) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 1126	(2000) Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C 1136	(1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 449/C 449M	(2000) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 552	(2000) Cellular Glass Thermal Insulation
ASTM C 591	(2001) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 647	(1995; R 2000) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 665	(2001e1) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 795	(1992; R 1998el) Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM C 921	(1989; R 1996) Determining the Properties of Jacketing Materials for Thermal Insulation

ASTM D 882	(1997) Tensile Properties of Thin Plastic Sheeting
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 96	(2000e1) Water Vapor Transmission of Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	(1999) National Commercial & Industrial Insulation Standards

1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

1.3 GENERAL QUALITY CONTROL

1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.3.3 Surface Burning Characteristics

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. The outside surface of insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread, and smoke developed ratings, shall be determined by ASTM E 84. Allinsulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Jackets shall comply with the flame spread and smoke developed ratings required by ASTM C 921

1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and all samples required for

approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

General Materials; G.

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means.

PART 2 PRODUCTS

2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

2.1.1 Adhesives

2.1.1.1 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50 when tested in accordance with ASTM E 84. Adhesive shall be pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding fibrous glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

2.1.2 Contact Adhesive

Adhesives may be dispersed in a volatile organic solvent. Adhesives may be any of, but not limited to, the neoprane based, rubber based, or elastomeric type that have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in the dry state in accordance with ASTM E 84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation shall be used to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.1.4 Corner Angles

Nominal 0.016 inch aluminum 1 x 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

2.1.5 Finishing Cement

ASTM C 449/C 449M: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must include testing per ASTM C 795.

2.1.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Tape shall be 4 inch wide rolls.

2.1.7 Staples

Outward clinching type ASTM A 167, Type 304 or 316 stainless steel.

2.1.8 Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, (measured before factory application or installation), minimum puncture resistance 50 Beach units on all surfaces where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require factory applied jackets are mineral fiber, cellular glass, and phenolic foam. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when

tested in accordance with ASTM E 84.

2.1.8.1 White Vapor Retarder All Service Jacket (ASJ)

For use on hot/cold pipes, or equipment vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

2.1.8.2 Aluminum Jackets

Aluminum jackets shall be smooth sheet, 0.016 inch nominal thickness; ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture retarder. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 x 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 x 0.020 inch) thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburg or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.1.8.3 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.1.9 Vapor Retarder Required

2.1.9.1 Vapor Retarder Mastic Coatings

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C 647.

2.1.9.2 Laminated Film Vapor Retarder

ASTM C 1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.9.3 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested per ASTM D 882, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

2.1.9.4 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for PVDC Film Vapor Retarder in paragraph 2.1.9.2 above.

2.1.10 Vapor Retarder Not Required

ASTM C 1136, Type III, maximum moisture vapor transmission 0.10 perms, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.11 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.1.12 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

2.2 PIPE INSULATION MATERIALS

Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.2.1 Aboveground Cold Pipeline

Insulation for minus 30 degrees to plus 60 degrees F for outdoor, indoor, exposed or concealed applications, shall be as follows:

a. Cellular Glass: ASTM C 552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

b. Phenolic Insulation: ASTM C 1126, Type III. Phenolic insulations shall comply with ASTM C 795 and with the ASTM C 665 paragraph Corrosiveness. Supply the insulation with manufacturer's recommended factory-applied jacket.

c. Polyisocyanurate Insulation: ASTM C 591, type I. Supply the insulation with manufacturer's recommended factory-applied vapor retarder.

2.2.2 Below-ground Pipeline Insulation

For below-ground pipeline insulation the following requirements shall be met.

2.2.2.1 Cellular Glass

ASTM C 552, type II.

2.2.2.2 Polyisocyanurate

ASTM C 591, Type 1, to 300 degrees F.

2.3 EQUIPMENT INSULATION MATERIALS

Equipment insulation materials shall be limited to those listed herein and

shall meet the following requirements:

2.3.1 Cold Equipment Insulation

For equipment operating temperatures below 60 degrees F.

2.3.1.1 Cellular Glass

ASTM C 552: Type I, Type III, or Type IV as required.

2.3.1.2 Phenolic Foam

ASTM C 1126: Type II shall comply with ASTM C 795.

2.3.1.3 Polyisocyanurate Foam

ASTM C 591, Type I. Supply the insulation with manufacturer's factory-applied jacket.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests and heat tracing specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.2 Painting and Finishing

Painting shall be as specified.

3.1.3 Welding

No welding shall be done on piping, or equipment without written approval of the Contracting Officer. .

3.1.4 Pipes/Equipment which require insulation

Insulation is required on all pipes, or equipment, except for omitted items, as specified.

3.2 PIPE INSULATION INSTALLATION

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground cold pipeline systems as designated on the drawings to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

a. Pipe insulation shall be continuous through the sleeve.

b. An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.

3.2.1.3 Pipes Passing Through Hangers

a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed.

b. Horizontal pipes larger than 2 inches at 60 degrees F and above shall be supported on hangers in accordance with MSS SP-69.

c. Horizontal pipes larger than 2 inches and below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, calcium silicate (or perlite above 80 F), or the necessary strength polyisocyanurate shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall

be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C 1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Pipes in high abuse areas.

In high abuse areas such as traffic areas stainless steel jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

3.2.2 Aboveground Cold Pipelines

The following cold pipelines shall be insulated per Table I minus 30 degrees to plus 60 degrees F:

a. Filtered water
b. Drinking water

3.2.2.1 Insulation Thickness

Insulation thickness for cold pipelines shall be determined using Table I.

Table I - Cold Piping Insulation Thickness
Pipe Size (inches)

Type of Service	Material	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
Filtered water & drinking water piping	CG	1.5	1.5	2.0	2.0	2.0
	PF	1.5	1.5	1.5	1.5	1.5
	PC	1.0	1.0	1.0	1.0	1.0

LEGEND:

PF - Phenolic Foam
CG - Cellular Glass
PC - Polyisocyanurate Foam

3.2.2.2 Jacket for Cellular Glass, Phenolic Foam, and Polyisocyanurate Foam Insulated Pipe

Insulation shall be covered with a factory applied vapor retarder jacket or field applied seal welded PVC jacket. Insulation to be protected with an aluminum or stainless steeljacket, shall have the insulation and vapor retarder jacket installed as specified herein. The jacket shall be installed as specified for piping exposed to weather, In high abuse areas such as traffic areas stainless steel jackets shall be utilized. Pipe insulation to the 6 ft level shall be protected.

3.2.2.3 Insulation for Straight Runs (Cellular Glass, Phenolic Foam and Polyisocyanurate Foam)

a. Insulation shall be applied to the pipe with joints tightly butted. All butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape.

b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. If staples are used, they shall be sealed per item "e." below. Note that staples are not required with cellular glass systems.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating or PVDC adhesive tape. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating or PVDC adhesive tape.

f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating or PVDC adhesive tape. The patch shall extend not less than 1-1/2 inches past the break.

g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating or PVDC adhesive tape.

3.2.2.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow'.

c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, an

aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished.

3.2.3.1 Aluminum Jacket

The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

3.2.3.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof.

3.2.3.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.3 EQUIPMENT INSULATION INSTALLATION

3.3.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

a. Hand-holes.

b. Boiler manholes.

c. Cleanouts.

d. ASME stamps.

e. Manufacturer's nameplates.

3.3.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

a. Pumps.

3.3.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Thicknesses shall be as follows:

a. Equipment handling media between 35 and 60 degrees F: 1.5 inch thick cellular glass, 1 inch thick flexible elastomeric cellular, 1.5 inch thick phenolic foam, or 1 inch thick polyisocyanurate foam.

3.3.2.2 Pump Insulation

a. Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.

b. Exposed insulation corners shall be protected with corner angles.

c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Caulking shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.3.2.3 Vapor Retarder

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

SECTION 15200

PIPELINES, PROCESS PIPING AND ACID SEWER
05/01

PART 1 GENERAL

This specification covers pipe classes 47P, 12I, and 156L as indicated on the plans.

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 basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5L	(2000) Line Pipe

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(2000) Carbon Structural Steel
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded, and Seamless
ASTM A 105/A 105M	(1998) Carbon Steel Forgings for Piping Applications
ASTM A 106	(1999el) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 126	(1995el) Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 153/A 153M	(2000) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 181/A 181M	(2000) Carbon Steel Forgings, for General-Purpose Piping
ASTM A 182/A 182M	(2000) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 193/A 193M	(2000) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(2000) Carbon and Alloy Steel Nuts for

	Bolts for High-Pressure and High-Temperature Service
ASTM A 216/A 216M	(1993; R 1998) Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A 269	(2000) Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 312/A 312M	(2000) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 334/A 334M	(1999) Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM A 395/A 395M	(1988; R 1998) Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A 403/A 403M	(2000) Wrought Austenitic Stainless Steel Piping Fittings
ASTM A 423/A 423M	(1995) Seamless and Electric-Welded Low-Alloy Steel Tubes
ASTM A 436	(1984; R 1997el) Austenitic Gray Iron Castings
ASTM A 479/A 479M	(2000) Stainless Steel Bars and Shapes for use in Boilers and Other Pressure Vessels
ASTM A 513	(2000) Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A 576	(1990b; R 1995el) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A 780	(2000) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 789/A 789M	(2000) Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASTM A 814/A 814M	(1996; R 1998) Cold-Worked Welded Austenitic Stainless Steel Pipe
ASTM A 858/A 858M	(2000) Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM D 2657	(1997) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping

ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3308	(1997) PTFE Resin Skived Tape
ASTM D 3839	(1994a) Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3892	(1993; R 1998) Packaging/Packing of Plastics
ASTM E 814	(2000) Fire Tests of Through-Penetration Fire Stops
ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 1199	(1988; R 1998) Cast (All Temperatures and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)
ASTM F 1200	(1988; R 1998) Fabricated (Welded) Pipe Line Strainers (Above 150 psig and 150 degrees F)
ASTM F 1290	(1998a) Electrofusion Joining Polyolefin Pipe and Fittings

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.20	(1993; R 1998) Metallic Gaskets for Pipe Flanges - Ring Joint, Spiral-Wound, and Jacketed
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.28	(1994) Wrought Steel Buttwelding Short Radius Elbows and Returns
ASME B16.34	(1997) Valves - Flanged, Threaded, and Welding End
ASME B31.3	(1999) Process Piping
ASME B36.10M	(1996) Welded and Seamless Wrought Steel Pipe
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(1990) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE 1020	(1998) Pressure Vacuum Breaker Assembly (Recommended for Outdoor Usage)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1999) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C207	(1994) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
AWWA C500	(1993; C500a) Metal-Seated Gate Valves for Water Supply Service
AWWA C504	(1994) Rubber-Seated Butterfly Valves
AWWA C511	(1997) Reduced-Pressure Principle Backflow-Prevention Assembly
AWWA C540	(1993) Power-Activating Devices for Valves and Sluice Gates
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1999) Disinfecting Water Mains

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel
AWS D1.6	(1999) Structural Welding Code - Stainless Steel
AWS D10.4	(1986) Recommended Practice for Welding Austinitic Cromium-Nickel Stainless Steel Piping and Tubing
AWS D10.8	(1996) Recommended Practice for Welding of Chromium-Molybdenum Steel Piping and Tubing
AWS D18.1	(1999) Specification for Welding of Austenitic Stainless Steel Tube and Pipe Systems in Sanitary (Hygenic) Applications

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-Restraint Design	(1997) Thrust Restraint Design for Ductile Iron Pipe

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 228-1	(1994) Pipe Threads Where Pressure-Tight Joints are not Made on the Threads - Part 1: Dimensions, Tolerances and Designation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-89	(1998) Pipe Hangers and Supports - Fabrication and Installation Practices

NACE INTERNATIONAL (NACE)

NACE RP0185	(1996) Extruded, Polyolefin Resin Coating Systems With Soft Adhesives for Underground or Submerged Pipe

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE 3	(1994) Commercial Blast Cleaning

1.2.2.1 Connections to Existing Piping

Connections to existing piping systems where new fittings in the existing line are required will be paid for according to the contract prices for such connection. The price will be considered as full compensation for material and labor required for the removal and replacement of the existing pipe as necessary.

1.2.2.2 Connections to Existing Equipment

Connections to existing equipment where new fittings for the existing equipment are required will be paid for according to the contract prices for such connection. The price will be considered as full compensation for material and labor required for the installation of new fittings or the removal and replacement of existing fittings, as necessary.

1.2 SYSTEM DESCRIPTION

This specification covers the requirements for above and below grade liquid process pipe, pipe supports, fittings, equipment and accessories located both inside and outside of tanks.

1.2.1 Design Requirements

Support systems shall be selected and designed within the specified spans and component requirements. The absence of pipe supports and details on the contract drawings does not relieve the Contractor of responsibility for sizing and providing supports throughout facility.

1.2.2 Performance Requirements

The pressure ratings and materials specified represent minimum acceptable standards for piping systems. The piping systems shall be suitable for the services specified and intended. Each piping system shall be coordinated to function as a unit. Flanges, valves, fittings and appurtenances shall have a pressure rating no less than that required for the system in which they are installed.

1.2.2.1 Buried Piping Systems

Piping systems shall be suitable for design conditions, considering the piping both with and without internal pressure. Consideration shall be given to all operating and service conditions both internal and external to the piping systems.

1.2.2.2 Above Grade Piping Systems

Piping systems shall be suitable for design conditions, considering the piping both with and without internal pressure, and installation factors such as insulation, support spans, and ambient temperatures. Consideration shall be given to all operating and service conditions both internal and external to the piping systems.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pipe and Equipment;

Equipment shop drawings and support system detail drawings showing piping systems and appurtenances, such as mechanical joints, valves, local indicators and hangers, including a complete list of equipment and materials. As-built drawings showing pipe anchors and guides, and layout of piping systems relative to other parts of the work including clearances for maintenance and operation. As-built piping and instrumentation diagrams (P&IDs) identifying and labeling equipment, instrumentation, valves, vents, drains, and all other inline devices; if the contract drawings contained P&IDs, the P&IDs found in the contract drawings shall be revised to reflect the constructed process system, as directed by the Contracting Officer.

Stainless Steel Pipe; G. Expansion Joints; G

SD-03 Product Data

Qualifications;

A statement certifying that the Contractor has the specified experience.

Welders;

The names of all qualified welders, their identifying symbols, and the qualifying procedures for each welder including support data such as test procedures used, standards tested to, etc.

Waste Water Disposal;

The method proposed for disposal of waste water from hydrostatic tests and disinfection, and all required permits, prior to performing hydrostatic tests.

Assistance and Training;

A signed statement certifying that the installation is satisfactory and in accordance with the contract drawings and specifications and the manufacturer's prescribed procedures and

techniques, upon completion of the project and before final acceptance.

Delivery, Storage and Handling;

Material safety data sheets

Materials and Equipment;

Manufacturer's descriptive and technical literature for each piping system, including design recommendations; pressure and temperature ratings; dimensions, type, grade and strength of pipe and fittings; thermal characteristics (coefficient of expansion and thermal conductivity); and chemical resistance to each chemical and chemical mixture in the liquid stream.

Installation

The manufacturer's installation recommendations or instructions for each material or procedure to be utilized, including materials preparation.

Pipe Schedule:

Valve Schedule:

Operator Schedule: See Spec 16900 A list of valve materials, pressure ratings, valve operator's materials, air supply pressure, electrical service, location, source of supply, and reference identification as indicated in the contract drawings. A list of any special tools necessary for each valve type and appurtenances furnished for adjustment, operation, maintenance and disassembly.

SD-06 Test Reports

Pipe Leakage Tests;

Hydrostatic Tests;

Pneumatic Tests;

Copies of all field test reports within 24 hours of the completion of the test.

SD-07 Certificates

Contractor's Installation;

A statement signed by the reinforced thermosetting resin pipe and plastic pipe manufacturer's representative certifying that the Contractor's personnel are capable of properly installing the piping system on the project.

SD-10 Operation and Maintenance Data

Piping and Appurtenances;

Six copies each of operation and maintenance manuals in indexed

booklet form. Operation manuals shall detail the step-by-step procedures required for specialized startup, operation and shutdown of piping systems, and shall include the manufacturer's name, model number, parts list and brief description of piping equipment such as valves and other appurtenances and their basic operating features. Maintenance manuals shall list routine maintenance procedures and troubleshooting guides for the equipment, and shall include piping layout and valve locations.

1.4 QUALIFICATIONS

1.4.1 Contractor

Contractor shall have successfully completed at least 3 projects of the same scope and size or larger within the last 6 years. Contractor shall demonstrate specific experience in regard to the system installation to be performed.

1.4.2 Welders

The welding of pressure piping systems shall be in accordance with qualifying procedures using performance qualified welders and operators. Procedures and welders shall be qualified in accordance with Section 05093 WELDING, PRESSURE PIPING AND ACID PIPINGand Structural members shall be welded in accordance with Section 05093 WELDING, STRUCTURAL.

1.5 GENERAL JOB REQUIREMENTS

Piping materials and appurtenances shall be as specified and as shown on the drawings, and shall be suitable for the service intended. Piping materials, appurtenances and equipment supplied as part of this contract shall be new and unused except for testing equipment. Components that serve the same function and are the same size shall be identical products of the same manufacturer. The general materials to be used for the piping systems are indicated by service in the Pipe Schedule G0008 piping class 35P, 47P, 121L, 35HP, and 156L.

1.5.1 Components

Piping equipment and appurtenances shall be new products of equal material and ratings as the connecting pipe.

1.5.2 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacturing of the products and shall essentially duplicate items that have been in satisfactory use for at least 5 years prior to bid opening. Nominal sizes for standardized products shall be used. Pipe, valves, fittings and appurtenances shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.5.3 Identification

Each piece of pipe shall bear the ASTM designation and all other markings required for that designation. Valves shall bear a securely attached tag with the manufacturer's name, valve model number, and valve identification permanently displayed and be marked in accordance with MSS SP-25.

1.6 DELIVERY, STORAGE AND HANDLING

Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of material before, during and after installation is the Contractor's responsibility. Any material found to be damaged shall be replaced at the Contractor's expense. During installation, piping shall be capped to keep out dirt and other foreign matter. A material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) shall accompany each chemical delivered for use in pipe installation. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds. Handling shall be in accordance with ASTM F 402. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1. Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage, or other damage. Pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendation. Plastic pipe shall be packed, packaged and marked in accordance with ASTM D 3892.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Environmental Requirements

Buried piping at the site may be subject to corrosion from the surrounding soil. Stainless pipe shall have protective coating field applied.

1.7.2 Existing Conditions

The Contractor shall be responsible for the verification of existing piping and penetrations. Prior to ordering materials, the Contractor shall expose all existing pipes which are to be connected to new pipelines. The Contractor shall verify the size, material, joint types, elevation, horizontal location, and pipe service of existing pipes, and inspect size and location of structure penetrations to verify adequacy of wall sleeves, and other openings before installing connecting pipes.

1.7.3 Verification of Dimensions

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.8 SEQUENCING AND SCHEDULING

For slab, floor, wall, and roof penetrations, the Contractor shall have onsite pertinent wall pipes and sleeves before they are required for placement in concrete forms. The Contractor shall verify and coordinate the size and location of building and structure pipe penetrations before forming and placing concrete.

1.9 MAINTENANCE

1.9.1 Service

Services for automatic valve or double containment leak detection monitoring system shall be provided by a manufacturer's representative who is experienced in the installation, adjustment and operation of the

equipment specified. The representative shall inspect the installation, and supervise the adjustment and testing of the equipment.

1.9.2 Extra Materials

PART 2 PRODUCTS

2.1 Ductile-Iron Pipe

Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. When installed underground, pipe shall be coated. Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA C115.

2.2 Steel Pipe

2.2.1 Pipe 80 mm (3 Inches) and Larger, Not Galvanized

Steel pipe, not galvanized, shall conform to AWWA C200 with dimensional requirements as given in ASME B36.10M for pipe 6 inches in diameter and larger, and ASTM A 53 for smaller sizes. Pipe shall be welded or seamless with plain or shouldered and grooved ends in accordance with AWWA C606 for use with mechanical couplings or bell-and-spigot ends with rubber gaskets. Bell-and-spigot ends for sizes less than 6 inches diameter shall be as required by AWWA C200.

2.2.2 Galvanized Steel Pipe

Galvanized steel pipe shall conform to ASTM A 53, standard weight.

2.2.3 Protective Materials for Steel Pipe

Protective materials for steel pipe, except as otherwise specified, shall be mechanically applied in a factory or plant especially equipped for the purpose. The materials shall, unless otherwise indicated on the drawings, consist of one of the following for the indicated pipe material and size:

a. Pipe and fittings less than 3 inches in diameter shall be thoroughly cleaned of foreign material by wire brushing and solvent cleaning, and then given 1 coat of coal-tar primer and 2 coats of coal-tar enamel conforming to AWWA C203; threaded ends of pipe and fittings shall be adequately protected prior to coating.

b. Pipe 3 Inches or Larger, Not Galvanized:

(1) Cement-mortar coating and lining shall conform to and shall be applied in conformance with AWWA C205. Cement-mortar coating and linings shall not be used for pipe less than 4 inches in diameter.

(2) Coal-tar enamel lining, coating and wrapping shall conform to AWWA C203 for materials, method of application, tests and handling. Non-asbestos material shall be used for the outerwrap.

(3) Cement-mortar lining, in lieu of coal-tar enamel lining, may be used with coal-tar enamel coating and wrapping. Cement-mortar lining shall conform to and shall be applied in conformance with AWWA C205.

2.3 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K, annealed.

2.4 Steel Pipe System

2.4.1 Not Galvanized Steel Pipe

Fittings and specials shall be made of the same material as the pipe. Specials and fittings may be made of standard steel tube turns or segmentally welded sections, with ends to accommodate the type of couplings or joints specified for the pipe. Dimensions of steel pipe fittings shall be in accordance with AWWA C208. The thickness and pressure rating of pipe fittings and specials shall be not less than the thickness specified and the pressure rating calculated for the pipe with which they are used. Protective materials for fittings and specials shall be as specified for the pipe. Specials and fittings that cannot be mechanically lined, coated, and wrapped shall be lined, coated, and wrapped by hand, using the same material used for the pipe with the same number of applications of each material, smoothly applied.

2.4.2 Galvanized Steel Piping

Steel fittings shall be galvanized. Screwed fittings shall conform to ASME B16.3. Flanged fittings shall conform to AWWA C207.

2.4.3 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.5 Copper Tubing System

Fittings and specials shall be flared and conform to ASME B16.26.

2.6 CARBON STEEL PIPING SYSTEM

2.6.1 Carbon Steel Pipe

2.6.1.1 General Service

Carbon steel pipe shall meet the requirements of ASTM A 53/A 53M seamless, ASTM A 106 Grade A API Spec 5L, Schedule 40 and shall be in accordance with Pipe Schedule, hot-dipped galvanized. Buried carbon steel piping and fittings shall be Schedule 80.

2.6.1.2 High Temperature Service, Stainless steel/PVC

2.6.1.3 Chemical Process Service

2.6.2 Carbon Steel Tubing

Tubing shall meet the requirements of ASTM A 334/A 334M, seamless Grade 1

carbon steelASTM A 423/A 423M, seamless, Grade 1 low-alloy carbon steel with nominal size and wall thickness in accordance with Pipe Schedule.

2.6.3 Carbon Steel Joints

Carbon steel piping shall be joined by straight-threaded couplings Tubing shall be joined using compression fittings. Dielectric fittings or isolation joints shall be provided between all dissimilar metals.

2.6.4 Carbon Steel Fittings

Fittings shall be carbon steel. Where cast fittings are not available, segmental welded steel fittings, ASTM A 53/A 53M, Grade B, meeting the requirements of manufacturer's recommended wall thicknesses shall be fabricated.

2.6.4.1 Threaded Fittings

Threaded fittings shall be Class 150, malleable iron, ASTM A 47/A 47M, conforming to ASME B16.3, black, banded, forged carbon steel ASTM A 105/A 105M, conforming to ASME B16.11 low carbon steel, ASTM A 858/A 858M, conforming to ASME B16.11, and threaded in accordance with ASME B1.20.1. Threaded, rigid couplings shall be welded, black Type I hot-dipped galvanized and threaded in accordance with ASME B1.20.1. Polytetrafluoroethylene (PTFE) pipe-thread tape conforming to ASTM D 3308 shall be used for lubricant/sealant.

2.6.4.2 Welding Fittings

Welding fittings shall be butt-welded. Welding fittings shall be forged steel, ASTM A 105/A 105M Class 150 low-carbon steel, ASTM A 858/A 858M welded conforming to ASME B16.9 and ASME B16.28.

2.6.4.3 Flanged Fittings

The internal diameter bores of flanges and flanged fittings shall be the same as that of the associated pipe. The flanges shall be slip-on or threaded type. Flanges and flanged fittings shall be forged steel, ASTM A 105/A 105M, faced and drilled to ASME B16.5 Class 150 with flat face. Cast steel backing flanges, ASTM A 216/A 216M Grade WCA, Van Stone type, shall be drilled in conformance with ASME B16.5 Class 150. For tie-in to existing flanges, the Contractor shall field check existing flanges for non-standard bolt hole configurations and shall design as required to assure new pipe and flange mate properly. Bolting shall be alloy-steel ASTM A 193/A 193M Grade B7 hex head bolts and ASTM A 194/A 194M Grade A hex head nuts. When mating flange on valves or equipment is cast iron, ASTM A 193/A 193M Grade B8 Class 1 bolts and ASTM A 194/A 194M Grade 8 heavy hex head nuts shall be used. Bolts shall be provided with washers of the same material as the bolts. Gaskets shall meet the requirements of ASME B16.5. Nonmetallic gaskets shall conform to ASME B16.21 and be a maximum 0.125 in. thick chloroprene rubber, durometer hardness No.80, 1,500 psi minimum tensile strength, 125 percent minimum elongation, flat ring type for use with raised face flanges and full face type for use with flat face flanges. Metallic ring joint gaskets shall conform to ASME B16.20 and be constructed of SS.

2.6.5 Carbon Steel Coatings

Carbon steel piping components shall be coated with corrosion resistant

materials. Coatings and finishes shall be 100 percent holiday free.

2.6.5.1 Silicone Coating

Carbon steel piping surfaces shall be prepared in accordance with SSPC SP 6/NACE 3. The surfaces shall have an alkyd primer of mils dry film thickness followed by two alkyd modified silicone final coats.

2.6.5.2 Zinc Coating

Galvanizing shall be hot-dip applied and meet the requirements of ASTM A 153/A 153M; electroplated zinc or cadmium plating is unacceptable. Stainless steel components may be substituted where galvanizing is specified.

2.6.5.3 Thermoplastic Resin Coating System

Carbon steel piping surfaces shall have a minimum of 4 coats of phenolic type coatings applied at a minimum dry film thickness of 1.6 mils per coat. Each coat shall be baked at 300 degrees F for 10 minutes. The full coating system shall be cured in an oven at 375 degrees F for 30 minutes. Carbon steel piping system components shall be coated with an adhesively mounted polyethylene coating system. The continuously extruded polyethylene and adhesive coating system materials shall conform to NACE RP0185 Type A.

2.6.6 Carbon Steel Cathodic Protection

Buried ferrous piping shall have cathodic protection.

2.6.7 Lined Steel Cathodic Protection

Buried ferrous piping shall have cathodic protection.

2.7 STAINLESS STEEL PIPING SYSTEM

2.7.1 Austenitic Piping

2.7.1.1 Stainless Steel Pipe

Stainless steel pipe shall be 316L and shall meet the welding requirements of Section 05093. Pipe shall be minimum Schedule 40. Stainless steel pipe shall conform to ASTM A 999/ A 999M. Pipe shall be acid resistant for a concentration of 50% nitric acid and 50% sulfuric acid with a maximum temperature of 150 F. Stainless steel pipe intended for general corrosive service shall meet the requirements of ASTM A 312/A 312M, seamless for fit-up and alignment quality, Class SW ASTM A 814/A 814M for flanged and cold-bending quality, Class SW, Grade TP316L, Schedule 40S in accordance with Standard Schedule Pipe.

2.7.1.2 Stainless Steel Pipe Jointing

All acid sewer pipe shall be continuous welded UON. Welding shall comply with Section 05093. All other pipes shall be flanged. Flanged gaskets shall be Teflon. Bolts, nuts, and washers for flanged joints shall be 316 stainless steel.

2.7.1.3 Expansion Joints

Expansion joints for stainless steel piping shall be PTFE lined rubber expansion joint. The body shall be constructed of polyester cord and fabric, wire reinforcement, chlorobutyl elastomer and PTFE liner. The expansion joint shall be double arch, spool type. It shall be provided with control rod plates and lateral compression sleeves, minimum four per expansion joint. Product shall be Proco Series 152/BT or approved equal.

2.7.1.4 Stainless Steel Tubing

Stainless steel tubing shall meet the requirements of ASTM A 269ASTM A 632, welded, Grade TP316L ASTM A 789/A 789M, seamless Grade S32760 with nominal size and wall thickness in accordance with Pipe Schedule.

2.7.1.5 Stainless Steel Joints

Stainless steel piping shall be joined by threaded couplings . Tubing shall be joined using compression fittings. Dielectric fittings or isolation joints shall be provided between all dissimilar metals.

2.7.1.6 Stainless Steel Welding Fittings

Welding fittings shall be butt-welding. Welding fittings shall be forged austenitic stainless steel, ASTM A 403/A 403M Grade TP316L, butt-welding fittings, Class CR, conforming to ASME B16.9 and ASME B16.28 socket-welding fittings, Class WP-S, conforming to ASME B16.11.

2.7.1.7 Stainless Steel Flanged Fittings

The internal diameter bores of flanges and flanged fittings shall be the same as that of the associated pipe. The flanges shall be welded neck type. Flanges and flanged fittings shall be forged austenitic stainless steel, ASTM A 182/A 182M Grade TP304L, Class 150, drilled to ASME B16.5 with a . For tie-in to existing flanges, the Contractor shall field check existing flanges for non-standard bolt hole configurations and shall design as required to assure new pipe and flange mate properly. Bolting shall be alloy-steel ASTM A 193/A 193M Grade hex head bolts and ASTM A 194/A 194M Grade 8 hex head nuts. When mating flange on valves or equipment is cast iron, ASTM A 193/A 193M Grade B8 Class 1 bolts and ASTM A 194/A 194M Grade 8 heavy hex head nuts shall be used. Bolts shall be provided with washers of the same material as the bolts. Gaskets shall meet the requirements of ASME B16.5. Nonmetallic gaskets shall conform to ASME B16.21 and be a maximum 1/8 inch thick chloroprene rubber, durometer hardness No.80, 1,500 psi minimum tensile strength, 125 percent minimum elongation, flat ring type for use with raised face flanges and full face type for use with flat face flanges. Metallic ring joint gaskets shall conform to ASME B16.20 and be constructed of

2.7.1.8 Compression Fittings for Tubing

Compression fittings shall be of ASTM A 479/A 479M stainless steel, Grade TP316, nuts, ferrules and bodies rated to a minimum psig. Threads shall be straight conforming to ISO 228-1ASME B1.1.

2.8 JOINTS

2.8.1 Ductile-Iron Pipe Jointing

a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

b. Push-on joints shall conform to AWWA C111.

c. Rubber gaskets and lubricants shall conform to the applicable requirements of AWWA C111.

2.8.2 Steel Pipe Jointing

2.8.2.1 Steel Pipe, Not Galvanized

a. Mechanical couplings shall be as specified.

b. Bell-and-spigot joints for use with rubber gaskets shall conform to AWWA C200, as appropriate for the type of pipe. Rubber gaskets shall conform to applicable requirements of AWWA C200.

c. Flanges shall conform to AWWA C207, and shall be used only in above ground installation or where shown on the drawings, or when approved.

2.8.2.2 Mechanical Couplings

Mechanical couplings for steel pipe shall be the sleeve type, or when approved, the split-sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

2.8.3 Bonded Joints

For all ferrous pipe, a metallic bond shall be provided at each joint, including joints made with flexible couplings, caulking, or rubber gaskets, of ferrous metallic piping to effect continuous conductivity. The bond wire shall be Size 1/0 copper conductor suitable for direct burial shaped to stand clear of the joint. The bond shall be of the thermal weld type.

2.8.4 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

a. Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.8.5 Copper Tubing Jointing

Joints shall be compression-pattern flared and shall be made with the specified fittings.

2.9 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

2.10 ISOLATION JOINTS AND COUPLINGS

2.10.1 Dielectric Fittings

Dielectric fittings shall be provided between threaded ferrous and nonferrous metallic pipe, fittings and valves. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure, temperature and corrosive application.

2.10.2 Isolation Joints

Isolation joints shall be provided between nonthreaded ferrous and nonferrous metallic pipe fittings and valves. Isolation joints shall consist of an isolation gasket of the dielectric type, isolation washers and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with an outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.10.3 Metallic Piping Couplings

Thrust ties shall be provided where shown on the contract drawings and where required to restrain the force developed by 1.5 times the maximum allowable operating pressures specified. For metallic pipe other than ductile iron, thrust ties shall be attached with fabricated lugs. For ductile iron pipe, thrust ties shall be attached with socket clamps against a grooved joint coupling or flange. For exposed installations, zinc-plated nuts and bolts shall be used. However, high-strength, low-alloy steel, in accordance with AWWA C111, may be substituted for use on cast iron and ductile iron couplings. For buried and submerged installations, stainless steel bolts and nuts shall be provided. Steel middle rings and followers shall be pressure tested beyond yield point.

2.10.3.1 Sleeve-Type Couplings

Sleeve-type couplings shall be used for joining plain end pipe sections in a flexible manner with a diameter to properly fit the pipe. A coupling shall consist of one steel ductile iron middle ring, two steel ductile iron followers, two elastomeric wedge section gaskets and elliptic-neck,

track-head steel bolts designed to properly compress the gaskets. For pipe sizes between 0.5 inch through 1.5 inch, the followers shall be ductile iron, and the middle ring shall be in accordance with ASTM A 513 with AWWA C111 bolting, light pattern coupling. For pipe sizes 2 inches and larger, the followers shall be ASTM A 395/A 395M , and the middle ring shall be ASTM A 513 with AWWA C111 bolting, light pattern coupling. Gaskets shall be natural rubber. Split sleeve-type couplings may be used in aboveground installations under special situations and when approved in advance by the Contracting Officer.

2.10.3.2 Transition Couplings

Transitional couplings may be used to connect two pipes of the same material that have small differences in outside diameter. A fully assembled transitional coupling shall be sized to properly fit pipe diameters. The coupling shall consist of one steel middle ring, two steel followers, two elastomeric wedge section gaskets and elliptic-neck, track-head steel bolts designed to properly compress the gaskets. The coupling shall use natural rubber, insulated gaskets. The coupling shall be sized to match the associated piping.

2.10.3.3 Flanged Coupling Adapters

Flanged coupling adapters shall be fully assembled units manufactured to meet ASTM A 126 Class B, cast iron. The flanges shall mate with ASME B16.1 Class B flanges of the same nominal size. A factory applied corrosion resistant coating shall be applied. The coupling shall use natural rubber gaskets. Where pipe movement out of the adaptor may occur, proper anchorage of the pipe shall be provided and couplings shall be furnished with lock pins. The coupling shall be sized to match the associated piping.

2.10.4 Couplings for Nonmetallic Piping

2.10.4.1 Bellows Coupling

A bellows coupling shall have a minimum of two polytetrafluoroethylene (PTFE) convolutions unless otherwise shown, with ductile iron flanged, faced and drilled to ASME B16.1 Class 150 end connections, and metal reinforcing bands. The maximum allowable working pressure shall be 140 psig at 120 degrees F. Bolting shall be limited to restrain the force developed by 1.5 times the specified maximum allowable operating pressure. The coupling shall be sized to match the associated piping.

2.11 VALVES

2.11.1 General Requirements For Valves

Valves shall include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and all other accessories required for a complete operation. The valves shall be suitable for the intended service. Renewable parts are not to be of a lower quality than those specified. Valves shall be the same size as adjoining pipe. Valve ends shall be compatible with adjacent piping system. An operator shall be sized to operate the associated valve for the full range of pressures and velocities. Valves will open by turning counterclockwise . Operators, actuators, and accessories shall be factory mounted.

2.11.2 Valve Schedule (See Section 16900 Attachment 1 and Appendix A&B)

Requirements relative to this paragraph are shown on the Valve Schedule and Operator Schedule located in the contract drawings under Section 16900.

2.11.3 Check Valves

2.11.3.1 Swing Check Valves

Swing check valves shall conform to the following:

a. Swing check valves, 2 inches and smaller, shall have a TP316 stainless steel body, in accordance with ASME B16.11 socket-welding ASME B16.11 threadedASME B16.5 flangedASME B16.1 flangedASME B16.18 solder joint ends. Valves shall have a swing type, replaceable butadiene acrylonitrile polytetrafluoroethylene (PTFE) disc. Valves shall be rated for 200 psig service.

b. Swing check valves, 2.5 inches through 12 inches, shall have a TP316 stainless steel body, in accordance with ASME B16.11 socket-weldingASME B16.11 threadedASME B16.5 flangedASME B16.1 flanged ends. Valves shall have a bronze-mounted swing type, hinges, and stainless steel hinge shaft with outside lever and weight spring. Valves shall be rated for 200 psig service.

2.11.3.2 Thermoplastic Check Valve

Thermoplastic check valves, 0.25 inch through 16 inches, shall be a ball-check design, manufactured of polyvinyl chloride (PVC) chlorinated polyvinyl chloride (CPVC) polypropylene (PP) polyvinylidene fluoride (PVDF) with flanged socket threaded, in accordance with ASME B1.20.1, end connections. Valves shall be rated for 150 psig service. Valves shall have fluoro-elastomeric O-ring seals and seats. Discs shall be fitted with a polyvinyl chloride (PVC) coil guide. Caps shall be of hex design.

2.11.3.3 Ball Check Valve

Ball check valves, 1 inch and larger, shall be in accordance with ASME B16.11 socket-weldingASME B16.11 threadedASME B16.5 flanged ends, and cast TP316 stainless steel polyvinyl chloride (PVC) bodies with a cleanout and floating ball. Flanges shall be ASME B16.1 Class 125. Valves shall be rated for 100 psig service and shall be suitable for vertical or horizontal flow.

2.11.4 Gate Valves

2.11.4.1 General Service Gate Valves

General service gate valves shall conform to the following:

a. Gate valves, 2 inches and smaller, shall have bronze bodies and stems, screwed bonnets, single solid wedge bronze discs, and rising stems. Valves shall be rated for 175 psig service and conform to ASME B16.34 Class A1. End connections shall be ASME B16.5 flanged ASME B16.1 flanged or ASME B16.11 threaded. Valves shall be equipped with handwheel operators.

b. Gate valves, 2.5 inches and larger, shall have Ni-resistant bodies with Ni-resistant stainless steel trim. Valves shall meet the

requirements of AWWA C500AWWA C509 and have Class 250 flanged, in accordance with ASME B1.20.1, mechanical joint end connections. Bonnet shall be a clamp OS&Y Bolted type. Discs shall be per RFAAP requirements. Each gate valve, 16 inches and larger, shall include a by-pass of the same materials as the gate valve. The bypass shall meet the requirements of AWWA C500. Valves shall be rated for 200 psig service. Valves shall be equipped with handwheel operators.

2.11.5 Globe Valves

2.11.5.1 General Requirements For Globe Valves

Globe valves, 3 inches and smaller, shall be globe style valve and shall have TP316 stainless steel bodies, with stainless steel trim, and bonnets. Valves shall conform to ASME B16.34 Class A1, and shall have ASME B16.11 socket-weldingASME B16.11 threadedASME B16.5 flangedASME B16.1 flangedASME B16.18 solder joint end connections. Valves shall include threaded OS&Y bonnets, inside screws, rising stems, discs constructed of stainless steel , and stainless steel rings. Valves shall be rated for 200 psig service. Valves shall be equipped with handwheel operators.

2.11.6 Butterfly Valves

2.11.6.1 Standard Service Butterfly Valve

Butterfly valves, 2 inches and larger, shall have iron stainless steel bodies, wafer with ASME B16.5 flanged end connections. Valves shall conform to AWWA C504 Class 150. Discs shall be contoured ASTM A 436 Type 1 Ni-resist cast iron with maximum lead content of 0.003 percent stainless steel. The valve shafts shall bestainless steel with self-lubricating, corrosion-resistant sleeve type bearings. Valve seats for 24 inch and smaller valves shall be attached to either the valve body or the disc and shall be constructed of chloroprene and approved equal. Valves shall have manual, locking hand lever.

2.11.7 Operators

2.11.7.1 Manual Operator

The force in a manual operator shall not exceed 39.3 pound under any operating condition, including initial breakaway. The operator shall be equipped with gear reduction when force exceeds 39.3 pound. The manual operator shall be a self-locking type or shall be equipped with a self-locking device. A position indicator shall be supplied on quarter-turn valves. Worm and gear operators shall be a one-piece design with worm-gears of gear bronze material. Worm shall be hardened alloy steel with the thread ground and polished. Traveling nut type operators shall have threader steel reach rods with an internally threaded bronze or ductile iron nut.

a. Exposed Operators. Exposed operators shall have galvanized and painted handwheels. Lever operators are allowed on quarter-turn valves 8 inches and smaller. Cranks shall be supplied on gear type operators. If located off of the operator floor, chain wheel operator with tiebacks, extension stem, floor stands, and other accessories shall be provided to permit operation from normal operation level. Valve handles shall be capable of padlocking, and wheels shall be lockable with a chain and padlock.

b. Underground Operators. Buried service operators on valves larger than 2.5 inches shall have a 2 inch operating nut. Buried operators on valves 2 inches and smaller shall have a cross handle for operation by a forked key. The moving parts of valve and operator shall be enclosed in housing to prevent contact with the soil. Buried service operators for quarter-turn valves shall be designed to withstand an input torque of 450 foot-pound of input torque at the fully open or fully closed positions, and shall be grease packed and gasketed to withstand a submersion in water to 10.2 psig. Buried valves shall have extension stems, bonnets, and valve boxes.

2.11.7.2 Pneumatic Operator

Pneumatic operators shall be provided complete with actuators, air sets, exhaust mufflers, speed controls, pilot solenoids, safety vented isolation valves, and accessories. The pneumatic operators shall be suitable for full operation range of valve at air supply pressure indicated. Actuators shall return the valve to the closed position upon loss of signal unless otherwise indicated. Springs shall return valve to this failed position. Pneumatic operators shall be furnished with features noted on the Operator Schedule in the contract drawings. Limit switches shall be provided on all actuators.

a. Cylinder Actuators. Cylinder actuators shall conform to AWWA C540 and operate with an air supply pressure of 80 psig. The nonswivel type shall be totally enclosed with travel stops and position indicator, and shall be factory lubricated and sealed, requiring no additional lubrication. The double acting type shall be nonmetallic for operation on nonlubricated air and shall have a manual override independent of the cylinder. The manual overide shall be located as directed by CO.

b. Diaphragm Actuators. Diaphragm actuators shall have a spring return with a steel or aluminum diaphragm case and spring barrel, steel spring and actuator stem, and fabric-reinforced chloroprene diaphragm. The actuators used on quarter-turn valves shall include a totally enclosed valve actuating mechanism with adjustable travel stops and valve position indicator with manual override if indicated. The actuating mechanism shall be factory lubricated and sealed. Diaphragm actuators shall be sized and configured for the service indicated and an air supply pressure of 35 psig.

c. Air Sets. The air set shall include a pressure regulator with internal relief, filter, outlet pressure gauge, and adjustable reduced pressure range as required by the valve actuator. The air set shall have an aluminum body and handwheel, safety vented lockout isolation valve, and gauge range 1.33 to 2 times maximum operating pressure.

d. Limit Switches. Limit switches shall be single-pole, double-throw (SPDT) type, rated 10 amps at 120 volts ac, housed in a NEMA 250 Type 4 enclosure, and adjustable for open and closed valve positions.

e. Positioners. The positioners for modulating actuators shall be pneumatic force balance instruments to control valve positions as a function of the input signals. The positioners shall accomplish

positive positioning of valve by a mechanical feedback connection from the valve actuating mechanism. Position feedback shall be provided through a characterized linear cam to allow adjustment of valve positioning and input signal. The positioner shall be suitable for either a double acting or spring return actuator. The positioner shall have zero and span adjustment and be field reversible for direct or reverse action. Gauges shall be included for supply and output pressure and for input signal pressure. Modulating valve positioners shall operate on a 3 to 15 psig pneumatic or 4 to 20 mA electric input signal unless otherwise indicated. A positioner for dc input signal with transducers shall convert the electrical signal to the appropriate pneumatic signal. The transducer shall be integral with the positioner or a separate component. If separate, the transducer shall be factory mounted on the pneumatic operator. Line electric power not shall not be required for transducer operation. Corrosion-resistant enclosures for positioners and transducers shall be splash- and moisture-proof with gasketed covers.

f. Solenoid Valve. A solenoid valve shall pilot the control actuator in the appropriate configuration for the type of actuator being controlled. A pilot operated diaphragm type solenoid valve shall have a brass body and resilient seat and operate with minimum operating pressure differential no greater than 10.2 psi and maximum operating pressure differential no less than 150 psi. Internal parts shall be corrosion-resistant. The solenoid valve shall have Class F molded coils for operation on 120 volts, 60-Hz, ac, unless otherwise indicated. The solenoid enclosure shall conform to NEMA 250 Type 4. Solenoids on double acting cylinders for open-close and throttling valves shall be four-way with dual coils. Solenoids on spring return cylinders for open-close and throttling valves shall be three-way, spring return. An air exhaust muffler shall be furnished in the exhaust port of all actuator pilot solenoid valves.

2.11.7.3 Electric Operator

Electric operators shall be provided complete with actuators, speed controls and accessories. The actuators shall operate on 120 VAC, 60 Hz with a 75 percent duty cycle and shall be equipped with an AC thermal overload protector with automatic rest, reversing bi-directional operation for use with quarter-turn valves, or rotating equipment to full rotation. Gearing shall be a two-stage planetary, permanently lubricated self-locking gear train with self-lubricating bearings; connections via male output staff. The start-up torque shall be 120 foot-pound. The stall torque shall be 150 foot-pound. Two travel stop limit switches with cams, internal, independent, adjustable, and actuated by cams shall be mounted on the drive shaft. A side mounted hand turn wheel shall be provided for a manual override. The actuators shall have a NEMA 250 Type 4 enclosure with a corrosion resistant, baked epoxy finish as standard. The actuator shall operate in a temperature range of -40 to 150 degrees F. Actuators shall fail in last position unless otherwise indicated. Electric operators shall be furnished with features noted on the Valve Schedule in the contract drawings under Section 16900 Attachment 1 or Appendix A&B. Limit switches shall be provided on all actuators.

a. Limit Switches. Limit switches shall be single-pole, double-throw (SPDT) type, rated 10 amps at 120 volts ac, housed in a NEMA 250 Type 4 enclosure, and adjustable for open and closed valve

positions.

b. Positioners. The positioners for modulating actuators shall control valve positions as a function of the input signals. The positioner shall operate on 120 VAC, 60 Hz. voltage. The mode of operation shall be direct acting. Modulating valve positioners shall operate on a 4 to 20 mA input signal unless otherwise indicated. Corrosion-resistant enclosures for positioners shall be splash-and moisture-proof with gasketed covers.

2.11.8 Valve Accessories

2.11.8.1 Tagging

Identification tags made of brass indicating service and valve number shown on the Valve Schedule in the contract drawings under Section 16900 Attachment 1 shall be installed on valves using No. 12 AWG copper wire. Tags shall be 1.375 inch minimum diameter. Indentations shall be black for reading clarity.

2.11.8.2 Extension Bonnet for Valve Operator

All extension bonnets shall be provided as necessary, complete with stem and accessories applicable to the specific valve and operator.

2.11.8.3 Floor Stand and Extension Stem

A floor stand and extension stem shall be the nonrising, indicating type; complete with stem, coupling, handwheel, stem guide brackets, and yoke attachment. The stem guide shall be spaced such that stem L/R ratio does not exceed 200. Anchors shall be supplied as required.

2.11.8.4 Floor Box and Stem

A floor box and stem shall be the plain type, for support of nonrising type stem; complete with stem, operating nut, and stem guide brackets. The stem guide shall be spaced such that stem L/R ratio does not exceed 200. Anchors shall be supplied as required.

2.11.8.5 Chain Wheel and Guide

A chain wheel and guide shall be the handwheel direct-mount type, complete with galvanized or cadmium-plated chain.

2.11.8.6 Valve Box

The Contractor shall provide valve boxes as follows: Cast iron valve boxes designed for traffic loads, and which are the sliding type with shafts that are a minimum of 6 inches in internal diameter. The boxes shall be cast iron with minimum depth of 10 inches. The lids shall be cast iron with a 3.1 inches minimum depth. Concrete valve boxes shall be designed for traffic loads, sliding type with shafts that have a minimum 8 inches internal diameter. The boxes shall be concrete, minimum depth inches, and have a cast iron ring seat. The lids shall be cast iron, minimum depth 3.1 inches, marked. Extensions shall be concrete acrylonitrile-butadiene-styrene (ABS), polyvinyl chloride (PVC) or cast iron pipe.

2.12 DRAINS

Valved drains may not be shown on the detailed drawings for individual pipelines; their absence will not relieve the Contractor of the responsibility for providing and installing them as indicated in the piping and instrumentation diagrams to complete the piping system for the use intended.

2.12.1 Locations

Drains shall be located as indicated on the contract drawings. All pipeline low points shall be drained.

2.12.2 Sizes

For pipelines 2.5 inches and larger, drains shall be 0.75 inch and equipped with globe valves. For pipelines 2 inches and smaller, drains shall be 0.5 inch and equipped with globe valves.

2.13 SAMPLE PORTS

Sample ports, shown on the flow diagrams and piping and instrument diagrams of the contract drawings, may not be shown on the detailed drawings of the individual pipelines; their absence shall not relieve the Contractor of the responsibility for providing them. Sample ports shall be provided as indicated in the piping and instrument diagrams to complete the piping systems for the use intended. The sample ports shall be located in easily accessible locations, and shall avoid potential stagnant points and/or areas where material could collect. A plug-type sampling valve with a stainless steel piston that extends beyond the inner surface of the pipe when closed shall be provided at all the sampling ports. The piston shall be sealed by two compressible replaceable polytetrafluoroethylene (PTFE) rings, one above the discharge port, the other below the discharge port. The valve body shall be stainless steel Class 150 with a male ASME B1.20.1 pipe threads inlet connection and female ASME B1.20.1 pipe threads outlet connection. Sampling ports shall be comprised of pipe fittings, pipe, and gate valves which comply with material, temperature, and pressure requirements of the associated piping system as specified elsewhere in this Section. A double block and bleed configuration shall be provided.

2.14 MISCELLANEOUS PIPING COMPONENTS

2.14.1 Air Release and Vacuum Breakers

Air release vents shall be located, and vented, such that a hazardous atmosphere will not be created upon operation.

2.14.1.1 Locations

Air release and vacuum breakers shall be located as indicated on the contract drawings. All pipeline high points shall have air release vents and vacuum breakers. Vacuum breakers shall be provided on all tanks and process equipment.

2.14.1.2 Vacuum Breakers

Vacuum breakers 2 inches and smaller shall be an angle type with all semi-steel bodies and bonnets, and shall be installed at least 6 inches above the flood line of associated equipment and shall conform to

ASSE 1001 for pipe applied units.

2.14.1.3 Air and Vacuum Valve Suitable for Corrosive Service

The air and vacuum valve shall conform to ASSE 1001 ASSE 1020, and automatically exhaust air during the filling of a system while allowing air to re-enter during draining or when vacuum occurs. The valve shall be rated for 150 psig working pressure and built with a special short body. The valve shall have a semi-steel body and cover, with stainless steel float and trim. End connections shall be as follows: for 0.5 inch through 3 inches ASME B1.20.1 pipe threaded inlet and outlet, for 4 inches and larger ASME B16.5ASME B16.1 150# flanged inlet with outlet. The air and vacuum valve shall be fitted with blowoff valve, quick disconnect couplings, and a minimum 6.6 feet of hose in order to permit back flushing after installation without dismantling the valve.

2.14.1.4 Air Release Valve Suitable for Corrosive Service

The air release valve shall automatically exhaust entrained air that accumulates in a system and shall be Factory Mutual listed ASSE approved. The valve shall be rated for 150 psig working pressure and built with a special short body. The valve shall have a semi-steel body and cover, with stainless steel float and trim. Valve end connections shall be ASME B1.20.1 pipe threaded ASME B16.5ASME B16.1 Class flanged . The air and vacuum valve shall be fitted with blowoff valve, quick disconnect couplings, and a minimum 6.6 feet of hose in order to permit back flushing after installation without dismantling the valve.

2.14.1.5 Combination Air Valve Suitable for Corrosive Service

The valve combines the operating functions of both an air and vacuum valve and an air release valve. The air and vacuum portion shall automatically exhaust air during filling of a piping system and allow air to re-enter during draining or when a vacuum occurs. Air release portion shall automatically exhaust entrained air that accumulates in the piping system. The valve shall be a single body unit or an individual air and vacuum valve and an air relief valve mounted on a common header. The valve shall be rated for 150 psig working pressure and built with a special short body. The valve shall have a semi-steel body and cover, with stainless steel float and trim. Valve end connections shall be ASME B1.20.1 pipe threaded ASME B16.5ASME B16.1 Class flanged . The air and vacuum valve to be fitted with a blowoff valve, quick disconnect couplings, and a minimum 6.6 feet of hose in order to permit back flushing after installation without dismantling the valve.

2.14.2 Backflow Preventer

The backflow preventer shall be identical in size to pipe. Total head loss through the complete backflow assembly shall not exceed 10.1 psi at rated flow.

2.14.2.1 Reduced Pressure Backflow Preventer

The assembly body shall be two independent bronze epoxy coated cast iron body check valves rated at 150 psig at 140 degrees F, with an intermediate relief valve, and isolation gate valve, full-ported ball valves as testing cocks. All internal parts shall be serviceable in-line. Port sizes shall be 1 inch and be ASME B1.20.1 threaded, female . The reduced pressure backflow prevention assembly shall be rated for 150

psig working pressure at 150 degrees F. The assembly body shall be in accordance with AWWA C511ASSE 1013.

2.14.2.2 Backflow Preventer with Intermediate Vent

The assembly body shall be two independent bronze epoxy coated cast iron body check valves rated at 175 psig at 140 degrees F, with an intermediate atmospheric vent, and isolation gate valve, full-ported ball valves as testing cocks. Port sizes shall be 1 inch and be ASME B1.20.1 threaded, . The backflow prevention assembly shall be rated for 150 psig working pressure at 150 degrees F. The assembly body shall be in accordance with AWWA C511ASSE 1012.

2.14.3 Strainers

Strainers shall be duplex with a Y-pattern body. Port sizes shall be 1 inch and be ASME B1.20.1 threaded, female male. The strainers shall be rated for 150 psig working pressure at 150 degrees F and conform to ASTM F 1199 ASTM F 1200. The body shall be cast iron with a bolted iron cap. The screen shall be heavy-gauge stainless steel Monel, 30 mesh and be equipped with a ASME B1.20.1 pipe threaded blowoff hole.

2.14.4 Indicating Devices

2.14.4.1 Pressure and Vacuum Gauges

Pressure and vacuum gauges shall be stem flush mounted, with glass filled nylon glass filled polypropylene (PP) cases equipped with safety pressure blowout backs and dry glycerine -filled dials. The gauge sensors shall be C-Type Bourdon tube actuated and constructed of Inconel. The gauges shall be equipped with TP316L stainless steel threaded 0.25 inch male connections. The dials of the gauges shall be 4.5 inches in diameter with scale readings in psig and inches of mercury ranging from zero to approximately twice the anticipated process operating or equipment pressure. A slotted adjustable pointer shall be provided with accuracy to conform to ASME B40.1, Grade A. A lever handled gauge cock and filter type snubber shall be provided. The gauges shall be isolated from the process fluids using remote corrosion resistant diaphragm seals. The housing of the corrosion resistant seals shall be constructed of stainless steel. Seals shall be composed of Monel.

2.14.4.2 Thermometers

Thermometers shall be bi-metal actuated, with 5 inches dished anti-parallax dials that have external calibration adjustment and stainless steel cases. The thermometers shall have stainless steel stems, back-connection type for the correct viewing angle. The union connections with associated thermowells shall be included. Scale shall be 25 to 125 degrees F with accuracy within one scale division.

2.14.4.3 Thermowells

Thermowells shall be TP316 stainless steel with a diameter of 1 inch. The length shall be as shown on the contract drawings and coordinated with the associated temperature element. Process connections shall be constructed of stainless steel and shall have flanges, faced and drilled to ASME B16.5 Class 150 fixed hex nipples male ASME B1.20.1 threaded sockets. Thermowells that shall be used with thermocouples or RTDs shall be equipped with terminal connection heads rated NEMA 250 Type 4X.

2.14.5 Expansion Joints

The Contractor shall provide all structural work and equipment required to control expansion and contraction of piping. The Contractor shall verify that the anchors, guides, and expansion joints provided, adequately protect the piping systems.

2.14.5.1 Expansion Joint for Metallic Pipe

The expansion joint shall be single slip teflon type with stainless steel wetted materials of construction. The expansion joint shall be sized to match the associated piping. The maximum allowable working pressure shall be 150 psig at 120 degrees F. End connections shall be as specified for the associated pipe joints ASME B16.5ASME B16.1 Class flanged ASME B16.11 threaded welding. Required accessories for a complete assembly shall be provided including: swivel joints, limit stops, internal guides, anti-torque device, internal flow liners, control rods.

2.14.5.2 Expansion Joint for Nonmetallic Piping

A bellows expansion joint shall have a minimum of convolutions to accommodate an axial deflection of 1 inch, a lateral movement of 1 inch, and an angular rotation of 2 degrees, with ductile iron flanged, faced and drilled to ASME B16.1ASME B16.5 Class 150, end connections, and metal reinforcing bands. The maximum allowable working pressure shall be 140 psig at 120 degrees F. Bolting shall be limited to restrain the force developed by 1.5 times the specified maximum allowable operating pressure. The expansion joint shall be sized to match the associated piping.

2.14.6 Pressure Relief Devices

Pressure relief devices shall conform to the requirements of ASME B31.3.

2.14.6.1 Pressure-Relief Valve

Pressure-relief valves shall conform to the following:

a. Pressure-relief valves, 2 inches and smaller, shall be a direct diaphragm, spring controlled type with cast iron bodies and spring cases. Trim shall be stainless steel and seats, nitrile. Diaphragms shall be elastomeric, nylon reinforced butadiene acrylonitrile rubber. Miscellaneous parts such as the valve stems, nuts, and springs shall be stainless steel. End connections shall be flanged, faced and drilled to ASME B16.1ASME B16.5 Class 150ASME B16.11 threaded. The valves shall open when the upstream pressure reaches a maximum set point. Sizes and ratings as shown in the Valve Schedule under Section 16900 in the contract drawings.

b. Pressure relief valves, 2.5 inches and larger, shall be hydraulically operated, diaphragm actuated, pilot controlled globe angle valves with externally mounted strainers and test cocks. Bodies shall be cast iron and trim shall be stainless steel. Stem shall be stainless steel. End connections shall be flanged, faced and drilled to ASME B16.1ASME B16.5 Class 150ASME B16.11 threaded. The valves shall open when the upstream pressure reaches a maximum set point. Sizes and ratings as shown in the Valve Schedule in the contract drawings under Section 16900 Attachment 1 and Appendix A&B.

2.15 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.16 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.17 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

2.18 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

2.19 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.20 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.21 PIPE SUPPORTS AND PENETRATIONS

Pipe supports shall be in accordance with MSS-SP-58 & 69. Auxiliary steel shall be provided by the Contractor where the support of piping systems and equipment is required between building structural elements. Light gauge

and structural steel shapes shall conform to the requirements of ASTM A 36/A 36M. The Contractor shall have the option to use pre-engineered support systems of electrogalvanized steel products. However, a mixture of support system manufacturers products is not permitted. Where auxiliary steel is indicated as stainless steel, the Contractor shall provide TP304 stainless steel conforming to ASTM A 167, No. 1 Finish. For pipe supports in and around stainless steel tanks use same grade stainless steel support material.

2.21.1 Pipe Supports

Pipe supports shall conform to the requirements of MSS SP-58, MSS SP-69, and MSS SP-89. Where pipe supports contact bare piping or in-line devices, provide supports of compatible material so that neither shall have a deteriorating action on the other.

2.21.1.1 Beam Clamps

For upper attachments on structural steel, the Contractor shall provide beam clamps of ASTM A 36/A 36M carbon steel or ASTM A 181/A 181M forged steel and MSS SP-58 Types 19 through 23, 25 or 27 through 30. Holes drilled in structural steel for hanger support rods will not be permitted. Clamps shall be provided with hardened steel cup-point set screws and lock-nuts for anchoring in place. Clamp size selection shall only be based on the support of the required load.

2.21.1.2 Riser Clamps

Vertical runs of piping shall be supported at each floor, or closer where required, with ASTM A 36/A 36M carbon steel clamps bolted around pipes and attached to the building construction. Copper plated clamps shall be provided for copper tubing support. Two bolt-type clamps designed for installation under insulation shall be used on insulated pipe runs.

2.21.1.3 Brackets

Where piping is run adjacent to walls or steel columns, the Contractor shall provide welded ASTM A 36/A 36M steel brackets, pre-punched with a minimum of two fastener holes.

2.21.1.4 Offset Pipe Clamp

Where pipes are indicated as offset from wall surfaces, a double-leg design two-piece pipe clamp shall be supplied by the Contractor.

2.21.1.5 Racks

Multiple pipe racks or trapeze hangers shall be fabricated from ASTM A 36/A 36M steel , and designed to suit the conditions at the points of installation. Pipes shall be kept in their relative positions to each other by the use of clamps or clips. Pipelines subject to thermal expansion must be free to slide or roll.

2.21.1.6 Hangers

Hangers shall be fabricated of malleable iron, ASTM A 47/A 47M or ASTM A 36/A 36M carbon steel. All hangers shall be of a uniform type and material for a given pipe run and application. Coated or plated hangers shall be used to isolate steel hangers from dissimilar metal tube or pipe. Hangers

for pipe sizes 2.5 inches or larger shall incorporate a means of vertical adjustment after erection while supporting the load. For piping systems with operating temperatures from 122 to 446 degrees F the following shall be used: MSS SP-58 Type 1 or 3 through 12 hangers with overhead support and appropriate saddle of MSS SP-58 Type 40 for insulated pipe; MSS SP-58 Types 41 or 43 through 46 hangers or supports with roller support and appropriate saddle of MSS SP-58 Type 39 on insulated pipe;MSS SP-58 Types 35 through 38 for sliding support. For piping systems with liquid temperatures up to 122 degrees F the following shall be used: MSS SP-58 Types 1,3 through 12, Types 24 and 26 with overhead support, or Types 35 through 38 with support from below.

2.21.1.7 Hanger Rods

Hanger rods shall be carbon steel conforming to ASTM A 576. The diameter of the rods for piping system support shall conform to and MSS-SP-58 & 69.

2.21.2 Pipe Guides

2.21.2.1 Intermediate Guides

For piping 6 inch and smaller, a pipe clamp with an oversize pipe sleeve shall be provided for a minimum .16 inch clearance. For piping 8 inch and larger, U-bolts with double nuts that are manufactured for the purpose shall be used to provide a minimum 0.28 inch clearance around pipe. The stock sizes for the U-bolts are as follows: for a 8 inch pipe use a 0.625 inch U-bolt; for a 10 inch pipe, use a 0.75 inch U-bolt; for a 12 inch to 16 inch pipe, use a 0.875 inch U-bolt; and for 18 inch to 30 inch pipes use 1 inch U-bolts.

2.21.2.2 Alignment Guides

For piping, 8 inch and smaller, alignment guides shall be galvanized steel, spider or sleeve type. For piping, 10 inch and larger, alignment guides shall be galvanized steel, roller type guides.

2.21.3 Flashing Sleeves

Galvanized steel flashing sleeves shall be installed wherever piping passes through concrete roof structures. Where piping penetrates roofs, 2 kg (4 lb.) 4 lb lead flashing shall be provided. The flashing shall extend mm inches from the pipe in all directions, extend up the pipe, and shall be fitted with double-threaded flashing for pipes 75 mm 3 inches and smaller. Flashing shall turn down inside the pipe for 100 mm 4 inches mm inches and larger pipes.

2.21.4 Wall Penetrations

2.21.4.1 Above Grade Wall Penetrations

Piping which passes through fire-rated or smoke-rated walls, floors, or ceilings shall be provided with insulated and encased pipe sleeves. Penetrations through an existing fire or fire barrier wall shall be sealed with a fire stop system that has an "F" rating not less than the required fire resistance rating of the penetrated wall. The fire stopping sealant for metal piping systems shall be a water based vibration resistant, polysiloxane (also known as silicone) based, nonslumping, premixed sealant with intumescent properties , that is rated for hours pursuant to ASTM E 814 and UL requirements. The fire stopping sealant for plastic and insulated

piping systems shall be a polysiloxane (also known as silicone) based, nonslumping, premixed sealant with intumescent properties acrylic based, nonslumping, premixed sealant with intumescent properties, that is vibration and moisture resistant, and is rated for 3 hours pursuant to ASTM E 814 and UL requirements with metal collars. Vented plastic pipe penetrations shall be fitted with galvanized steel collars that have intumescent inlays.

2.21.4.2 Below Grade Wall Penetrations

Below-grade wall penetrations shall be provided with hydrostatic seals designed to seal opening between pipe or conduit and a through-structure opening. The seals shall be modular mechanical type consisting of Teflon gaskets.

2.21.4.3 Galvanizing

Galvanizing shall be hot-dip applied and meet the requirements of ASTM A 153/A 153M. Stainless steel components may be substituted where galvanizing is specified.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 10 feet each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Copper Tubing Lines

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inchesshall be maintained between pipes.

3.1.2.5 Structures

Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

3.1.3 Joint Deflection

3.1.3.1 Allowable for Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

3.1.3.2 Allowable for Steel Pipe

For pipe with bell-and-spigot rubber-gasket joints, maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets shall be 5 degrees unless a lesser amount is recommended by the manufacturer. Short-radius curves and closures shall be formed by short lengths of pipe or fabricated specials specified.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed

using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA Work Practices.

3.1.4.2 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.4.3 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

3.1.5.1 Ductile-Iron Pipe Requirements

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

3.1.5.2 Not Galvanized Steel Pipe Requirements

a. Mechanical Couplings: Mechanical couplings shall be installed in accordance with the recommendations of the couplings manufacturer.

b. Rubber Gaskets: Rubber gaskets shall be handled, lubricated where necessary, and installed in accordance with the pipe manufacturer's recommendations.

3.1.5.3 Galvanized Steel Pipe Requirements

Screw joints shall be made tight with a stiff mixture of graphite and oil, inert filler and oil, or with an approved graphite compound, applied with a brush to the male threads only. Compounds shall not contain lead.

3.1.5.4 Copper Tubing Requirements

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

3.1.5.5 Bonded Joints Requirements

Bonded joints shall be installed in accordance with details specified for joints in paragraph JOINTS.

3.1.5.6 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance with details specified in paragraph JOINTS. Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 1/8 inch thickness of coal tar over all fitting surfaces.

3.1.5.7 Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 50 mm (2 Inches) and Smaller

Service lines 2 inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where 2 or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLET

Pipe Size Inches	Corporation Stops, Inches For Ductile-Iron Pipe	Outlets w/Service Clamps, Inches Single & Double Strap
3	--	1
4	1	1
6	1-1/4	1-1/2
8	1-1/2	2
10	1-1/2	2
12 & larger	2	2

NOTE:

a. Service lines 1-1/2 inches and smaller shall have a service stop.

b. Service lines 2 inches in size shall have a gate valve.

3.1.6.2 Service Lines Larger than 50 mm (2 Inches)

Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Lines 3 inches and larger may use rubber-seated butterfly valves as specified above, or gate valves.

3.1.7 Field Coating and Lining of Pipe

3.1.7.1 Steel Pipe 80 mm (3 In.) and Larger, Not Galvanized

a. Cement-mortar coating and lining: Field jointing shall conform to Appendix, AWWA C205. Any defective area found in the coating and/or lining of pipe and joints shall be removed to the pipe wall and repaired. The repaired areas shall be at least equal in thickness to the minimum coating and/or lining required for the pipe. Steel reinforcement in the coating shall be repaired or replaced as necessary to assure a complete and soundly reinforced coating.

b. Coal-tar enamel coating, lining and wrapping: Field jointing shall conform to AWWA C203. The applied materials shall be tested by means of a spark-type electrical inspection device in accordance with the requirements of AWWA C203. Any flaws or holidays found in the coating and/or lining of pipe and joints shall be repaired by patching or other approved means. The repaired areas shall be at least equal in thickness to the minimum coating and/or lining required for the pipe.

3.1.7.2 Galvanized Steel Pipe, Field Coating

Field joints shall be given 1 coat of coal-tar primer and 2 coats of coal-tar enamel conforming to AWWA C203. The tests of the coating shall conform to AWWA C203, and any flaws or holidays found in the coating of pipe and joints shall be repaired by patching or other approved means; the repaired areas shall be at least equal in thickness to the minimum coating required for the pipe.

3.1.8 Setting of Fire Hydrants, Meters, Valves and Valve Boxes

3.1.8.1 Location of Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 6 inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 18 inches above the finished surrounding grade, and the operating nut not more than 48 inches above the finished surrounding grade. Fire hydrants designated on the drawings as low profile shall have the lowest outlet not less than 18 inches above the finished surrounding grade, the top of the hydrant not more than 24 inches above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished grade immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than 4 inches thick and 15 inchessquare. Not less than 7 cubic feet of free-draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

3.1.8.2 Location of Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are

in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

3.1.8.3 Location of Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.9 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.1.10 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.10.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.10.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-Restraint Design.

3.2 PREPARATION

3.2.1 Protection

Pipe and equipment openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage.

3.2.2 System Preparation

3.2.2.1 Pipe and Fittings

Pipe and fittings shall be inspected before exposed piping is installed or buried piping is lowered into the trench. The Contractor shall clean the ends of pipes thoroughly, remove foreign matter and dirt from inside of pipes, and keep piping clean during and after laying.

3.2.2.2 Damaged Coatings

The Contractor shall repair damaged coating areas in the field with material equal to the original coating, except for damaged glass-lined pipe which shall be promptly removed from the site. The Contractor shall not install damaged piping materials. Field repair of damaged and uncoated areas of galvanized piping shall conform to ASTM A 780.

3.2.2.3 Field Fabrication

The Contractor shall notify the Contracting Officer at least 2 weeks prior to the field fabrication of pipe or fittings and at least 3 days prior to the start of any surface preparation or coating application work. Field welding shall be performed in accordance with Section 05093 WELDING PRESSURE PIPING AND ACID PIPING. Welding electrodes shall be provided in accordance with Table 4.1 of AWS D1.1, AWS D1.6, AWS D10.4, AWS D10.8, and AWS D18.1 as required for the applicable base metals and welding process. Fabrication of fittings shall be performed in accordance with the manufacturer's instructions.

3.3 EXPOSED PIPING INSTALLATION

Exposed piping shall be run as straight as practical along the alignment shown on the contract drawings and with a minimum of joints. Piping and appurtenances shall be installed in conformance with reviewed shop drawings, manufacturer's instructions and ASME B31.3. Piping shall be installed without springing or forcing the pipe.

3.3.1 Anchors and Fasteners

Impact expansion (hammer and explosive charge drive-type) anchors and fastener systems are not acceptable. Lead shields, plastic or fiber inserts, and drilled-in plastic sleeve/nail drive systems are also not acceptable.

3.3.1.1 Drilled-In Expansion Anchors and Fasteners

Anchors shall be designed to accept both machine bolts and/or threaded rods. Such anchors shall consist of an expansion shield and expander nut contained inside the shield. The expander nut shall be fabricated and designed to climb the bolt or rod thread and simultaneously expand the shield as soon as the threaded item, while being tightened, reaches, and bears against the shield bottom. The shield body shall consist of four legs, the inside of each shall be tapered toward shield bottom (or nut end). The end of one leg shall be elongated and turned across shield bottom. The outer surface of shield body shall be ribbed for grip-action. The expander nut shall be of square design with sides tapered inward from bottom to top. The anchor materials of construction shall be TP304 stainless steel of 43,541 psi minimum tensile strength. Fasteners shall be

machine bolts for use with above anchors; nuts and washers shall conform to ASTM A 194/A 194M. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application. The anchor/fastener assembly shall be UL listed with a one-piece stud (bolt) that has integral expansion wedges, nuts and washers. The stud shall be constructed of TP304 stainless steel, and nut and washer of TP304 stainless steel. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application.

3.3.1.2 Drilled-In Adhesive Anchors

Drilled-in adhesive anchors shall not be used for overhead applications. The anchors shall be composed of an anchor rod assembly and an anchor rod adhesive cartridge. The anchor rod assembly shall be a chamfered and threaded stud rod of TP304 stainless steel with a nut and washer of ASTM A 194/A 194M alloy-steel TP316 stainless steel. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application. The adhesive cartridge shall be a sealed capsule containing premeasured amounts of resin, quartz sand aggregate, and a hardener contained in a separate vial within the capsule. The capsule ingredients shall be activated by the insertion procedure of the anchor rod assembly.

3.3.2 Piping Expansion Provisions

The piping shall be installed to allow for thermal expansion resulting from the difference between installation and operating temperatures. Anchors shall be installed as shown in the contract drawings to withstand expansion thrust loads and to direct and control thermal expansion. An intermediate pipe guide shall be installed for every pipe at each metal channel framing support not carrying an anchor or alignment guide. Where pipe expansion joints are required, pipe alignment guides shall be installed adjacent to the expansion device and within four pipe diameters. Expansion devices shall be installed in accordance with the manufacturer's instructions and at the locations shown in the contract drawings.

3.3.3 Piping Flexibility Provisions

Thrust protection shall be provided as required. Flexible couplings and expansion joints shall be installed at connections to equipment, and where shown on the contract drawings. Per Paragraph 3.12 and 3.12.1, additional pipe anchors and flexible couplings beyond those shown on the contract drawings, shall be provided to facilitate piping installation, in accordance with reviewed shop drawings.

3.3.4 Couplings, Adapters and Service Saddles

Pipes shall be thoroughly cleaned of oil, scale, rust, and dirt in order to provide a clean seat for gaskets. Gaskets shall be wiped clean prior to installation. Flexible couplings and flanged coupling adapter gaskets shall be lubricated with soapy water or the manufacturer's standard lubricant before installation on the pipe ends. Couplings, service saddles, and anchor studs shall be installed in accordance with manufacturer's instructions. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Torque-limiting wrenches shall be used to tighten bolts.

3.3.5 Piping Equipment/Component Installation

Piping components and indicators shall be installed in accordance with manufacturer's instructions. Required upstream and downstream clearances, isolation valves, and miscellaneous devices shall be provided for an operable installation. Straight runs of piping upstream and downstream of flow measuring devices shall be as shown in the contract drawings. The upstream and downstream lengths of undisturbed piping shall be in accordance with flow indicator manufacturer's recommendations.

3.3.5.1 Backflow Preventers

Backflow preventers shall be installed with nameplate and test cocks accessible from front of unit, and with a minimum clearance of 12.2 inches between the port and grade. The assemblies shall be installed in accordance with local codes and shall discharge to an open drain with an air gap; vertical installation shall be avoided.

3.3.5.2 Local Indicators

All direct-reading indicator devices, thermometers, and pressure gauges shall be installed so that they can be easily read from floor level, and are readily accessible for maintenance and service. All temperature sensing bulbs shall be coated with a silver base heat transfer grease prior to insertion into the thermowell. Pressure gauges and thermometers shall be installed where indicated in the contract drawings. Field calibration of all indicators shall be performed at time of installation to ensure measuring and reading accuracy. Differential pressure gauges shall be installed across the process equipment indicated in the contract drawings, in accordance with the manufacturer's recommendations, and arranged for easy observation.

3.3.6 Pipe Flanges

Pipe flanges shall be set level, plumb, and aligned. Flanged fittings shall be installed true and perpendicular to the axis of the pipe. The bolt holes shall be concentric to the centerline of the pipe and shall straddle the vertical centerline of the pipe.

3.3.7 Valve Locations

Valves shall be located in accordance with the contract drawings where actuators are shown. Where actuators are not shown, valves shall be located and oriented to permit easy access to the valve operator, and to avoid interferences.

3.3.8 Pipe Tap Connections

Taps to pipe barrels are unacceptable. Taps to ductile iron piping shall be made only with a service saddle or at a tapping boss of a fitting, valve body, or equipment casting. Taps to steel piping shall be made only with a welded threadolet connection.

3.3.9 Plastic Pipe Installation

All plastic pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Heat joining shall be performed in accordance with ASTM D 2657. Electrofusion joining shall be performed in accordance with ASTM F 1290. Schedule 40 pipe shall not be threaded.

Schedule 80 threaded nipples shall be used where necessary to connect to threaded valves or fittings. Strap wrenches shall be used for tightening threaded plastic joints, and care shall be taken not to over tighten these fittings. Pipe shall not be laid when the temperature is below 40.1 degrees F, nor above 90 degrees F when exposed to direct sunlight. Any plastic pipe installed above grade and outdoors shall be ultraviolet (UV) protected or UV resistant. The pipe ends that are to be joined shall be shielded from direct sunlight prior to and during the laying operation. Adequate ventilation shall be provided when working with pipe joint solvent cement and the handling of solvent cements, primers and cleaners shall be in accordance with ASTM F 402. The Contractor shall provide and install supports and hangers in accordance with the manufacturer's recommendations and as specified and shown on the contact drawings. Where plastic pipe is subjected to severe temperature fluctuations, provisions for expansion and contraction must be provided. This shall be accomplished with the use of expansion joints and offset piping arrangements. All lines shall be hydrostatically tested at the maximum operating pressures as shown on the contract drawings.

3.3.9.1 PVC Piping

Solvent-cemented joints shall be constructed in accordance with ASTM D 2855.

3.3.10 Double Containment Piping Installation

Factory trained field representatives of the piping supplier shall provide technical field support during critical periods of piping .

3.3.11 Insulation

Insulation shall be installed on piping as indicated on the Pipe Schedule in the contract drawings in accordance with the provisions of the Section THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.4 BURIED PIPE PLACEMENT

Thermoplastic piping systems shall be installed underground in accordance with ASTM D 2774. Thermosetting resin and reinforced plastic mortar piping systems shall be installed underground in accordance with ASTM D 3839.

3.4.1 Excavation and Backfilling

Earthwork shall be performed as specified in the Section EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. The Contractor shall exercise care when lowering pipe into the trench to prevent damage or twisting of the pipe.

3.4.2 Fittings

At valves and connections, the trench bottom shall be dug out with sufficient length, width, and depth to ensure clearance between the undisturbed trench bottom and the valves and such connections.

3.4.3 Thrust Restraint

Thrust restraint devices are generally not shown in the contract drawings; their absence will not relieve Contractor of the responsibility for providing them as required to provide complete systems for the use

intended. The Contractor shall provide thrust blocks and ties where required, whether or not shown on the contract drawings. At a minimum, thrust restraint shall be provided at pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist.

3.4.3.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than the ratio of 1 cement, 2.5 sand and 5 gravel, and have a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust blocks shall be poured against undisturbed earth. The sides of thrust blocks not subject to thrusts may be poured against forms. The area of bearing shall be as shown or directed. Blocking shall be placed so that fitting joints shall be accessible for repair. Steel rods and clamps, protected by galvanizing or a coating of bituminous paint shall be used to anchor vertical down bends into gravity thrust blocks.

3.4.3.2 Restrained Joints

The restrained pipe length shall be 25 feet. For ductile iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-Restraint Design.

3.4.4 Marking Tape

Pipe marking tape shall be provided and installed in accordance with the requirements of Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING.

3.4.5 Plastic Pipe Installation

Plastic pipe shall be cut, fabricated, and installed in strict conformance with the pipe manufacturer's recommendations. Offset loops from the trench centerline shall be as recommended by the manufacturer for the maximum temperature variation between the pipe temperature at the time of solvent welding and operating temperature. Flexible plastic pipe connected to heavy fittings, manholes, and rigid structures shall be supported in such a manner that no subsequent relative movement between the plastic pipe at the flanged joint and the rigid structures is possible. Thrust blocking shall not be used for flexible plastic piping. The piping shall be designed and installed to withstand the compression and expansion forces imposed by the trench conditions. Concrete thrust blocks shall be constructed where required on the contract drawings.

3.5 CONNECTING DISSIMILAR PIPE

Flexible transition couplings, dielectric fittings and isolation joints shall be installed in accordance with the manufacturer's instructions.

3.6 EXTERNAL CORROSION PROTECTION

Protect all pipe and piping accessories from corrosion and adverse environmental conditions.

3.6.1 Underground Metallic Piping

Buried metallic piping shall be protected from corrosion using protective

coatings. Where dissimilar metals are joined underground, gas-tight isolation joints shall be used. Insulating joint material shall be provided where shown to control galvanic or electrical action.

3.6.2 Above Grade Metallic Piping

Nonferrous and stainless steel piping shall not be painted except for aluminum alloy piping. Where dissimilar metals are joined, isolation joints shall be used.

3.6.2.1 Ferrous Piping

Shop primed surfaces shall be touched up with ferrous metal primer. Surfaces that have not been shop primed shall be solvent cleaned. Surfaces that contain loose rust, mill scale or other foreign substances shall be mechanically cleaned by power wire brushing commercial sand blasting conforming to SSPC SP 6/NACE 3 and primed with a ferrous metal primer . Primed surfaces shall be finished with two coats of exterior vinyl paint in accordance with the Section PAINTING, GENERAL.

3.7 FLEXIBLE JOINTS AT CONCRETE STRUCTURES

Flexible joints shall be provided at the face of all structures, whether or not shown on the contract drawings. Ring joints, mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints shall be considered flexible joints; welded pipe joints shall not. Joints may be flush with the structure face or may be located up to 1 pipe diameter away from face , but not further than 17.7 inches away from face. For pipelines larger than 18 inches in diameter the first joint shall be within 1 pipe diameter.

3.8 CLOSURES

Closure pieces shall be installed as necessary to end pipe runs and shall conform to ASME B16.9 or ASME B16.11. Elastomer sleeves bonded to pipe ends are not acceptable. Pressure piping shall have closures of butt-welded caps blind flanges threaded plugs plain end pieces, with thickness matching the nominal wall thickness of the associated pipe, mounted on double flexible couplings, unless otherwise shown on contract drawings or approved by the Contracting Officer. Pipes with restrained joints shall have pipe closures installed with thrust tie-rod assemblies as required.

3.9 PENETRATIONS

Steel pipe sleeves shall be hot-dipped galvanized after fabrication for above grade applications in nonsubmerged areas. For below grade, or in submerged and damp environments, steel pipe sleeves shall be lined and coated as specified in the Section PAINTING, GENERAL. Embedded metallic piping shall be isolated from concrete reinforcement using coated pipe penetrations. Coatings shall be as specified in the Section PAINTING, GENERAL. Wall pipes shall be securely supported by form work to prevent contact with reinforcing steel and tie-wires. Joints shall be caulked with rubber sealant or sealed with a wall penetration seal. For existing concrete walls, rotary drilled holes may be provided in lieu of sleeves.

3.10 VALVE INSTALLATION

Flanged valve bolt holes shall be installed so as to straddle the vertical

centerline of pipe. Flanged faces shall be cleaned prior to inserting the gasket and bolts, and then the nuts shall be tightened progressively and uniformly. Threaded ends shall have the threads cleaned by wire brushing or swabbing prior to installation.

3.10.1 Valve Orientation

The operating stem of a manual valve shall be installed in a vertical position when the valve is installed in horizontal runs of pipe having centerline elevations 4.5 feet or less above finished floor, unless otherwise shown on contract drawings. The operating stem of a manual valve shall be installed in a horizontal position in horizontal runs of pipe having centerline elevations between 4.5 feet and 6.75 feet above finish floor, unless otherwise shown on contract drawings. Automatic valves shall be installed in accordance with the manufacturer's instructions and approved drawings.

3.10.1.1 Butterfly Valves

Orientation of butterfly valves shall take into account changes in pipe direction. Valve shafts shall be oriented so that unbalanced flows caused by pipe direction changes or other disturbances are equally divided to each half of the disc.

3.10.1.2 Plug Valves

If a plug valve seat position is not shown in the contract drawings, locate the seat position as follows: for horizontal flow, the flow shall produce an "unseating" pressure, and the plug shall open into the top half of valve; and for vertical flow, the seat shall be installed in the highest portion of the valve.

3.10.2 Line Size Ball Valves

A line size ball valve and union shall be installed upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

3.10.3 Isolation Valve

Safety isolation valves shall be installed on compressed air supplies. The valve shall be located to provide accessibility for control and maintenance. If necessary, access doors shall be installed in finished walls and plaster ceilings for valve access.

3.10.4 Operator Extension Stems

Where the depth of the valve is such that its centerline is more than 3 feet below grade, an operator extension stem shall be furnished with a 2 inch operating nut to bring the operating nut to a point 5.9 inches below the surface of the ground and/or box cover. The operating nut shall be located in a floor box.

3.10.5 Torque Tube

Where the operator for quarter-turn valve is located on a floor stand, an extension stem torque tube shall be furnished, properly sized for the maximum torque capacity of the valve.

3.10.6 Chain Wheel and Guide

Chain wheel and guide assemblies or chain lever assemblies shall be installed on manually operated valves located over 6.73 feet above finished floor elevation. Where chains hang in normally traveled areas, appropriate "L" type tie-back anchors shall be used.

3.11 AIR RELEASE, DRAINS AND SAMPLE PORTS

Sample ports shall be provided where indicated on the contract drawings. The Contractor shall install specified vents at piping high points for entrapped air release and install drains in the low points of pipelines regardless of whether shown on contract drawings.

3.12 PIPING SUPPORT SYSTEMS INSTALLATION

The absence of pipe supports and details on the contract drawings shall not relieve the Contractor of responsibility for sizing and providing supports throughout plant.

3.12.1 General Support Requirements

Pipe support systems shall meet the requirements of MSS SP-58. Contractor-designed and selected support systems shall be installed in accordance with MSS SP-69, and as specified herein. Piping connections to equipment shall be supported by pipe supports and not off the equipment. Large or heavy valves, fittings, and/or equipment shall be supported independently of associated piping. Pipes shall not be supported off other pipes. Supports shall be provided at piping changes in direction or in elevation, adjacent to flexible joints and couplings, and where otherwise shown on the contract drawings. Pipe supports and hangers shall not be installed in equipment access areas or bridge crane runs. Hanging pipes shall be braced against horizontal movement by both longitudinal and lateral sway bracing. At each channel type support, every pipe shall be provided with an intermediate pipe guide, except where pipe anchors are required. Existing support systems may be used to support additional new piping only if the Contractor can demonstrate that the existing support systems are adequate for the additional loads, or if the existing systems are strengthened to support the additional loads. Pedestal type pipe supports shall be provided under base flanges adjacent to rotating equipment and where required to isolate vibration. Piping 2.5 inches in diameter and larger shall be braced for seismic forces. Lateral supports for seismic loads shall be installed at all changes in direction.

3.12.2 Support of Insulated Piping

The Contractor shall install oversized supports to fit the insulation inserts. Supports shall be provided with galvanized or stainless steel protection shields and oversized rollers.

3.12.3 Dielectric Barriers

Dielectric barriers shall be installed between supports and copper or stainless steel piping, and between stainless steel supports and non-stainless steel ferrous piping.

3.12.4 Support Spacing

3.12.4.1 Acceptable Limits for Metallic Piping

Stainless steel Schedule 10S, diameter 6 inches, shall have a maximum span of 72 inches and a minimum rod size for single rod hangers of 0.5 inches.

3.12.4.2 Acceptable Limits for Thermoplastic Piping

PVC, Schedule 40 SDR 35, diameter 6 inches, shall have a maximum span of 60 inches and a minimum rod size for single rod hangers of 0.5 inches.

3.12.4.3 Acceptable Limits for Rubber/Elastomer Piping

Chloroprene, internal diameter 6 inches, shall have a maximum span of 60 inches and a minimum rod size for single rod hangers of 0.5 inches.

3.12.5 Support Methods

Piping support shall be provided as specified and as shown in the contract drawings. Single horizontal suspended piping shall be supported by adjustable swivel-ring, split-ring, or clevis hangers. Multiple horizontal suspended piping shall be supported by trapeze hangers with channel type supports. Horizontal pedestal mounted piping shall have saddle type supports. Horizontal wall mounted piping shall have wall brackets. Vertical piping shall be supported by wall brackets, base elbows, or riser clamps on floor penetrations.

3.12.6 Supports and Hangers for Stainless Steel Piping

All hanger-pipe contact surfaces shall have a dielectric barrier consisting of chloroprene rubber wrapping or plastic coated hangers. The load rating of universal concrete inserts shall not be less than that of the hanger rods they support.

3.13 PIPE IDENTIFICATION, PAINTING AND COLOR CODING

Color, coating, and lettering requirements for exposed piping shall be in accordance with the Section PAINTING, GENERAL. Except where piping is required to be completely painted in its code color, piping or its insulation covering may be banded either with plastic adhesive tapes or painted stripes around pipe designating piping contents in accordance with following options and requirements. A single individual band, of plastic adhesive tape or paint, designating pipe contents shall be provided with sufficient length to permit the stenciling of pipe contents in letters. Identification shall be provided at branch connections, inlets and outlets of equipment, every 19.7 feet of straight run, upstream of valves, and within 3.3 feet of entrance to or exit from wall curtains, or other similar type barrier.

3.14 FIELD QUALITY CONTROL

3.14.1 Hydrostatic Tests

Where any section of a pipeline is provided with concrete thrust blocking for fitting, the hydrostatic tests shall not be made until at least days after the installation of the concrete thrust blocking, unless otherwise approved by the Contracting Officer.

3.14.1.1 Buried Piping

After the pipe is laid, the joints completed and the trench partially

backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic test pressure of 150 psig. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced as necessary. Defective pipe, joints, fittings, and valves found during the pressure test shall be removed and replaced with new material, and the test repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions are encountered: (1) wet or unstable soil conditions in the trench; (2) compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions; or (3) maintaining the trench in an open condition would delay completion of the Contract. The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of the Section EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.14.1.2 Exposed Piping

Hydrostatic testing shall be conducted in accordance with ASME B31.3. Piping systems shall be tested under normal service conditions (as indicated in the Pipe Schedule in the contract drawings) to demonstrate compliance. The test pressure shall not be less than 1.5 times the design pressure. Water shall be used as the hydrostatic test fluid. The Contractor shall provide clean test water of such quality to prevent corrosion of the piping system materials. Air release vents shall be opened at all high points of the piping system in order to purge air pockets while the piping system is filling.

a. For rigid piping hydrostatic testing, the maximum test pressure shall be calculated according to ASME B31.3, but shall not exceed the yield strength of the piping system. The maximum velocity during filling shall be 0.25 fps applied over full area of pipe in accordance with the manufacturer's instructions. Venting during filling may also be provided by loosening flanges with a minimum of four bolts or by the use of equipment vents. The Contractor shall test all parts of the piping system. The hydrostatic test pressure shall be maintained continuously for 30 minutes minimum and for such additional time as necessary to conduct examinations for leakage. All joints and connections shall be examined by the Contractor for leakage. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leaking. The Contractor shall correct visible leakage and retest. Unless otherwise directed by the Contracting Officer, the piping system shall be left full of water after leaks are repaired.

b. For non-rigid, non-metallic piping and metallic piping with a non-metallic liner hydrostatic testing, the maximum test pressure shall be calculated according to ASME B31.3, but shall not exceed 1.5 times the maximum pressure rating of the lowest rated component in the piping system. The maximum velocity during filling shall be 0.25 fps applied over full area of pipe in accordance with the manufacturer's instructions. The system shall be initially

pressurized to 50 percent of the normal service conditions and inspected. Any leaks shall be repaired by the Contractor. The system shall then be pressurized to the test pressure. Small amounts of water shall be added as required on a hourly basis for a maximum of 3 hours in order to maintain the test pressure. After 4 hours, the test pressure shall be lowered by 10.2 psi. If the hydrostatic pressure remains steady for 1 hour, then no leakage is indicated. The Contractor shall inspect for leaks, repair and retest if necessary. The piping system shall be allowed to relax for 8 hours before retesting.

3.14.1.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a delay, underground piping jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Tests for above ground pressure piping shall be conducted after the piping has been completely installed, including all supports, hangers, and anchors, and inspected for proper installation but prior to installation of insulation.

3.14.2 Pneumatic Tests

Pneumatic testing shall be prepared for and conducted in accordance with the requirements of ASME B31.3. Care must be taken to minimize the chance of a brittle fracture or failure during a pneumatic leak test. Only non-toxic, nonflammable, inert gases or air shall be used.

3.14.2.1 Pressure Relief Device

During pneumatic testing, a pressure relief device shall be provided for each piping section being tested. The device shall have a set pressure not higher than the test pressure plus the lesser of 10 percent of the test pressure or 50.8 psi.

3.14.2.2 Pneumatic Testing Procedures

The test fluid shall be air and the test pressure shall be 110 percent of the design pressure. The test pressure shall be incrementally increased until the gage pressure reaches the lesser of 50 percent of the test pressure or 25 psig. The Contractor shall examine piping joints for leakage. If no leakage is occurring, the Contractor shall continue to increase the pressure incrementally, while maintaining each incremental increase long enough to equalize pipe strains, until the test pressure is reached. The test pressure shall then be reduced to the design pressure and maintained for 10 minutes without additional energy expenditure. If the pneumatic pressure remains steady, then no leakage is indicated. The Contractor shall inspect for and repair leaks, and retest if necessary.

3.14.3 Pipe Leakage Tests

Unless approved by the Contracting Officer, leakage testing shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the piping shall be subjected to not less than 200 psig pressure. Leakage is defined as the quantity of the test liquid, water, that is supplied to the piping system, or any valved or approved section thereof, in order to maintain pressure within 5 psi of the specified leakage test

pressure after the piping has been filled with the test liquid and all air is expelled. No piping installation will be accepted if leakage exceeds the allowable leakage determined by the following formula:

L = Cf x N x D x P0.5
Cf = conversion factor = 0.0001351
L = allowable leakage, gallons per hour
N = number of joints in the length of piping tested
D = nominal pipe diameter, inches
P = average test pressure during the test, psig.

Should any test disclose leakage greater than that allowed, the leaks shall be located and repaired until the leakage is within the specified allowance, without additional cost.

3.14.4 Testing New to Existing Connections

New piping connected to existing pipe, existing equipment, existing treatment systems, or tanks and treatment systems furnished under other Sections shall be tested. The Contractor shall isolate the new piping with pipe caps, spectacle blinds, or blind flanges. The joint between new piping and existing piping shall be tested by methods that do not place the entire existing system under the test load. The Contractor shall then proceed with the testing of new piping systems as specified herein.

3.14.5 Valve Testing

Valves may either be tested while testing pipelines, or as a separate step. It shall be demonstrated that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, and in both directions for two-way valve applications. The Contractor shall count and record the number of turns required to open and close each valve, and account for any discrepancies with manufacturer's data. Air and vacuum relief valves shall be examined as the associated pipe is being filled to verify venting and seating is fully functional. The Contractor shall set, verify, and record set pressures for all relief and regulating valves. Self-contained automatic valves shall be tested at both maximum and minimum operating ranges, and reset upon completion of test to the design value. Automatic valves that are not self-contained shall be tested in conjunction with control system testing.

3.15 FINAL CLEANING

3.15.1 Interim Cleaning

The Contractor shall prevent the accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping sections during fabrication. The piping shall be examined to assure removal of these and other foreign objects prior to assembly and installation.

3.15.2 Flushing

Following assembly and testing, and prior to final acceptance, piping systems shall be flushed with to remove accumulated construction debris and other foreign matter. The piping shall be flushed until all foreign matter is removed from the pipeline. The Contractor shall provide all hoses, temporary pipes, ditches, and other items as required to properly dispose of flushing water without damage to adjacent properties. The minimum

flushing velocity shall be 2.5 fps. For large diameter pipe where it is impractical to flush the pipe at the minimum flushing velocity, the pipeline shall be cleaned in-place from the inside by brushing and sweeping, then flushing the pipeline at a lower velocity. Cone strainers shall be installed in the flushing connections of attached equipment and left in place until cleaning is completed. Accumulated debris shall be removed through drains, or by removing spools or valves.

3.15.3 Disinfection

The Contractor shall disinfect the pipelines as noted. Before acceptance of piping system operation, each section of completed pipeline shall be disinfected in accordance with AWWA C651. After pressure tests have been made, the piping section to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be liquid chlorine calcium hypochlorite or sodium hypochlorite . The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the piping in an approved manner. PVC pipe lines shall be chlorinated using only the above specified chlorinating material in solution. In no case shall the agent be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. All valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each outlet on the line shall be opened and closed several times. From several points in the pipeline section, contractor personnel, approved by the Contracting Officer, shall take samples in sterilized containers and have a bacterial examination performed by a commercial laboratory in accordance with state approved methods. The commercial laboratory must be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until the piping system passes the bacterial examination for 2 consecutive days. The piping system will not be accepted until satisfactory bacteriological results have been obtained.

3.16 WASTE WATER DISPOSAL

The water used for testing, cleaning, flushing and/or disinfection shall be disposed of in accordance with all applicable regulations. Disposal is solely the responsibility of the Contractor. The method proposed for disposal of waste water shall be provided to, and approved by, the Contracting Officer prior to performing any testing, cleaning, flushing and disinfection activities.

3.17 SCHEDULES

The Contractor shall comply with the following schedules found in the contract drawings: Pipe Schedule Valve Schedule and Valve Operator Schedule under Section 16900 Attachment 1 and Appendix A&B.

-- End of Section --

SECTION 16050

HIGH RESISTANCE GROUND UNIT
02/01

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 FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

1.2 RELATED REQUIREMENTS

1.3 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be for a 480V , three phase, 60 hz, wye connected, power system. .

1.4 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of Section 01330, "Submittal Procedures" 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 Factor Engineer

Submittal indicating the Factory Engineer who will size, adjust and test this equipment along with the engineer qualifications. The engineer must have a minimum of 3 years experience with High Resistance Ground Units and have been with the company supplying the equipment for a minimum of 3 years. Provide the name, qualifications, telephone number, and company name of this enginner in the submittal.

1.4.2 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.

1.4.3 Drawings

Submit drawings a minimum of 14 by 20 inches in size using a minimum scale of 1/8 inch per foot. 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.

1.4.4 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.

1.4.5 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.

1.4.5.1 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 (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.

1.4.5.2 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.

1.4.6 Operation and Maintenance Manuals

Comply with the requirements of Section 01780, CLOSEOUT SUBMITTALS and the technical sections.

1.4.6.1 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. 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.

1.5.2 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.

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.

1.5.7 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for High Resistance Ground Unit. 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 one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

PART 2 PRODUCTS

2.1 Equipment

2.1.1 High Resistance Ground System

The equipment shall be designed to operate on a 480V, 3-phase, 43-wire WYE connected system. It shall be provided in a NEMA 3R outdoor enclosure. It shall be shipped complete with the following items and features:

a. Line fuses, 600 volt, 10 amp, interrupting capacity of 25,000 amps RMS symmetrical.

b. Control Power Transformer

c. Meter relay-double set point

d. Pulsing contactor, set to produce approximately 40 current pulses per minute.

e. Neutral grounding resistor, continuous rated

f. Relay for pulsing contractor

g. Control relay with interlocks for remote alarm

h. "Ground Fault" red indicating light

i. "Normal" green indicating light

j. "Normal-Pulse" selector switch

k. Test Resistor

l. Outdoor NEMA 3R, pad-mounted enclosure

m. Portable ground-current detector with carrying case

n. Bottom cable entry

o. Green Rotating Beacon mounted on top of the enclosure as shown on drawing.

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.

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 FACTORY ENGINEER

An engineer, from the factory who manufacturer's this equipment, shall size, adjust and test the high resistance grounding system.

3.4 TESTING

Perform all standard factory field testing that can be performed on a high resistance ground unit to show it will operate as required by the specification. The contractor shall notify the Contracting Officer 30 days before the performance and acceptance tests are to be conducted. The tests shall be performed in the presence of the Contracting Officer under the supervision of the Field Engineer Representative. The Contractor shall furnish all instruments and personnel required fo the test.

-- End of Section --

SECTION 16263

DIESEL-GENERATOR SET STATIONARY 100-2500 KW, WITH AUXILIARIES
06/02

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 basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1999el) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 181/A 181M	(2000) Carbon Steel Forgings for General-Purpose Piping
ASTM A 234/A 234M	(2000) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM D 975	(1998b) Diesel Fuel Oils

ASME INTERNATIONAL (ASME)

ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

EGSA 101P	(1995a) Engine Driven Generator Sets

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE Std 1	(1986; R 1992) General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation

	of Electrical Insulation
IEEE Std 43	(1974; R 1991) Testing Insulation Resistance of Rotating Machinery
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 115	(1995) IEEE Guide: Test Procedures for Synchronous Machines
IEEE Std 120	(1989) Electrical Measurements in Power Circuits
IEEE Std 484	(1996) Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
IEEE Std 485	(1997) Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations
IEEE Std 519	(1992) Harmonic Control in Electrical Power systems

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA MG 1	(1998) Motors and Generators
NEMA SG 5	(1995) Power Switchgear Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1996; Errata; TIA 96-2) Flammable and Combustible Liquids Code
NFPA 37	(1998) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(2002) National Electrical Code
NFPA 110	(1999) Emergency and Standby Power Systems

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J 537	(1996) Storage Batteries

UNDERWRITERS LABORATORIES (UL)

UL 1236	(1994; Rev thru Mar 1999) Battery Chargers for Charging Engine-Starter Batteries

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Layout; G
General Installation; G

Drawings shall include the following:

a. Base-mounted equipment, complete with base and attachments, including anchor bolt template and recommended clearances for maintenance and operation.

b. Complete starting system.

c. Complete fuel system.

d. Complete cooling system.

e. Complete exhaust system.

f. Layout of relays, breakers, programmable controllers,switchgear, and switches including applicable single line and wiring diagrams with written description of sequence of operation and the instrumentation provided.

g. The complete lubrication system, including piping, pumps, strainers, filters, heat exchangers for lube oil and turbocharger cooling, electric heater, controls and wiring.

h. Location, type, and description of vibration isolation devices for all applications.

i. The safety system, together with a detailed description of how it is to work. Wiring schematics, safety devices with a listing of their normal ranges, alarm and shutdown values (to include operation parameters such as pressures, temperatures voltages, currents, and speeds) shall be included.

j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and instrumentation.

k. Layout of each panel.

l. Mounting and support for each panel and major piece of electrical equipment.

m. Engine-generator set lifting points and rigging instructions.

Acceptance; G

Drawings which accurately depict the as-built configuration of the installation, upon acceptance of the diesel-generator set installation. Layout drawings shall be revised to reflect the as-built conditions and shall be submitted with the as-built drawings.

SD-03 Product Data

Performance Criteria; G

Calculations of the engine and generator output power capability, including efficiency and parasitic load data.

Sound Limitations; G

Sound power level data for the packaged unit operating at 100% load in a free field environment. The data should demonstrate compliance with the sound limitation requirements of this specification.

Harmonic Requiremants
Engine-Generator Parameter Schedule

Description of the generator features which mitigate the effects of the non-linear loads listed.

Integral Main Fuel Storage Tank
Day Tank

Calculations for the capacity of each external, diesel, storage tank, including allowances for recirculated fuel, usable tank capacity, and duration of fuel supply.

Power Factor; G

The generator capability curve showing generator kVA output capability (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0.

Heat Rejected To Engine-Generator Space

Manufacturers data to quantify heat rejected to the space with the engine generator set at rated capacity.

Cooling System

A letter which certifies that the engine-generator set and cooling system function properly in the ambient temperature specified.

a. The maximum allowable inlet temperature of the coolant fluid.

b. The minimum allowable inlet temperature of the coolant fluid.

c. The maximum allowable temperature rise in the coolant fluid through the engine.

Time-Delay on Alarms

The magnitude of monitored values which define alarm or action set points, and the tolerance (plus and/or minus) at which the devices activate the alarm or action for items contained within the alarm panels.

Generator;

Manufacturer's standard data for each generator (prototype data at the specified rating or above is acceptable), listing the following information:

Direct-Axis subtransient reactance (per unit).

The generator kW rating and short circuit current capacity (both symmetric and asymmetric).

Manufacturer's Catalog; G

Manufacturer's standard catalog data describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate complete specification compliance.

Site Welding

A copy of qualifying procedures and a list of names and identification symbols of qualified welders and welding operators.

A letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their identification symbols.

Spare Parts

A complete list of spare parts for each piece of equipment and a complete list of all material and supplies needed for continued operation. Lists shall include supply source and current prices. Each list shall be separated into two parts, those elements recommended by the manufacturer to be replaced after 3 years of service, and the remaining elements.

Onsite Training; G

A letter giving the date proposed for conducting the onsite training course, the agenda of instruction, a description of the video taping service to be provided, and the kind and quality of the tape to be left with the Contracting Officer at the end of the instructional period.

Battery Charger

Battery charger sizing calculations.

Vibration-Isolation;

Vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

Posted Data and Instructions; G

Posted data including wiring and control diagrams showing the key mechanical and electrical control elements, and a complete layout of the entire system.

Instructions

Instructions including: the manufacturers pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, and automatic transfer switches). Instructions shall be weatherproof, laminated in plastic, and posted where directed.

Experience; G

Each component manufacturer has a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacturer/assembler has a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

Field Engineer; G

A letter listing the qualifications, schools, formal training, and experience of the field engineer.

General Installation; G

A copy of the manufacturer's installation procedures and a detailed description of the manufacturer's recommended break-in procedure.

SD-06 Test Reports

Factory Inspection and Tests;

Six complete reproducible copies of the factory inspection result on the checklist format specified in paragraph FACTORY INSPECTION AND TESTS.

Factory Tests;

a. A letter giving notice of the proposed dates of factory inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the manufacturer's procedures for factory tests at least 14 days prior to beginning tests.

c. Six copies of the Factory Test data described below in 8-1/2 x 11 inch binders having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs. Data plots shall be full size (8-1/2 x 11 inch minimum), showing grid lines, with full resolution.

(1) A detailed description of the procedures for factory tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) A list of the parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of adjustments made.

Onsite Inspection and Tests; G

a. A letter giving notice of the proposed dates of onsite inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the Contractor's procedures for onsite tests including the test plan and a listing of equipment necessary to perform the tests. Submission shall be at least 30 days prior to beginning tests.

c. Six copies of the onsite test data described below in 8-1/2 x 11 inch binders having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs. Data plots shall be full size (8-1/2 x 11 inchminimum), showing grid lines, with full resolution.

(1) A detailed description of the procedures for onsite tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) A list of the parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of adjustments made.

SD-07 Certificates

Prototype Test;

Manufacturer's standard certification that prototype tests were performed for the generator model proposed.

Reliability and Durability;

A reliability and durability certification letter from the manufacturer and assembler to prove that existing facilities are and have been successfully utilizing the same components proposed to meet this specification, in similar service. Certification may be based on components, i.e. engines used with different models of generators and generators used with different engines, and does not exclude annual technological improvements made by a manufacturer in the basic standard-model component on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets the performance requirements specified. Provide a list with the name of the installations, completion dates, and name and telephone number of a point of contact.

Emissions;

A certification from the engine manufacturer stating that the engine exhaust emissions meet the federal, state, and local regulations and restrictions specified. At a minimum this certification shall include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HPAs).

Sound Limitations;

A certification from the manufacturer stating that the sound emissions meet the specification.

Site Visit;

A letter stating the date the site was visited and listing discrepancies found.

Flywheel Balance; G

A certification stating that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125% of rated speed without vibration or damage.

Materials and Equipment;

A certification stating that where materials or equipment are specified to comply with requirements of UL, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

Inspections;

A letter certifying that all facilities are complete and functional; that each system is fully functional; and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.

Cooling System;

Certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Six copies of the operation manual (approved prior to commencing onsite tests) in 8-1/2 x 11 inch binders, having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each system or subsystem. Sections shall be separated by heavy plastic dividers with tabs which identify the material in the section. Drawings shall be folded blue lines, with the title block visible, and placed in 8-1/2 x 11 inch plastic pockets with reinforced holes. One full size reproducible mylar of each drawing shall accompany the booklets. Mylars shall be rolled and placed in a heavy cardboard tube with threaded caps on each end. The manual shall include: step-by-step procedures for system startup, operation, and shutdown; drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems together with their controls, alarms, and safety systems; the manufacturer's name, model number, and a description of equipment in the system. The instructions shall include procedures for interface and interaction with related systems to include automatic transfer switches. Each booklet shall include a CDROM containing an ASCII file of the procedures.

Maintenance Procedures; G

Six copies of the maintenance manual containing the information described below in 8-1/2 x 11 inch binders having a minimum of three rings from which material may readily be removed and

replaced, including a separate section for each item listed. Each section shall be separated by a heavy plastic divider with tabs. Drawings shall be folded, with the title block visible, and placed in plastic pockets with reinforced holes.

a. Procedures for each routine maintenance item.

Procedures for troubleshooting.

Factory-service, take-down overhaul, and repair service manuals, with parts lists.

b. A copy of the posted instructions.

c. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components specified for nameplates.

Six complete reproducible copies of the final relay and protective device settings. The settings shall be recorded with the name of the company and individual responsible for their accuracy.

Special Tools;

Two complete sets of special tools required for maintenance (except for electronic governor handset). Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. The tools shall be supplied complete with a suitable tool box. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings.

Filters;

Two complete sets of filters, required for maintenance, shall be supplied in a suitable storage box. These filters shall be in addition to filters replaced after testing.

1.3 SYSTEM DESCRIPTION

Each engine-generator set shall be provided and installed complete and totally functional, with all necessary ancillary equipment to include: air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine-generator set shall satisfy the requirements specified in the Engine-Generator Parameter Schedule.

1.3.1 Engine-Generator Parameter Schedule

ENGINE-GENERATOR PARAMETER SCHEDULE

Power Rating	Emergency Standby
Overload Capacity (Prime applications only)	110% of Service Load for 1 hour in 12 consecutive hours
Service Load	273 kVA (maximum)

ENGINE-GENERATOR PARAMETER SCHEDULE

	273 kVA (continuous
Total LoadMotor HP	75hp, two 40hp, and two 25hp
Power Factor	0.8 lagging
Engine-Generator Applications	stand-alone
Maximum Speed	1800 rpm
Heat Exchanger Type	fin-tube (radiator)
Governor Type	droop
Frequency Bandwidth (steady state)	± .4 %
Frequency Regulation (droop) (No Load to Full Load)	3 % (maximum)
Voltage Regulation (No Load to Full Load) (Stand alone applications)	± 2% (maximum)
Voltage Bandwidth (steady state)	± 2 %
Frequency	60 Hz
Voltage	480 volts
Phases	3 Phase, Wye
Minimum Generator Subtransient Reactance	Factory Standard
Max Step Load Increase	100 % of Service Load at 0.8 PF
Transient Recovery Time with Step Load Increase (Voltage)	2 Seconds
Transient Recovery Time with Step Load Increase (Frequency)	2 Seconds
Maximum Voltage Deviation with Step Load Increase	10 % of rated voltage
Maximum Frequency Deviation with Step Load Increase	5 % of rated frequency

ENGINE-GENERATOR PARAMETER SCHEDULE

Max Step Load Decrease (without shutdown)	100 % of Service Load at 0.8 PF
Max Time to Start and be Ready to Assume Load	10 seconds
Max Allowable Heat Transferred To Engine Generator Space at Rated Output Capacity	Factory Standard MBTU/hr
Max Summer Outdoor Temp F. (Ambient)	115 degrees
Min Winter Outdoor Temp (Ambient)	0 degrees F.
Installation Elevation	2200 above sea level

1.3.2 Rated Output Capacity

Each engine-generator-set shall provide power equal to the sum of Service Load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator oversizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

1.3.3 Power Ratings

Power ratings shall be in accordance with EGSA 101P.

1.3.4 Transient Response

The engine-generator set governor and voltage regulator shall cause the engine-generator set to respond to the maximum step load changes such that output voltage and frequency recover to and stabilize within the operational bandwidth within the transient recovery time. The engine-generator set shall respond to maximum step load changes such that the maximum voltage and frequency deviations from bandwidth are not exceeded.

1.3.5 Reliability and Durability

Each standby engine-generator set shall have both an engine and a generator capable of delivering the specified power on a standby basis with an anticipated mean time between overhauls of no less than 5,000 hours operating with a load factor of 70%. Two like engines and two like generators shall be cited that have performed satisfactorily in a stationary power plant, independent and separate from the physical location of the manufacturer's and assembler's facilities, for standby without any failure to start, including all periodic exercise. Each like engine and generator shall have had no failures resulting in downtime for repairs in excess of 72 hours during two consecutive years of service. Like engines shall be of the same model, speed, bore, stroke, number and configuration

of cylinders, and rated output capacity. Like generators shall be of the same model, speed, pitch, cooling, exciter, voltage regulator and rated output capacity.

1.4 GENERAL REQUIREMENTS

1.4.1 Engine-Generator Set

Each set shall consist of one engine, one generator, and one exciter mounted, assembled, and aligned on one base; and other necessary ancillary equipment which may be mounted separately. Sets having a capacity of 750 kW or smaller shall be assembled and attached to the base prior to shipping. Each set component shall be environmentally suitable for the location shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. Any nonstandard products or components and the reason for their use shall be specifically identified in paragraph SUBMITTALS.

1.4.2 Nameplates

Each major component of this specification shall have the manufacturer's name, type or style, model or serial number and rating on a plate secured to the equipment. As a minimum, nameplates shall be provided for:

Engines	Relays
Generators	Transformers (CT & PT)
Regulators	
Pumps and pump motors	Governors
Generator Breaker	
Economizers	Heat exchangers (other than base mounted)

Where the following equipment is not provided as a standard component by the diesel engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger	Heaters
Exhaust mufflers	
Silencers	
Battery	Exciters

1.4.3 Personnel Safety Devices

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

1.4.4 Verification of Dimensions

Before performing any work, the premises shall be visited and all details of the work verified. The Contracting Officer shall be advised in writing of any discrepancies.

1.4.5 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, NEMA, etc., the design, fabrication and installation

shall also conform to the code.

1.4.6 Site Welding

Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL.

1.4.7 Engine-Generator Set Enclosure

The engine-generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components and provide ventilation to permit operation at Service Load under secured conditions. Doors shall be provided for access to controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than the exhaust system. The enclosure shall reduce the noise of the generator set to within the limits specified in the paragraph SOUND LIMITATIONS.

1.4.8 Vibration Limitation

The maximum engine-generator set vibration in the horizontal, vertical, and axial directions shall be limited to 6 mils (peak-peak RMS), with an overall velocity limit of 0.95 inches/second RMS, for all speeds through 110% of rated speed.

1.4.9 Starting Time Requirements

Upon receipt of a signal to start, each engine generator set will start, reach rated frequency and voltage and be ready to assume load within the time specified. For standby sets used in emergency power applications, each engine generator set will start, reach rated frequency and voltage, and power will be supplied to the load terminals of the automatic transfer switch within the starting time specified.

1.4.10 Experience

Each component manufacturer shall have a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacturer/assembler shall have a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

1.4.11 Field Engineer

The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer shall have attended the engine generator manufacturer's training courses on installation and operation and maintenance of engine generator sets.

1.5 STORAGE AND INSTALLATION

The Contractor shall properly protect material and equipment, in accordance with the manufacturers recommended storage procedures,before, during, and

after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Filter Elements

Fuel-oil, lubricating-oil, and combustion-air filter elements shall be manufacturer's standard.

2.1.2 Instrument Transformers

ANSI C12.11.

2.1.3 Pipe (Sleeves, Fuel/Lube-Oil, Compressed Air, Coolant, and Exhaust)

ASTM A 53/A 53M, or ASTM A 106 steel pipe. Pipe smaller than 2 inches shall be Schedule 80. Pipe 2 inches and larger shall be Schedule 40.

a. Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME B16.5, Grade 1, Class 150.

b. Pipe Welding Fittings: ASTM A 234/A 234M, Grade WPB or WPC, Class 150 or ASME B16.11, 3000 lb.

c. Threaded Fittings: ASME B16.3, Class 150.

d. Valves: MSS SP-80, Class 150.

e. Gaskets: Manufacturer's standard.

2.1.4 Pipe Hangers

MSS SP-58 and MSS SP-69.

2.1.5 Electrical Enclosures

NEMA ICS 6.

2.1.5.1 Power Switchgear Assemblies

NEMA SG 5.

2.1.6 Electric Motors

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings and a maximum speed of 1800 rpm. Motors used indoors shall have drip-proof frames; those used outside shall be totally enclosed. Alternating current motors larger than 1/2 Hp shall be of the squirrel-cage induction type for operation on 480 volts, 60 Hz, and three-phase power.

2.1.7 Motor Controllers

Motor controllers and starters shall conform to the requirements of NFPA 70 and NEMA ICS 2.

2.2 ENGINE

Each engine shall operate on No. 2-D diesel fuel conforming to ASTM D 975, shall be designed for stationary applications and shall be complete with ancillaries. The engine shall be a standard production model described in the manufacturer's catalog. The engine shall be naturally aspirated, supercharged, or turbocharged. The engine shall be 2- or 4-stroke-cycle and compression-ignition type. The engine shall be vertical in-line, V- or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have not less than four cylinders. Each block shall have a coolant drain port. Each engine shall be equipped with an overspeed sensor.

2.3 FUEL SYSTEM

The entire fuel system for each engine-generator set shall conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.

2.3.1 Pumps

2.3.1.1 Main Pump

Each engine shall be provided with an engine driven pump. The pump shall supply fuel at a minimum rate sufficient to provide the amount of fuel required to meet the performance indicated within the parameter schedule. The fuel flow rate shall be based on meeting the load requirements and all necessary recirculation.

2.3.2 Fuel Filter

A minimum of one full-flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.3.3 Relief/Bypass Valve

A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line and prevent the build-up of excessive pressure in the fuel system.

2.3.4 External, Fuel, Storage Tank

The generator shall be provided with a separate self-supporting tank. Each tank shall be provided with connections for fuel supply line, fuel return line, fuel overflow line, local fuel fill port, gauge, vent line, drain line, and float switch assembly for control. A fuel return line cooler shall be provided as recommended by the manufacturer and assembler. The temperature of the fuel returning to the tank shall be below the flash point of the fuel. A temperature sensing device shall be installed in the fuel supply line . The engine-generator set provided with weatherproof enclosure

2.3.4.1 Capacity, Standby

The external, fuel storage, tank shall have capacity as shown on the plans. .

2.3.4.2 Drain Line

The tank drain line shall be accessible and equipped with a shutoff valve. Self-supporting day tanks shall be arranged to allow drainage into a 12 inch tall bucket.

2.3.4.3 Fuel Level Controls

a. Each external fuel storage tank shall have a float-switch assembly to perform the following functions:

(2) Provide a solenoid valve located on the fuel supply line to shut off fuel to the generator as required..

(3) Activate the "Overfill Fuel Level" alarm at 95% of the rated tank capacity.

(4) Activate the "Low Fuel Level" alarm at 70% of the rated tank capacity.

(5) Activate the automatic fuel supply shut-off valve located on the fill line of the tank and shut down the fuel pump which supplies fuel to the day tank at 95% of the rated tank capacity. The flow of fuel shall be stopped before any fuel can be forced into the fuel overflow line.

2.3.4.4 Arrangement

External, fuel, storage tanks may allow gravity flow into the engine. Gravity flow tanks shall be provided with an internal or external valve located as near as possible to the shell of the tank. The valve shall close when the engine is not operating. S

2.4 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven pumps. System pressure shall be regulated as recommended by the engine manufacturer. A pressure relief valve shall be provided on the crankcase for closed systems. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by the engine manufacturer.

2.4.1 Lube-Oil Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.4.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil pressure sensors. Pressure sensors shall be located downstream of the filters and provide signals for required indication and alarms.

2.4.3 Precirculation Pump

A motor-driven precirculation pump powered by the station battery, complete with motor starter shall be provided if recommended by the engine manufacturer.

2.5 COOLING SYSTEM

Each engine shall have its own cooling system. Each system shall operate automatically while its engine is running. The cooling system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across each engine shall not exceed that recommended and submitted in paragraph SUBMITTALS.

2.5.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven and have automatic controllers.

2.5.2 Heat Exchanger

Each heat exchanger shall be of a size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted in paragraph SUBMITTALS for the maximum summer outdoor design temperature and site elevation. Each heat exchanger shall be corrosion resistant, suitable for service in ambient conditions of application.

2.5.2.1 Fin-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosive resistant film, provided that correction measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via over sizing, or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Heat exchangers shall be pressure type incorporating a pressure valve, vacuum valve and a cap. Caps shall be designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system shall be capable of withstanding a minimum pressure of 7 psi and shall be protected with a strong grille or screen guard. Each heat exchanger shall have at least two tapped holes; one tapped hole shall be equipped with a drain cock, the rest shall be plugged.

2.5.3 Thermostatic Control Valve

A modulating type, thermostatic control valve shall be provided in the coolant system to maintain the coolant temperature range submitted in paragraph SUBMITTALS.

2.5.4 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.

2.6 SOUND LIMITATIONS

The noise generated by the installed diesel generator set operating at 100 percent load shall not exceed the following sound pressure levels in any of the indicated frequencies when measured at a distance of 75 feetfrom the end of the exhaust and air intake piping directly along the path of intake and discharge for horizontal piping; or at a radius of 75 feet from the engine at 45 degrees apart in all directions for vertical piping.

Frequency Band (Hz)	Maximum Acceptable Pressure Level (Decibels)
31	87
63	87
125	77
250	70
500	64
1,000	61
2,000	60
4,000	60
8,000	62

2.7 AIR INTAKE EQUIPMENT

Filters and silencers shall be provided in locations that are convenient for servicing. The silencer shall be of the high-frequency filter type, located in the air intake system as recommended by the engine manufacturer. Silencer shall be capable of reducing the noise level at the air intake so that the indicated pressure levels specified in paragraph SOUND LIMITATIONS will not be exceeded. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Expansion elements in air-intake lines shall be copper.

2.8 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported to minimize vibration. Where a V-type engine is provided, a V-type connector, with necessary flexible sections and hardware, shall connect the engine exhaust outlets.

2.8.1 Flexible Sections and Expansion Joints

A flexible section shall be provided at each engine and an expansion joint at each muffler. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements

shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.8.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be constructed of welded steel and designed for outside horizontal mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be zinc coated or painted with high temperature resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

2.8.3 Exhaust Piping

Horizontal sections of exhaust piping shall be sloped downward away from the engine to a drip leg for collection of condensate with drain valve and cap. Changes in direction shall be long radius. Exhaust piping, mufflers and silencers installed inside any building shall be insulated in accordance with paragraph THERMAL INSULATION and covered to protect personnel. Vertical exhaust piping shall be provided with a hinged, gravity-operated, self-closing, rain cover.

2.9 PYROMETER

A pyrometer, with calibrated leads shall be provided to show the temperature of the combined exhaust. For a supercharged engine, additional points, thermocouples and leads shall be provided to show the temperature in the turbocharger exhaust gas outlet and combustion air discharge passages. Graduated scale length shall be not less than 6 inches. The selector switch shall be double pole, with an "off" position, one set of points for each thermocouple, and suitable indicating dial. The pyrometer, thermocouples, leads and compensating devices shall be calibrated to show true exhaust temperature within plus or minus 1% above the highest temperature encountered at 110% load conditions.

2.10 EMISSIONS

The finished installation shall comply with Federal, state, and local regulations and restrictions regarding the limits of emissions.

2.11 STARTING SYSTEM

The starting system for engine generator sets used in non-emergency applications shall be as follows.

2.11.1 Controls

An engine control switch shall be provided with functions including: run/start(manual), off/reset, and, automatic mode. Start-stop logic shall be provided for adjustable cycle cranking and cooldown operation. The logic shall be arranged for fully automatic starting in accordance with paragraph AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION. Electrical starting systems shall be provided with an adjustable cranking limit device

to limit cranking periods from 1 second up to the maximum duration.

2.11.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing a minimum of three cranking periods with 15 second intervals between cranks. Each cranking period shall have a maximum duration of 15 seconds.

2.11.3 Electrical Starting

Manufacturers recommended dc system, utilizing a negative circuit ground.

2.11.3.1 Battery

A starting battery system shall be provided and shall include the battery, battery rack, intercell connectors, spacers, automatic battery charger with overcurrent protection, metering and relaying. The battery shall be in accordance with SAE J 537. The battery shall be nickel-cadmium, with sufficient capacity, at the minimum outdoor and maximum outdoor temperature specified, to provide the specified cranking periods. Valve-regulated lead-acid batteries are not acceptable.

2.11.3.2 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize-charging rate for recharging fully depleted batteries within 24 hours and a floating charge rate for maintaining the batteries at fully charged condition. An ammeter shall be provided to indicate charging rate. A voltmeter shall be provided to indicate charging voltage. A timer shall be provided for the equalize-charging-rate setting. A battery is considered to be fully depleted when the output voltage falls to a value which will not operate the engine generator set and its components.

2.11.4 Starting Aids

The manufacturer shall provide one or more of other following methods to assist engine starting.

2.11.4.1 Glow Plugs

Glow plugs shall be designed to provide sufficient heat for combustion of fuel within the cylinders to guarantee starting at an ambient temperature of minus 25 degrees F.

2.11.4.2 Jacket-Coolant Heaters

A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 3 degrees F of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized. Power for the heaters shall be 120 volts ac.

b. Standby Rated Sets

The control temperature shall be the temperature recommended by the engine manufacturer to meet the starting time specified at the minimum winter outdoor temperature.

2.11.5 Exerciser

The exerciser shall be in accordance with Section 16410 AUTOMATIC TRANSFER SWITCH .

2.12 GOVERNOR

Each engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100% of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine-generator set, without special tools, from 90 to 110% of the rated speed/frequency, over a steady state load range of 0 to 100% or rated capacity.

2.12.1 Governor Performance

Droop governors shall maintain the midpoint of the frequency bandwidth linearly for steady-state loads over the range of zero to 100% of rated output capacity, with 3% droop .

2.13 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Insulation shall be Class F. Generator design shall protect against mechanical, electrical and thermal damage due to vibration, 25% overspeeds, or voltages and temperatures at a rated output capacity of 110% for prime applications and 100% for standby applications. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type.

2.13.1 Current Balance

At 100% rated output capacity, and load impedance equal for each of the 3 phases, the permissible current difference between any 2 phases shall not exceed 2% of the largest current on either of the 2 phases.

2.13.2 Voltage Balance

At any balanced load between 75 and 100% of rated output capacity, the difference in line-to-neutral voltage among the 3 phases shall not exceed 1% of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25% load at unity power factor placed between any phase and neutral with no load on the other 2 phases, the maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3% of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25% load for single phase load conditions means 25% of rated current at rated phase voltage and unity power factor.

2.13.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at

balanced rated output capacity shall not exceed 10%. The RMS of all harmonics shall be less than 5.0% and that of any one harmonic less than 3.0% of the fundamental at rated output capacity. Each engine-generator shall be designed and configured to meet the total harmonic distortion limits of IEEE Std 519.

2.14 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300% for peak inverse voltage and forward current ratings for all operating conditions, including 110% generator output at 104 degrees F ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified.

2.15 VOLTAGE REGULATOR

Each generator shall be provided with a solid-state voltage regulator, separate from the exciter. The regulator shall maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100% of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine-generator voltage output without special tools, during operation, from 90 to 110% of the rated voltage over the steady state load range of 0 to 100% of rated output capacity. Regulation drift shall not exceed plus or minus 0.5% for an ambient temperature change of 68 degrees F.

2.15.1 Steady State Performance (Regulation or Voltage Droop)

The voltage regulator shall have a maximum droop of 2% of rated voltage over a load range from 0 to 100% of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.16 GENERATOR ISOLATION AND PROTECTION

Devices necessary for electrical protection and isolation of each engine-generator set and its ancillary equipment shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit withstand, and interrupting current ratings to match the generator capacity. The generator circuit breaker shall be electrically operated. Monitoring and control devices shall be as specified in paragraph GENERATOR PANEL.

2.17 SAFETY SYSTEM

Devices, wiring, local panels, etc. shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. The safety system shall be provided with a self-test method to verify its operability. Alarm signals shall have manual acknowledgment and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be configured so that loss of any monitoring device shall be dealt with as an alarm on that system element.

2.17.1 Audible Signal

The audible alarm signal shall sound at a frequency of 70 Hz at a volume of

75 dB at 10 feet. The sound shall be continuously activated upon alarm and silenced upon acknowledgment. Signal devices shall be located as shown.

2.17.2 Visual Signal

The visual alarm signal shall be a panel light. The light shall be normally off, activated to be blinking upon alarm. The light shall change to continuously lit upon acknowledgement. If automatic shutdown occurs, the display shall maintain activated status to indicate the cause of failure and shall not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms shall be red; all other alarms shall be amber.

2.17.3 Alarms and Action Logic

2.17.3.1 Shutdown

Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator main circuit breakers shall be accomplished.

2.17.3.2 Problem

Activation of the visual signal shall be accomplished.

2.17.4 Local Alarm Panel

A local alarm panel shall be provided with the following shutdown and alarm functions NFPA 110 level 1 and including the listed Corps of Engineer requirements mounted either on or adjacent to the engine generator set.

Device/Condition /Function	What/Where/Size	NFPA 110 Level 1	Corps of Engrs Required
Shutdowns w/Alarms			
High engine temperature	Automatic/jacket/ water/cylinder	SD/CP VA	SD VA
Low lube-oil pressure	Automatic/pressure/ level	SC/CP VA	SD VA
Overspeed Shutdown& Alarm	(110 percent (± 2 % of rated speed)	SD/CP VA	SD CP
Overcrank, Failure to start	Automatic/Failure to start when used	SD/CP VA SD/CP VA	
Air shutdown damper (200-600kW)	When Used	SD/CP VA	
Red emergency stop switch	Manual Switch	SD/CP VA	SD VA
Alarms			

Device/Condition /Function	What/Where/Size	NFPA 110 Level 1	Corps of Engrs	Required
Day Tank integral main fuel storage tank (Low fuel Limit indication) (70 percent volume remaining)	Automatic/Day Tank Level			CP VA
Low fuel level	Main tank, 3 hrs remaining	CP VA	CP VA	
Integral Main Fuel Storage Tank High Fuel Level	95% volume			CP VA
Low Coolant Temperature	jacket water	CP VA		
Pre-High Temperature	jacket water/ cylinder	CP VA	CP VA	
Pre-Low Lube-oil Pressure		CP VA	CP VA	
High battery Voltage		CP VA		
Low battery Voltage		CP VA		
Battery charger AC Failure	AC supply not available	CP VA		
Control switch not in AUTO		CP VA		
Low starting Air pressure		CP VA		
Low starting hydraulic pressure		CP VA		

SD - Shut Down
CP - On Control Panel
VA - Visual Alarm
AA - Audible Alarm
O - Optional

2.17.5 Time-Delay on Alarms

For startup of the engine-generator set, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

2.18 ENGINE GENERATOR SET CONTROLS AND INSTRUMENTATION

Devices, wiring, local panels, etc. shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions.

2.18.1 Controls

A local control panel shall be provided with controls in accordance with NFPA 110 level 1 mounted either on or adjacent to the engine generator set.

Device/Condition/ Function	Corps Requirement	NFPA 110 Level 1	MFG Offering	
Controls				
Switch: run/start - off/reset - auto	CP			CP/STD
Emergency stop switch & alarm	CP			CP/STD
Lamp test/indicator test	CP	CP VA	CP/STD	
Common alarm contacts/ fault relay			X	CP/O
Panel lighting	CP			CP/STD
Audible alarm & silencing/reset switch	CP			
Voltage adjust for voltage regulator	CP			CP/STD
Pyrometer display w/selector switch	CP			
Remote emergency stop switch		CP VA		
Remote fuel shutoff switch				
Remote lube-oil shutoff switch				

2.18.2 Engine Generator Set Metering and Status Indication

A local panel shall be provided with devices in accordance with NFPA 110 level 1and as follows mounted either on or adjacent to the engine generator set.

Device/Condition/ Function	CorpsNFPA 110MFG Requirement	Level 1	Offering
Genset Status & Metering			
Genset supplying load		CP VA	CP VAO
System ready			CP/STD

Device/Condition/ Function	CorpsNFPA 110MFG Requirement	Level 1	Offering
Engine oil pressure	CP		CP/STD
Engine coolant temperatur	CP		CP/STD
Engine RPM (tachometer)	CP		CP/STD
Engine run hours	CP		CP/STD
Pyrometer display w/selector switch	CP		
AC volts (generator), 3-phase	CP		CP/STD
AC amps (generator), 3 - phase	CP		CP/STD
Generator Frequency	CP		CP/STD
Phase selector switches (amps & volts)	CP		CP/STD
Watts/kW			CP/VA-O
Voltage Regulator Adjustment	CP		

X - Required

CP - On Control Panel
VA - Visual Alarm
AA - Audible Alarm
STD- Manufacturers Standard Offering
O - Optional

2.19 PANELS

Each panel shall be of the type and kind necessary to provide specified functions. Panels shall be mounted on the engine-generator set base by vibration/shock absorbing type mountings. Instruments shall be mounted flush or semiflush. Convenient access to the back of panels shall be provided to facilitate maintenance. Instruments shall be calibrated using recognized industry calibration standards. Each panel shall be provided with a panel identification plate which clearly identifies the panel function. Each instrument and device on the panel shall be provided with a plate which clearly identifies the device and its function as indicated. Switch plates shall clearly identify the switch-position function.

2.19.1 Enclosures

Enclosures shall be designed for the application and environment, conforming to NEMA ICS 6. Locking mechanisms shall be keyed alike.

2.19.2 Electronic

Electronic indicating instruments shall be true RMS indicating instruments, 100% solid state, state-of-the-art, microprocessor controlled to provide specified functions. Control, logic, and function devices shall be compatible as a system, sealed, dust and water tight, and shall utilize modular components with metal housings and digital instrumentation. An interface module shall be provided to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy shall be not less than 98% for unit mounted devices and 99% for control room, panel mounted devices, throughout

a temperature range of minus 4 to 158 degrees F. Data display shall utilize LED or back lit LCD. Additionally, the display shall provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height shall be 0.5 inch.

2.19.3 Parameter Display

Indication or readouts of the tachometer, lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and safety system parameters shall be provided. A momentary switch shall be specified for other panels.

2.20 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Fully automatic operation shall be provided for the following operations: engine-generator set starting and load transfer upon loss of normal source; retransfer upon restoration of the normal source; sequential starting; paralleling, and load-sharing for multiple engine-generator sets; and stopping of each engine-generator set after cool-down. Devices shall automatically reset after termination of their function.

2.20.1 Automatic Transfer Switch

Automatic transfer switches shall be in accordance with Section 16410 AUTOMATIC TRANSFER SWITCH AND BY-PASS/INSOLATION SWITCH.

2.20.2 Monitoring and Transfer

Devices shall be provided to monitor voltage and frequency for the normal power source and each engine-generator set, and control transfer from the normal source and retransfer upon restoration of the normal source. Functions, actuation, and time delays shall be as described in Section 16410 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.21 MANUAL ENGINE-GENERATOR-SET SYSTEM OPERATION

Complete facilities shall be provided for manual starting and testing of each set without load, and loading and unloading of each set.

2.22 STATION BATTERY SYSTEM

A station battery system shall be provided to include the battery, battery rack, spacers, automatic battery charger and distribution panelboard with overcurrent protection, metering and relaying. Components shall be sized to withstand the seismic acceleration forces specified. The batteries shall have a rated life of 20 years and a manufacturer's 5-year, no cost replacement guarantee.

2.22.1 Battery

The battery shall be nickel-cadmium, sized in accordance with IEEE Std 485 and conform to the requirements of IEEE Std 484. Valve-regulated lead-acid batteries are not acceptable.The battery environment temperature shall range between 0 and 115 degrees F.

2.22.2 Battery Capacity

The battery shall be rated for at least the specified cranking capacity of the generator.

a. Diesel-generator safety circuits.

b. Switchgear indicating lights, control relays, protective relays, and other switchgear dc components as required for 24 hours.

c. Voltage regulator (dc power supplies).

2.22.3 Battery Charger

A current-limiting, 12-volt battery charger shall be furnished to automatically recharge the batteries. The charger shall be capable of an equalize charging rate for recharging fully depleted batteries within 8 hours and a floating-charge rate for maintaining the batteries in a fully charged condition. The charger shall be equipped with a low-voltage alarm relay, 0- to 24-hour equalizing timer, an ammeter to indicate charging rate, and necessary circuit breakers. The charger shall conform to the requirements of UL 1236. A battery is considered to be fully depleted when the voltage falls to a level incapable of operating the equipment loads served by the battery.

2.23 BASE

The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment is maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall withstand and mitigate the affects of synchronous vibration of the engine and generator. The base shall be provided with suitable holes for anchor bolts and jacking screws for leveling.

2.24 PAINTING AND FINISHING

The engine-generator set shall be cleaned, primed and painted in accordance with the manufacturer's standard color and practice.

2.25 FACTORY INSPECTION AND TESTS

The factory tests shall be performed on each engine-generator set. The component manufacturer's production line test is acceptable as noted. Each engine-generator set shall be run not less than 1 hour at rated output capacity prior to inspections. Inspections shall be completed and all necessary repairs made, prior to testing. Engine generator controls and protective devices that are provided by the generator set manufacturer as part of the standard package shall be used for factory tests. When controls and switchgear are not provided as part of the generator set manufacturer's standard package, the actual controls and protective devices provided for the project are not required to be used during the factory test. The Contracting Officer may provide one or more representatives to witness inspections and tests.

2.25.1 Factory Inspection

Inspections shall be performed prior to beginning and after completion of testing of the assembled engine-generator set. Inspectors shall look for leaks, looseness, defects in components, proper assembly, etc. and any item

found to be in need of correction shall be noted as a necessary repair. The following checklist shall be used for the inspection:

INSPECTION ITEM	GOOD	BAD	NOTES
1. Drive belts			
2. Governor and adjustments			
3. Engine timing mark			
4. Starting motor			
5. Starting aids			
6. Coolant type and concentration			
7. Radiator drains			
8. Block coolant drains			
9. Coolant fill level			
10. All coolant line connections			
11. All coolant hoses			
12. Combustion air filter			
13. Combustion air silencer			
14. Lube oil type			
15. Lube oil sump drain			
16. Lube-oil filter			
17. Lube-oil-level indicator			
18. Lube-oil-fill level			
19. All lube-oil line connections			
20. All lube-oil lines			
21. Fuel type and amount			
22. All fuel-line connections			
23. All fuel lines			
24. Fuel filter			
25. Coupling and shaft alignment			
26. Voltage regulators			
27. Battery-charger connections			
28. All wiring connections			
29. Instrumentation			
30. Hazards to personnel			
31. Base			
32. Nameplates			
33. Paint			
34. Exhaust-heat recovery unit			
35. Switchboard			
36. Switchgear			

2.25.2 Factory Tests

On engine-generator set tests where the engine and generator are required to be connected and operated together, the load power factor shall be the power factor specified in the engine generator set parameter schedule power factor. . Electrical measurements shall be performed in accordance with IEEE Std 120. Definitions of terms are in accordance with IEEE Std 100. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulation shall be in accordance with IEEE Std 1. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Tests specifically for the generator may be performed utilizing any prime mover.

a. Insulation Resistance for Stator and Exciter Test, IEEE Std 115 and

IEEE Std 43, to the performance criteria in NEMA MG 1, Part 22. Generator manufacturer's production line test is acceptable.

b. High Potential Test, per IEEE Std 115 and NEMA MG 1, test voltage in accordance with NEMA MG 1. Generator manufacturer's production line test is acceptable.

c. Winding Resistance Test, Stator and Exciter, per IEEE Std 115. Generator manufacturer's production line test is acceptable.

e. Phase Balance Voltage Test, to the performance criteria specified in paragraph GENERATOR. This test can be performed with any prime mover. Generator manufacturer's production line test results are acceptable.

(1) Start and operate the generator at no load.

(2) Adjust a regulated phase voltage (line-to-neutral) to rated voltage.

(3) Read and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.

(4) Apply 75% rated load and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.

(5) Apply rated load and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.

(6) Calculate average line-neutral voltage and percent deviation of individual line-neutral voltages from average for each load condition.

f. Current Balance on Stator Winding Test, by measuring the current on each phase of the winding with the generator operating at 100 % of Rated Output Capacity, with the load impedance equal for each of the three phases: to the performance criteria specified in paragraph GENERATOR.

h. Voltage and Frequency Droop Test. Verify that the output voltage and frequency are within the specified parameters as follows:

(1.) With the generator operating at no load, adjust voltage and frequency to rated voltage and frequency. Record the generator output frequency and line-line and line-neutral voltages.

(2.) Increase load to Rated Output Capacity. Record the generator output frequency and line-line and line-neutral voltages.

3. Calculate the percent droop for voltage and frequency with the following equations:

$$\text{Voltage droop \%} = \frac{\text{(No-Load Volts) - (Rated Capacity volts)}}{\text{(Service-Load Volts)}} \times 100$$

$$\text{Frequency droop \%} = \frac{\text{(No-Load Hertz) - (Rated Capacity hertz)}}{\text{(Service-Load hertz)}} \times 100$$

4. Repeat steps 1 through 3 two additional times without making any adjustments.

i. Frequency and Voltage Stability and Transient Response. Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results in tabular form and with high resolution, high speed strip chart recorders or comparable digital recorders, as approved by the Contracting Officer. Tabular data shall include the following:

Ambient temperature (at 15 minute intervals).

Generator output current (before and after load changes).

Generator output voltage (before and after load changes).

Frequency (before and after load changes).

Generator output power (before and after load changes).

Graphic representations shall include the actual instrument trace of voltage and frequency showing: charts marked at start of test; observed steady-state band; mean of observed band; momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change. Generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

(1.) Perform and record engine manufacturer's recommended prestarting checks and inspections.

(2.) Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

(3.) With the unit at no load, apply the Maximum Step Load Increase.

(4.) Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.

(5.) Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100% of Service Load.

(6.) Apply the Maximum Step Load Increase.

(7.) Decrease load to zero percent in steps equal to the Maximum

Step Load Decrease.

(8.) Repeat steps 3. through 7.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

Installation shall provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Installation of pipe, duct, conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.2 PIPING INSTALLATION

Piping shall be welded. Connections at valves shall be flanged. Connections at equipment shall be flanged except that connections to the diesel engine may be threaded if the diesel-engine manufacturers standard connection is threaded. Except where otherwise specified, welded flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Connections to equipment shall be made with vibration-isolation-type flexible connectors. Piping and tubing shall be supported and aligned to prevent stressing of flexible hoses and connectors. Pipes extending through the roof shall be properly flashed. Piping shall be installed clear of windows, doors and openings, to permit thermal expansion and contraction without damage to joints or hangers, and shall be installed with a 1/2 inch drain valve with cap at each low point.

3.2.1 Support

Hangers, inserts, and supports shall be of sufficient size to accommodate any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports shall be spaced not more than 7 feet on center for pipes 2 inches in diameter or less, not more than 12 feet on center for pipes larger than 2 inches but smaller than 4 inches in diameter, and not more than 17 feet on center for pipes larger than 4 inches in diameter. Supports shall be provided at pipe bends or change of direction.

3.2.2 Flanged Joints

Flanges shall be Class 125 type, drilled, and of the proper size and configuration to match the equipment and diesel engine connections. Flanged joints shall be gasketed and made up square and tight.

3.2.3 Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of debris.

3.2.4 Pipe Sleeves

Pipes passing through construction such asconcrete slabs shall be fitted with sleeves. Each sleeve shall extend through and be securely fastened in its respective structure and shall be cut flush with each surface. The structure shall be built tightly to the sleeve. The inside diameter of

each sleeve shall be minimum 1/2 inch, and where pipes pass through combustible materials 1 inch larger than the outside diameter of the passing pipe or pipe insulation/covering.

3.3 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 16415 ELECTRICAL WORK, INTERIOR.

3.3.1 Vibration Isolation

Flexible fittings shall be provided for conduit, cable trays, and raceways attached to engine-generator sets. Metallic conductor cables installed on the engine generator set and from the engine generator set to equipment not mounted on the engine generator set shall be flexible stranded conductor. Terminations of conductors on the engine generator set shall be crimp-type terminals or lugs.

3.4 FIELD PAINTING

Field painting shall be as specified.

3.5 ONSITE INSPECTION AND TESTS

3.5.1 Test Conditions

3.5.1.1 Data

Measurements shall be made and recorded of all parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments, replacements, or repairs shall be made and the step repeated until satisfactory results are obtained. Unless otherwise indicated, data shall be recorded in 15 minute intervals during engine-generator set operation and shall include: readings of all engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set.Electrical measurements shall be performed in accordance with IEEE Std 120. Definitions of terms are in accordance with IEEE Std 100. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulations shall be in accordance with IEEE Std 1.

3.5.1.2 Power Factor

For all engine-generator set operating tests the load power factor shall be the power factor specified in the engine-generator set parameter schedule .

3.5.1.3 Contractor Supplied Items

The Contractor shall provide equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.5.1.4 Instruments

Readings of panel gauges, meters, displays, and instruments provided as permanent equipment shall be verified during test runs, using test instruments of greater precision and accuracy. Test instrument accuracy shall be within the following: current plus or minus 1.5%, voltage plus or

minus 1.5%, real power plus or minus 1.5%, reactive power plus or minus 1.5%, power factor plus or minus 3%, frequency plus or minus 0.5%. Test instruments shall be calibrated by a recognized standards laboratory within 30 days prior to testing.

3.5.1.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance is authorized by the Contracting Officer. Field testing shall be performed in the presence of the Contracting Officer. Tests may be scheduled and sequenced in order to optimize run-time periods; however, the following general order of testing shall be followed: Construction Tests; Inspections; Pre-operational Tests; Safety Run Tests; Performance Tests; and Final Inspection.

3.5.2 Construction Tests

Individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.3.5.2.1 Electrical Equipment Tests

a. Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the automatic transfer switch. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

   R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters)

   R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

   Each cable failing this test shall be repaired or replaced. The repair cable shall be retested until failures have been eliminated.

c. Ground-Resistance Tests. The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the requirements resistance, but the specified number of electrodes must still be provided as follows:

   (1.) Single rod electrode - 25 ohms.

d. Circuit breakers and switchgear shall be examined and tested in accordance with the manufacturer's published instructions for functional testing.

3.5.3 Inspections

The following inspections shall be performed jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1.	Drive belts.	(I)
2.	Governor type and features.	(I)
3.	Engine timing mark.	(I)
4.	Starting motor.	(I)
5.	Starting aids.	(I)
6.	Coolant type and concentration.	(D)
7.	Radiator drains.	(I)
8.	Block coolant drains.	(I)
9.	Coolant fill level.	(I)
10.	Coolant line connections.	(I)
11.	Coolant hoses.	(I)
12.	Combustion air filter.	(I)
13.	Intake air silencer.	(I)
14.	Lube oil type.	(D)
15.	Lube oil sump drain.	(I)
16.	Lube-oil filter.	(I)
17.	Lube-oil level indicator.	(I)
18.	Lube-oil fill level.	(I)
19.	Lube-oil line connections.	(I)
20.	Lube-oil lines.	(I)
21.	Fuel type.	(D)
22.	Fuel-level.	(I)
23.	Fuel-line connections.	(I)
24.	Fuel lines.	(I)
25.	Fuel filter.	(I)
26.	Access for maintenance.	(I)
27.	Voltage regulator.	(I)
28.	Battery-charger connections.	(I)
29.	Wiring & terminations.	(I)
30.	Instrumentation.	(I)
31.	Hazards to personnel.	(I)
32.	Base.	(I)
33.	Nameplates.	(I)
34.	Paint.	(I)
35.	Exhaust-heat system.	(I)
36.	Exhaust muffler.	(I)
37.	Switchboard.	(I)
38.	Switchgear.	(I)
39.	Access provided to controls.	(I)

40. Enclosure is weather resistant. (I)
41. Engine & generator mounting bolts (application). (I)

3.5.4 Pre-operational Tests

3.5.4.1 Insulation Test

Generator and exciter circuits insulation resistance shall be tested in accordance with IEEE Std 43. Stator readings shall be taken at the circuit breaker. Results of insulation resistance tests shall be recorded. Readings shall be within limits specified by the manufacturer. Precautions shall be taken to preclude damaging generator components during test.

3.5.5 Safety Run Test

For the following tests, if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries, the associated safety tests shall be repeated.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

c. Activate the manual emergency stop switch and verify that the engine stops.

j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

k. Operate the engine generator-set for at least 2 hours at 75% of Service Load.

l. Verify proper operation and setpoints of gauges and instruments.

m. Verify proper operation of ancillary equipment.

n. Manually adjust the governor to increase engine speed past the overspeed limit. Record the RPM at which the engine shuts down.

o. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75% of Service Load.

p. Manually adjust the governor to increase engine speed to within 2% of the overspeed trip speed previously determined and operate at that point for 5 minutes. Manually adjust the governor to the rated frequency.

w. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it

above low level alarm limits.

3.5.6 Performance Tests

In the following tests, where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. For the following tests, if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries, the associated tests shall be repeated.

3.5.6.1 Continuous Engine Load Run Test

Test the engine-generator set and ancillary systems at service load to demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, the entire test shall be repeated. The engine load run test shall be accomplished principally during daylight hours, with an average ambient temperature of 80 degrees F, during the month of MAY. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Data taken at 15 minute intervals shall include the following:

Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.

Pressure: Lube-oil.

Temperature: Coolant.
Lube-oil.
Exhaust.
Ambient.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warmup period.

c. Operate the engine generator-set for 2 hours at 75% of Service Load.

d. Increase load to 100% of Service Load and operate the engine generator-set for 4 hours.

e. For prime rated units, increase load to 110% of Service Load and operate the engine generator-set for 2 hours.

f. Decrease load to 100% of Service Load and operate the engine generator-set for 2 hours or until all temperatures have stabilized.

g. Remove load from the engine-generator set.

3.5.6.2 Voltage and Frequency Droop Test

For the following steps, verify that the output voltage and frequency return to and stabilize within the specified bandwidth values following each load change. Record the generator output frequency and line-line and line-neutral voltages following each load change.

a. With the generator operating at no load, adjust voltage and frequency to rated voltage and frequency.

b. Increase load to 100% of Rated Output Capacity. Record the generator output frequency and line-line and line-neutral voltages.

c. Calculate the percent droop for voltage and frequency with the following equations.

$$\text{Voltage droop \%} = \frac{\text{No-load volts - rated output capacity volts}}{\text{Rated output capacity volts}} \times 100$$

$$\text{Frequency droop \%} = \frac{\text{No load hertz - rated output capacity hertz}}{\text{Rated output capacity volts}} \times 100$$

d. Repeat steps a. through c. two additional times without making any adjustments.

3.5.6.3 Voltage Regulator Range Test

a. While operating at no load, verify that the voltage regulator adjusts from 90% to 110% of rated voltage.

b. Increase load to 100% of Rated Output Capacity. Verify that the voltage regulator adjusts from 90% to 110% of rated voltage.

3.5.6.4 Governor Adjustment Range Test

a. While operating at no load, verify that the governor adjusts from 90% to 110% of rated frequency.

b. Increase load to 100% of Rated Output Capacity. Verify that the governor adjusts from 90% to 110% of rated frequency.

3.5.6.5 Frequency and Voltage Stability and Transient Response

Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results in tabular form and with high resolution, high speed strip chart recorders or comparable digital recorders, as approved by the Contracting Officer. Tabular data shall include the following:

(1.) Ambient temperature (at 15 minute intervals).

(2.) Generator output current (before and after load changes).

(3.) Generator output voltage (before and after load changes).

(4.) Frequency (before and after load changes).

(5.) Generator output power (before and after load changes.

(6.) Graphic representations shall include the actual instrument trace of voltage and frequency showing:

Charts marked at start of test; observed steady-state band; mean of observed band; momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change. Generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

c. With the unit at no load, apply the Maximum Step Load Increase.

d. Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.

e. Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100% of Service Load.

f. Apply the Maximum Step Load Increase.

g. Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.

h. Repeat steps c. through g.

3.5.7 Automatic Operation Tests for Stand-Alone Operation

The automatic loading system shall be tested to demonstrate automatic starting, of each engine-generator set. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. Data taken shall include the following:

(1.) Ambient temperature (at 15 minute intervals).

(2.) Generator output current (before and after load changes).

(3.) Generator output voltage (before and after load changes).

(4.) Generator output frequency (before and after load changes).

a. Initiate loss of the primary power source and verify automatic sequence of operation.

b. Restore the primary power source and verify sequence of operation.

c. Verify resetting of controls to normal.

3.5.8 Final Testing and Inspection

a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Increase the load in steps no greater than the Maximum Step Load Increase to 100% of Service Load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.

c. Remove load and shut down the engine-generator set after the recommended cool down period.

d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 8 hours at Service Load, then re-examining the oil and filter.

e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.

f. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.

g. Replace air, oil, and fuel filters with new filters.

3.6 POSTED DATA AND INSTRUCTIONS

Posted Data and Instructions shall be posted prior to field acceptance testing of the engine generator set. Two sets of instructions/data shall be typed and framed under weatherproof laminated plastic, and posted side-by-side where directed. First set shall include a one-line diagram, wiring and control diagrams and a complete layout of the system. Second set of shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches).

3.7 ONSITE TRAINING

The Contractor shall conduct training course for operating staff as designated by the Contracting Officer. The training period shall consist of a total 4hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. All operation and maintenance manuals shall bee approved and made available for the training course. All posted instructions shall be approved and posted prior to the

beginning date of the training course. The training course schedule shall be coordinated with the Using Service's work schedule, and submitted for approval 14 days prior to beginning date of proposed beginning date of training. The course instructions shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate routine maintenance procedures as described in the operation and maintenance manuals. Two copies of a video tape of the entire training session shall be submitted.

3.8 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the contractor has successfully completed all tests and all defects in installation material or operation have been corrected.

-- End of Section --

SECTION 16375

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
02/02

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 basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C119.1	(1986; R 1997) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C12.10	(1997) Electromechanical Watthour Meters
ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C12.4	(1984; R 1996) Mechanical Demand Registers
ANSI C29.1	(1988; R 1996) Electrical Power Insulators - Test Methods
ANSI C37.121	(1989; R 1995) Switchgear, Unit Substations Requirements
ANSI C37.46	(1981; R 1992) Power Fuses and Fuse Disconnecting Switches
ANSI C37.72	(1987)Manually-Operated, Dead-Front Padmounted Switchgear with Load Interrupting Switches and Separable Connectors for Alternating-Current Systems
ANSI C57.12.13	(1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations
ANSI C57.12.27	(1982) Conformance Requirements for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations
ANSI C57.12.28	(1999) Switchgear and Transformers -Padmounted Equipment - Enclosure Integrity
ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2001) Zinc (Hot-Dip Galvanized) Coatings

	on Iron and Steel Products
ASTM A 153/A 153M	(2001) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 48M	(1994e1) Gray Iron Castings (Metric)
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 3	(1995) Soft or Annealed Copper Wire
ASTM B 496	(1999) Compact Round Concentric-Lay-Stranded Copper Conductors
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2472	(2000) Sulfur Hexafluoride
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
ASTM D 923	(1997) Sampling Electrical Insulating Liquids

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994; CS5a-1995) Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV
AEIC CS6	(1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C37.20.2	(1993; C37.20.2b) Metal-Clad and Station-Type Cubicle Switchgear

IEEE C37.20.3	(1997) Metal-Enclosed Interrupter Switchgear
IEEE C37.30	(1997) Requirements for High-Voltage Switches
IEEE C37.34	(1994) Test Code for High-Voltage Air Switches
IEEE C37.41	(1994; C37.41c) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
IEEE C57.12.00	(1993) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(1993) Instrument Transformers
IEEE C57.98	(1993) Guide for Transformer Impulse Tests \$avail only as part of Distribution, Power, and Regulating Transformers Stds Collection
IEEE C62.1	(1989; R 1994) Surge Arresters for AC Power Circuits
IEEE C62.11	(1999) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 404	(1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V
IEEE Std 48	(1998) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 592	(1990; R 1996) Exposed Semiconducting Shields on Premolded High Voltage Cable Joints and Separable Insulated Connectors
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) \$31.00$\F

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA FB 1	(1993) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA LA 1	(1992) Surge Arresters
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA SG 2	(1993) High Voltage Fuses
NEMA TC 5	(1990) Corrugated Polyolefin Coilable Plastic Utilities Duct
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 7	(1990) Smooth-Wall Coilable Polyethylene Electrical Plastic Duct
NEMA WC 7	(1988; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988; Rev 3 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1072	(1995; Rev Mar 1998) Medium Voltage Power Cables
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors

UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 6	(1997) Rigid Metal Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 Service Conditions

Items provided under this section shall be specifically suitable for the following service conditions.

a. Altitude 2550ft Above Sea Level feet

b. Ambient Temperature From 0 degrees to 110 degrees degrees F

c. Frequency 60

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Electrical Distribution System; G

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

Detail drawings shall as a minimum depict the installation of the following items:

a. Medium-voltage cables and accessories including cable installation plan.

b. Transformers.

c. Substations.

d. Switchgear.

e. Pad-mounted loadbreak switches.

f. High Resistance Ground

g. Surge arresters.

As-Built Drawings; G

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction.

The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

SD-03 Product Data

Nameplates; G

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

Material and Equipment; G

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

General Installation Requirements; G

As a minimum, installation procedures for transformers, substations, switchgear, high resistive ground unit, and medium-voltage cable terminations and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Factory Tests; G

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing; G

A proposed field test plan, 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Operating Tests; G

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Cable Installation; G

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Material and Equipment; G

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a

certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

Cable Joints; G

A certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. 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 and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

Cable Installer Qualifications; G

The Contractor shall provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-10 Operation and Maintenance Data

Electrical Distribution System; G

Six copies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Three additional copies of the instructions manual shall be

provided within 30 calendar days following the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00. Nameplates shall indicate the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 50 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall or as specified my the Manufacturer's printed instructions.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 General

Cable construction shall be Type MV, conforming to NFPA 70 and UL 1072 with an interlocked tape armor and thermoplastic jacket. Cables shall be manufactured for use in duct applications .

2.4.1.2 Ratings

Cables shall be rated for a circuit voltage 15 kV.

2.4.1.3 Conductor Material

Underground cables shall be soft drawn copper complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding or ASTM B 496 for compact stranding .

2.4.1.4 Insulation

Cable insulation shall be cross-linked thermosetting polyethylene (XLP) insulation conforming to the requirements of NEMA WC 7 and AEIC CS5. A 133 percent insulation level shall be used on 15 kV rated cables. The

Contractor shall comply with EPA requirements.

2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape shield for each phase. The shield tape shall be sized to meet IEEE C2 requirements for a ground fault availability of amperes.

2.4.1.6 Neutrals

Neutral conductors of shall be copper. employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.

2.4.1.7 Jackets

Cables shall be provided with a PVCjacket.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B 3 and ASTM B 8. Intermixing of copper and aluminum conductors is not permitted.

2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.3 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404 and IEEE Std 592. Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and IEEE Std 592 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall comply with wet withstand voltage test requirements of IEEE Std 48 for the next higher Basic Insulation Level (BIL) level.

2.6 CONDUIT AND DUCTS

All undergroundduct lines shall be concrete-encased, thick-wall type.

2.6.1 Metallic Conduit

IRigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least5,000 psi. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

Transformers, substations, and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation level.

2.8.1 Secondary Unit Substation

Secondary unit substations shall comply with ANSI C37.121 and shall be of the radial type. Substations shall be subassembled and coordinated by one manufacturer and shall be shipped in complete sections ready for connection at the site. Complete sections shall include incoming, transformer, and outgoing sections and, where practicable, shall be shipped as one unit.

2.8.1.1 Incoming Section

Metal-enclosed interrupter switchgear consisting of fused, air-insulated or vacuum-insulated or SF6-insulated, interrupters in series with automatic, visible blade disconnects shall be provided for protection of incoming circuits. SF6 gas shall conform to ASTM D 2472. Metal-enclosed interrupter switchgear shall comply with IEEE C37.30 for load-interrupter switches, NEMA SG 2 for power fuses, and shall be of the outdoor no-aisle type that meets or exceeds the requirements of applicable publications

listed. Switch construction shall be of the manually-operated, "OPEN-CLOSED," air-insulated or vacuum-insulated or SF6-insulated, load interrupter type equipped with a stored energy operator for quick-make quick-break to make operating speeds independent of manual switch operations. Where indicated, suitable bus or lug connections shall be provided to mount field-installed, slip-on, medium-voltage cable terminations for cable entering via conduit from below and a flanged throat suitable for direct connection to the associated transformer. Surge protection shall be provided in accordance with paragraph SURGE ARRESTERS. Switches shall be of the 2-position type, open-closed.

a. Ratings. Fuse continuous current ratings shall be as indicated for the transformer for an incoming line unit and for the line tie unit. Unless otherwise indicated, fuses shall be of the current limiting type. Switch ratings at 60 Hz shall be:

Nominal voltage.....12.47 kv.

Rated maximum voltage.....15 kv.

Symmetrical interrupting capacity.....40 kA.

3-Second short time current carrying capacity.....12 kA.

Rated continuous current.....600 A.

BIL.....95 kV.

b. Basic Requirements. The electrical devices listed below shall be rated for the application and voltage and current indicated. Unless otherwise noted, manufacturer's standard devices shall be provided and shall include the following:

(1) A switch-operating handle with provisions for locking in either the open or closed position.

(2) A switch mechanical position indicator.

(3) A heater continuously energized to prevent condensation over an ambient temperature range of minus 20 degrees F to 40 degrees F at 90% relative humidity and wired in series with a cabinet door-actuated switch, so the heater is de-energized when doors are open. High-temperature thermal protection shall be included.

(4) One-pole or 2-pole thermal-magnetic, molded-case circuit breakers suitable for the operating voltage for heater circuits.

(5) Safety devices as necessary to ensure that the load interrupter switch is in the open position whenever unit doors are in the open position.

(6) A key interlock if indicated.

(7) An interface terminal block wired for required exterior connections.

2.8.1.2 Transformer Section

Transformers shall have two separate windings per phase and shall be of the

mineral oil-insulated type. Transformers shall be suitable for outdoor use. Liquid-insulated transformers shall comply with IEEE C57.12.00, ANSI C57.12.13, and ANSI C57.12.27, and shall have two 2-1/2 percent full capacity taps above and two 2-1/2 percent full capacity taps below rated voltage. Transformers shall be of the sealed tank type construction with welded-on cover. High-voltage terminals shall be provided for direct connection to the incoming section. Low-voltage terminals shall be provided for direct connection to the outgoing switchboard section. Provision shall be made for the future addition of forced air cooling equipment to give 112 percent kVA capacity. The transformer bushings, leads, and other components shall be designed to carry the increased load. A top liquid thermometer for control of future fans shall be furnished. Provision for future mounting of fans, conduit, and terminal box shall be provided. Transformer accessories and ratings at 60 Hz shall be as follows:

Three-phase capacity, self-cooled.....500 kVA.

Three-phase capacity, (future) forced-cooled.....560 kVA.

Impedance.....5.75 percent, standard.

Temperature rise.....55/65 degrees C.

High-voltage winding.....12470 volts.

High-voltage winding connection.....Delta.

Low-voltage winding.....480/277 volts.

Low-voltage winding connection.....Wye.

Accessories:

a. drain and filter connection.

b. filling and top filter press connection.

c. pressure-vacuum gauge.

d. dial type thermometer with alarm contacts.

e. magnetic liquid level indicator with high and low level alarm contacts.

f. pressure relief device with alarm contacts.

g. ground connection pad.

h. provision for jacking, lifting, and towing.

i. diagram and rating nameplate.

2.8.1.3 Integral Outgoing Section

Integral outgoing section shall be of the dead-front distribution switchboard type. Each circuit breaker and auxiliary compartment shall have a suitable metal or laminated plastic nameplate with white cut letters at least 1/4 inch high on contrasting backgrounds identifying the breaker unit and/or circuit number.

a. Dead-Front Distribution Switchboard Type: Outgoing section shall be of the switchboard type mounted integrally with the transformer and shall consist of metering devices and main and branch circuit breakers mounted in panelboard/switchboard enclosures. Switchboards shall comply with NEMA PB 2. Molded-case and low-voltage power circuit breakers shall comply with paragraph METERING AND PROTECTIVE DEVICES. Plug-in type circuit breakers are not acceptable. Directories to indicate loads served by each circuit shall be typed and mounted in holders provided on panelboard doors behind protective coverings.

b. Metering: The main secondary bus of each outgoing section assembly shall include a watthour demand meter with the necessary instrument transformers, and VT and CT test blocks. Metering shall be as specified in paragraph METERING AND PROTECTIVE DEVICES.

2.8.2 Pad-Mounted, Metal-Enclosed, Switchgear(Loop Switch)

The switchgear shall be configured with 2 incoming compartments for loop-feed arrangement, equipped with air-insulated, load-interrupter switches or oil-insulated, load-interrupter switches or SF6-insulated, load-interrupter switches indicated. The outgoing compartments shall be provided with cable to bus connection as indicated.

2.8.2.1 Ratings at 60 Hz shall be:

Nominal voltage (kV).....12.47.

Rated maximum voltage (kV).....15.

Rated continuous current (A).....600.

Symmetrical interrupting capacity (kA).....40.

Three-second short-time current-carrying capacity (kA)..... 12.

BIL (kV).....95.

2.8.2.2 Operators, Devices, and Controls

Operators and controls shall be provided for the switchgear as follows:

a. Switches shall be provided with a manual, handle-type operator or a push-button mechanical spring tripping mechanism, utilizing a stored-energy (spring-driven) mechanism to simultaneously open or close all phases. The switchgear shall be configured so that the switch actuator is padlockable, but may be accessed without opening the switch compartment doors.

2.8.2.3 Enclosures

Switchgear enclosures shall be of freestanding, self-supporting construction provided with separate incoming and outgoing compartments configured for bottom cable entry. Enclosures shall be of deadfront construction, provided with a hinged door for access to each compartment, and conform to the requirements of ANSI C57.12.28, ANSI C37.72, and IEEE C37.20.3, Category A.

2.9 METERING AND PROTECTIVE DEVICES

2.9.1 Circuit Breakers, Low-Voltage

2.9.1.1 Molded-Case Circuit Breakers

NEMA AB 1 and UL 489.

2.9.2 Fuses, Medium-Voltage, Including Current-Limiting

2.9.2.1 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.9.2.2 Ratings

Current-limiting power fuses shall have ratings in accordance with ANSI C37.46 and as follows:

Nominal voltage.....12.47 kV.

Rated maximum voltage.....15 kV.

Maximum symmetrical interrupting capacity.....40 kA.

Rated continuous current.....as indicated or recommended by the equipment manufacturer.

BIL.....95.

2.9.2.3 E-Rated, Current-Limiting Power Fuses

E-rated, current-limiting, power fuses shall conform to ANSI C37.46.

2.9.2.4 C-Rated, Current-Limiting Power Fuses

C-rated, current-limiting power fuses shall open in 1000 seconds at currents between 170 and 240 percent of the C rating.

2.9.3 Fuses, Low-Voltage, Including Current-Limiting

Low-voltage fuses shall conform to NEMA FU 1. Time delay and nontime delay options shall be as shown. Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilizes fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination.

2.9.3.1 Cartridge Fuses

Cartridge fuses, current-limiting type, Class RK5 shall have tested interrupting capacity not less than 200,000 amperes. Fuse holders shall be the type that will reject Class H fuses.

a. Class K fuses shall conform to UL 198D.

b. Class R fuses shall conform to UL 198E.

2.9.3.2 Transformer Circuit Fuses

Transformer circuit fuses shall be Class RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.9.4 Instrument Transformers

2.9.4.1 General

Instrument transformers shall comply with ANSI C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.9.4.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall not be less than 1.5. Other thermal and mechanical ratings of current transformers and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accident open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.9.4.3 Current Transformers for Kwh and Demand Metering (Low-Voltage)

Current transformers shall conform to IEEE C57.13. Provide current transformers with a metering accuracy Class of 0.3 through B-0.5, with a minimum RF of 3 at 30 degrees C, with 600-volt insulations, and 10 kV BIL. Provide butyl-molded, window-type current transformers mounted on the transformer low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters.

2.9.5 Watthour Meters

Watthour meters shall conform to ANSI C12.10, except numbered terminal

wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the switchboard type or socket mounted outdoor type having a 15 minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than 2-1/2 stators. Watthour demand meters shall have factory-installed electronic pulse initiators. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures, shall be capable of operating up to speeds of 500 pulses per minute with no false pulses, and shall require no field adjustments. Initiators shall be calibrated for a pulse rate output of 1 pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment.

2.10 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, IEEE C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be distribution class, rated as shown. Arresters for use at elevations in excess of 6000 feet above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the valve or metal-oxide varistor type.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 5/8 inchn diameter by 10 feet 8 feet in length. Sectional type rods may be used.

2.11.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.12 CONCRETE AND REINFORCEMENT

Concrete work shall conform to the requirements of Section 03301 CONCRETE.

2.13 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.13.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods

used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.13.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.13.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10 mil thick, conforming to UL 510.

2.14 LIQUID DIELECTRICS

Liquid dielectrics for transformers and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 50 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 50 ppm shall be replaced.

2.15 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard routine tests in accordance with IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

c. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE C37.34 and IEEE C37.41.

f. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

g. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.

h. Outdoor Switchgear: Manufacturer's standard tests in accordance with IEEE C37.20.1, IEEE C37.20.2, and IEEE C37.20.3.

i. Electrical Power Insulators: Manufacturer's standard tests in

accordance with ANSI C29.1.

2.16 FENCING

Fencing shall conform be provided around the switchyard as indicated on the Electrical Plans.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall conform to the requirements of Section 03301 CONCRETE.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.1.3 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. The Contractor shall furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

3.2 CABLE INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. The Contractor shall then prepare a checklist of significant requirements which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

3.2.1.5 Cable Installation Plan For 15kv Cables and 600V Cables Over #1 AWG

The Contractor shall submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall thrust pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels

used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.2.2 Underground Concrete Encased Duct Line

Cables shall be installed in underground concrete encased duct lines .Cable splices in low-voltage cables shall be made in manholes and handholes only. Cable joints in medium-voltage cables shall be made in manholes or approved pullboxes only. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.3 Cables installed in Galvanized Rigid Steel Conduit

Rigid Steel Conduit shall protect all cables above grade and all cables from grade level to 24 inches below grade level..3.2.3.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil.

3.2.3.2 Medium-Voltage Cable Joints or Low-Voltage Cable Splices

Cable joints or splices in direct-burial cables are not permitted in runs of 1000 feet or less, nor at intervals of less than 1000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in direct burial installations shall be installed in above-ground junction boxes or in cast metal splice boxes suitable for direct burial use. Cable joints or splices in duct banks shall be made only in manholes, handholes, or pullboxes.

3.2.4 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.3 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable.

3.4 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing. Fire-stops shall be installed in each conduit entering or leaving a manhole.

3.4.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

3.4.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825a. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.5 DUCT LINES

3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and

deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any pointthe tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

3.5.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.5.4.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.6 MANHOLES, HANDHOLES, AND PULLBOXES

3.6.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a

precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.6.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.6.3 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

3.6.4 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inchabove surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

3.6.5 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

3.7.1 Concrete Pads

3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment shall be poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished grade and sloped to drain. Edges of

concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.7.1.2 Concrete and Reinforcement

Concrete work shall comform to the requirements of Section 03301 CONCRETE.

3.7.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed as directed by the Contracting Officer.

3.7.3 Fencing

Fencing shall conform to the requirement of and be installed as indicated on the plans. Fences shall provide working clearances for operation and maintenance in accordance with IEEE C2. The entire space between fences and concrete pads shall be excavated to a minimum depth of 4 inches below finished gradelines, shall be graded to reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 1/2 to 1-1/2 inches graded size up to finished gradelines. Space between fences and concrete pads shall be excavated to a minimum depth of 4 inches below finished gradelines, shall be graded to reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 1/2 to 1-1/2 inches graded size up to finished gradelines.

3.8 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in galvanized rigid steel conduit to cable terminations. Conduits shall be secured to the poles by 2-hole galvanized steel pipe straps spaced not more than 10 feet apart and with 1 strap not more than 12 inches from any bend or termination. Conduits shall be equipped with bushings to protect cables and minimize water entry.

3.9 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 2 feet below finished grade as specified and provided under Section 16415 ELECTRICAL WORK,

INTERIOR. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.10 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a switchgear ground bus, and a unit substation to the ground ring. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.

c. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed 24 inches, plus or minus 3 inches, below finished top of soil grade. Ground ring conductors shall be sized as shown.

d. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors to achieve the specified ground resistance. The additional electrodes will be up to three,10 feet rods spaced a minimum of 10 feet apart.

3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.10.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.10.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.10.6 Metal Splice Case Grounding

Metal splice cases for medium-voltage direct-burial cable shall be grounded by connection to a driven ground rod located within 2 feet of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

3.10.7 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, static wire, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding2 feet.

3.11 FIELD TESTING

3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 30 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which

are damaged due to improper test procedures or handling.

3.11.3 Ground-Resistance Tests

The resistance of each grounding electrode and the ground ring shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

b. Multiple rod electrodes - 25 ohms.

d. Ground ring - 25 ohms.

3.11.4 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.5 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.11.6 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers. Pass-fail criteria shall be in accordance with transformer manufacturer's specifications.

a. Insulation resistance test phase-to-ground.

b. Turns ratio test.

c. Correct phase sequence.

d. Correct operation of tap changer.

3.11.7 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

a. Secondary unit substation

b. Switchboards

c. Metal-enclosed switchgear

d. Switches

3.11.8 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for

approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

3.12 MANUFACTURER'S FIELD SERVICE

3.12.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations.

3.12.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 16403

MOTOR CONTROL CENTERS, SWITCHBOARDS
08/95

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 basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 187	(1994) Copper Bar, Bus Bar, Rod and Shapes

ASME INTERNATIONAL (ASME)

ASME B1.1	(1989) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C12.1	(1988) Code for Electricity Metering
IEEE C12.4	(1984; R 1990) Mechanical Demand Registers
IEEE C12.10	(1987) Electromechanical Watthour Meters
IEEE C12.11	(1987) Instrument Transformers for Revenue Metering, 10 kV BIL Through 350 kV (0.6 kV NSV Through 69 kV NSV)
IEEE C57.13	(1993) Instrument Transformers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control Devices, Controllers and Assemblies
NEMA ICS 4	(1993) Industrial Control and Systems Terminal Blocks
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA PB 1	(1990) Panelboards

NEMA PB 2	(1989) Deadfront Distribution Switchboards
NEMA ST 1	(1988) Specialty Transformers (Except General Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 44	(1991; Rev thru Jan 1995) Rubber- Insulated Wires and Cables
UL 50	(1992) Enclosures for Electrical Equipment
UL 67	(1993; Rev thru May 1994) Panelboards
UL 489	(1991; Rev thru Dec 1994) Molded Case Circuit Breakers and Circuit Breaker Enclosures
UL 845	(1995) Motor Control Centers
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 1063	(1993; Rev thru Oct 1994) Machine-Tool Wires and Cables

1.2 SYSTEM DESCRIPTION

These specifications include the design, fabrication, assembly, wiring, testing, and delivery of the items of equipment and accessories and spare parts listed in the Schedule and shown on the drawings.

1.2.1 Rules

The equipment shall conform to the requirements of NFPA 70 unless more stringent requirements are indicated herein or shown. NEMA rated and UL listed equipment has been specified when available. Equipment must meet NEMA and UL construction and rating requirements as specified. No equivalent will be acceptable. The contractor shall immediately notify the Contracting Officer of any requirements of the specifications or contractor proposed materials or assemblies that do not comply with UL or NEMA. International Electrotechnical Commission (IEC) rated equipment will not be considered an acceptable alternative to specified NEMA ratings.

1.2.2 Coordination

The general arrangement of the motor control centers, switchboards and panelboards is shown on the contract drawings. Any modifications of the equipment arrangement or device requirements as shown on the drawings shall be subject to the approval of the Contracting Officer. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. All equipment shall be completely assembled at the factory. The motor control centers and switchboards may be disassembled into sections, if necessary, for convenience of handling, shipping, and installation.

1.2.3 Standard Products

Material and equipment shall be standard products of a manufacturer regularly engaged in their manufacture and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials shall conform to the requirements of these specifications. Materials shall be of high quality, free from defects and imperfections, of recent manufacture, and of the classification and grades designated. All materials, supplies, and articles not manufactured by the Contractor shall be the products of other recognized reputable manufacturers. If the Contractor desires for any reason to deviate from the standards designated in these specifications, he shall, after award, submit a statement of the exact nature of the deviation, and shall submit, for the approval of the Contracting Officer, complete specifications for the materials which he proposes to use.

1.2.4 Nameplates

Nameplates shall be made of laminated sheet plastic or of anodized aluminum approximately 4 millimeters (1/8 inch) thick, engraved to provide white letters on a black background. The nameplates shall be fastened to the panels in proper positions with anodized round-head screws. Lettering shall be minimum 15 millimeters (1/2 inch) high. Nameplate designations shall be in accordance with lists on the drawings, and as a minimum shall be provided for the following equipment:

a. Motor Control Centers

b. Individual items of equipment mounted in the Motor Control Centers

c. Switchboards

d. Individually-mounted circuit breakers in Switchboard

e. Panelboards

f. Individually-mounted circuit breakers in Panelboard

Equipment of the withdrawal type shall be provided with nameplates mounted on the removable equipment in locations visible when the equipment is in place.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G
Shop Drawings; G

The Contractor shall, within 30 calendar days after date of receipt by him of notice of award, submit for the approval of the Contracting Officer six (6) copies of outline drawings of all

equipment to be furnished under this contract, together with weights and overall dimensions. Drawings shall show the general arrangement and overall dimensions of the motor control centers, switchboards, and panelboards. These drawings shall show space requirements, details of any floor supports to be embedded in concrete and provisions for conduits for external cables.

Motor Control Centers; G

The Contractor shall, within 30 calendar days after date of receipt by him of notice of award, submit for the approval of the Contracting Officer six (6) copies of electrical equipment drawings. The NEMA Class II motor control center drawings shall include a connection diagram with wire designations and schematic diagrams to illustrate operation of associated motor unit controls. An individual wiring diagram for each motor control center shall be submitted. A single-line diagram, equipment list and nameplate schedule shall be provided for each motor control center.

Switchboards; G
Panelboards; G

The Contractor shall, within 30 calendar days after date of receipt by him of notice of award, submit for the approval of the Contracting Officer six (6) copies of electrical equipment drawings. A single-line diagram, equipment list and nameplate schedule shall be provided for each switchboard and panelboard.

SD-03 Product Data

Equipment; G

The Contractor shall within 30 calendar days after date of receipt by him of notice of award submit for approval six (6) copies of such descriptive cuts and information as are required to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications. Data shall include descriptive data showing typical construction of the types of equipment proposed, including the manufacturer's name, type of molded case circuit breakers or motor circuit protectors, performance capacities and other information pertaining to the equipment.

Factory Tests;

The Contractor shall submit, within a minimum of 14 days prior to the proposed date of tests, six (6) copies of manufacturer's routine factory test procedures and production line tests for all motor control centers and switchboards.

SD-06 Test Reports

Factory Tests;

The Contractor shall submit six (6) complete reproducible copies of the factory inspection results and six (6) complete reproducible copies of the factory test results in booklet form, including all plotted data curves, all test conditions, a listing of test equipment complete with calibration certifications, and all

measurements taken. Report shall be signed and dated by the Contractor's and Contracting Officer's Representatives.

SD-07 Certificates

Motor Control Centers;

The contractor shall submit certification of factory test reports. Certification shall be signed by official authorized to certify on behalf of the manufacturer, attesting that the motor control center meets the specified requirements. The statement must be dated after the award of this contract, must state the Contractors name and address, must name the project and location, and must list the specific requirements which are being certified.

1.4 DELIVERY, STORAGE, AND HANDLING

The equipment shall be shipped as completely assembled and wired as feasible so as to require a minimum of installation work. Each shipping section shall be properly match marked to facilitate reassembly, and shall be provided with removable lifting channels with eye bolts for attachment of crane slings to facilitate lifting and handling. Any relay or other device which cannot withstand the hazards of shipment when mounted in place on the equipment shall be carefully packed and shipped separately. These devices shall be marked with the number of the panel which they are to be mounted on and fully identified. All finished painted surfaces and metal work shall be wrapped suitably or otherwise protected from damage during shipment. All parts shall be prepared for shipment so that slings for handling may be attached readily while the parts are in a railway car or transport truck. All spare parts and accessories shall be carefully packaged and clearly marked.

1.5 MAINTENANCE

1.5.1 Accessories and Tools

A complete set of accessories and special tools unique to equipment provided and required for erecting, handling, dismantling, testing and maintaining the apparatus shall be furnished by the Contractor.

PART 2 PRODUCTS

2.1 CONNECTIONS

All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME B1.1. The sizes and threads of all conduit and fittings, tubing and fittings, and connecting equipment shall be in accordance with ASME B1.20.1. All ferrous fasteners shall have rust-resistant finish and all bolts and screws shall be equipped with approved locking devices. Manufacturer's standard threads and construction may be used on small items which, in the opinion of the Contracting Officer, are integrally replaceable, except that threads for external connections to these items shall meet the above requirements.

2.2 MOLDED CASE CIRCUIT BREAKERS

Molded case circuit breakers shall conform to the applicable requirements of NEMA AB 1 and UL 489. The circuit breakers shall be manually-operated, shall be quick-make, quick-break, common trip type, and shall be of

automatic-trip type unless otherwise specified or indicated on the drawings. All poles of each breaker shall be operated simultaneously by means of a common handle. The operating handles shall clearly indicate whether the breakers are in "On," "Off," or "Tripped" position and shall have provisions for padlocking in the "Off" position. Personnel safety line terminal shields shall be provided for each breaker. The circuit breakers shall be products of only one manufacturer, and shall be interchangeable when of the same frame size.

2.2.1 Trip Units

Except as otherwise noted, the circuit breakers, of frame sizes and the trip unit ratings as shown on the drawings, shall be provided with combination thermal and instantaneous magnetic or solid state trip units. The Government reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval. The breaker trip units shall be interchangeable and the instantaneous magnetic trip units shall be adjustable on frame sizes larger than 150 amperes. Nonadjustable instantaneous magnetic trip units shall be set at approximately 10 times the continuous current ratings of the circuit breakers.

2.2.2 480-Volt AC Circuits

Circuit breakers for 480-volt or 277/480-volt ac circuits shall be rated 600 volts ac, and shall have an UL listed minimum interrupting capacity of symmetrical amperes at 600 volts ac as indicated on the plans..

2.2.3 120/240-Volt AC Circuits

Circuit breakers for 120-volt ac circuits shall be rated not less than 120/240 or 240 volts ac, and shall have a UL listed minimum interrupting capacity of 10,000 symmetrical amperes.

2.3 WIRING

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44 or Type MTW meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.4 TERMINAL BLOCKS

Control circuit terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 600 volts. The terminals shall be removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts. The terminals shall be not less than No. 10 in size and shall have sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal. The terminal arrangement shall be subject to the approval of the Contracting Officer and not less than four (4) spare terminals or 10 percent, whichever is greater, shall be provided on each block or group of

blocks. Modular, pull apart, terminal blocks will be acceptable provided they are of the channel or rail-mounted type. The Contractor shall submit data showing that the proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.4.1 Types of Terminal Blocks

2.4.1.1 Short-Circuiting Type

Short-circuiting type terminal blocks shall be furnished for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks shall meet the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.

2.4.1.2 Load Type

Load terminal blocks rated not less than 600 volts and of adequate capacity shall be provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits except those for feeder tap units. The terminals shall be of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, screws shall have hexagonal heads. Conducting parts between connected terminals shall have adequate contact surface and cross-section to operate without overheating. Each connected terminal shall have the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.4.2 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for identification of remote (external) circuits shall be provided for the Government's wire designations. Prints of drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

2.5 MOTOR CONTROL CENTERS

Each motor control center shall be designed for operation on 480-volts ac, 3-phase, 60-Hz system, and the equipment shall conform to all the applicable requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 4and NEMA ICS 6. Vertical sections and individual units shall be listed and labeled under UL 845 where ever possible. In lieu of the UL listing, certification from any nationally recognized, adequately equipped, testing agency that the

individual units and vertical sections have been tested and conform to the UL requirements of that agency will be acceptable when approved by the Contracting Officer. The motor control center shall be NEMA Class II, Type C, motor control centers in accordance with NEMA ICS 2.

2.5.1 Enclosures

Each motor control center shall consist of the required number of vertical sections of 2250 millimeters (90 inches) nominal height, bolted together, with steel channel sills and suitable for mounting against a wall. Vertical section shall be 510 millimeters (20 inches) deep and buses, control wiring, control transformers, small power transformers, terminal blocks, line terminals, cable supports, and clamps shall be accessible from the front. Enclosure shall be NEMA Type 1 gasketed. The control centers shall be fabricated from smooth select steel sheets shaped and reinforced to form rigid free-standing structures. Metal thickness for enclosures shall be not less than specified in NEMA ICS 6 without exception. Vertical edges of sections exposed to view shall be so fabricated and bolted that the joints will not pass a 1.6 millimeter (1/16 inch) gage. Each structure shall be designed for addition of future sections required. Individual compartments shall be isolated from adjacent compartments.

2.5.1.1 Unit Compartments

Each operating unit shall contain equipment as shown on the drawings, mounted in an individual cell. The unit assembly, except main circuit breakers, panelboards and auxiliary control devices, shall be drawout type removed from the front, without rear access or disturbing other units in the control center assembly. All drawout type unit assemblies shall have positive guide rail system to ensure alignment of connection to vertical bus. Units shall be mechanically interlocked with the door to prevent removal while in the energized position. Each removable unit shall have provision for padlocking in a position in which it is disconnected from the vertical bus although not removed from the stationary structure. All ventilating openings shall be provided with corrosion-resistant insect-proof screens on the inside. Bus closing plugs shall be provided for all unused openings in vertical bus barriers.

2.5.1.2 Motor Control Center Doors and Covers

Each unit compartment, including blank compartments for future use, shall be provided with either a flange-formed or a rolled-edge door. Each door shall be mounted on fully-concealed or continuous full-length piano-type hinges and shall be provided with positive fasteners. Door sag shall be prevented by proper alignment of hinges made of sufficiently strong material. The door fastenings shall be so interlocked to prevent opening when the equipment is energized. The external operating handle shall clearly indicate whether the equipment is in an "ON", "OFF" or "TRIPPED" position.

2.5.1.3 Horizontal Wireways

Structure shall have a minimum 150 millimeters (6 inches) high wireway at the top and a 300 millimeters (12 inches) minimum wireway at the bottom. Both horizontal wireways shall run the length of the structure A master terminal block compartment with full length wireway space shall be provided at the bottom in all Type C assemblies. Cover plates shall be provided on the side of the assembly to permit extension of the horizontal bus and wireway when vertical sections are added.

2.5.1.4 Vertical Wireways

Vertical wireways shall be provided in all vertical sections accepting multiple plug-in components. Vertical wireways shall connect with horizontal wireways at the top and bottom and be a minimum 100 millimeters (4 inches) wide. Barriers shall be provided in sections containing both ac and dc vertical buses. Doors shall be provided on each vertical wireway. The exposed surface of any door shall not deviate more than 1.5 millimeters (1/16-inch) from a true plane.

2.5.1.5 Shutters

Drawout units shall have shutters which close when the unit is withdrawn to isolate the vertical bus.

2.5.2 Buses

All buses shall be of copper and all bolted splices and connections between buses and for extensions or taps for equipment shall be tin or silver-plated. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187. All splices for field assembly shall be bolted with at least two bolts and shall employ the use of "Belleville" washers in the connection. The bus ratings shall be based on a 65 degree Celsius maximum temperature rise in accordance with UL 845 requirements. Bus shall have a short-circuit current rating of not less than 42,000 RMS symmetrical amperes. All bus work shall be supported on wet process porcelain insulators, glass polyester, or suitable molded material.

2.5.2.1 Horizontal Bus

Each control center assembly shall be provided with a three-phase main horizontal bus, with a continuous current rating not less than 600 amperes, located across the top of each vertical section. The ends of horizontal buses shall be drilled for future extensions.

2.5.2.2 Vertical Bus

Each vertical section shall be provided with a three-phase vertical bus with a continuous current rating of 600 amperes connected to the horizontal bus by brazing, welding, or bolting. Where the incoming feeder breakers are located at the bottom of a control center, the vertical bus in that section shall be rated the same as the main horizontal bus. Vertical buses shall extend from the horizontal bus to the bottom of the lowest available unit mounting space. The vertical bus shall be isolated from wireways and equipment in compartments.

2.5.2.3 Ground Bus

A copper ground bus shall be provided full width at the bottom of the motor control center line-up. A full clamp-type solderless copper or copper alloy lug for No. 2/0 AWG stranded copper cable shall be provided at each end of the bus for connection to the station grounding system.

2.5.2.4 Neutral Bus

A half rated neutral bus shall be furnished continuous through the control center. Lugs of appropriate capacity will be furnished.

2.5.3 Combination Starters

Combination motor controller units shall contain motor circuit protectors , auxiliary and pilot devices and a magnetic contactor with thermal overload relays . The ratings of motor circuit protectors,, contactors, motor controllers and other devices shall be as shown on the drawings. All combination motor controller units shall have short circuit ratings equal to minimum of 14,000Aor greater. Where control push-buttons, indicating lamps, "Hand-Off-Automatic" switches, and similar control devices are associated with a unit, they shall be mounted on the unit compartment door. Door-mounted components shall not interfere with access within the compartments. Motor circuit protectors shall be only part of the combination starters as required by NFPA 70 and shall conform to all requirements of paragraph MOLDED CASE CIRCUIT BREAKERS, except that trip units shall have provision for locking the selected trip setting.

2.5.3.1 Magnetic Contactors

Magnetic contactors shall be of the NEMA sizes indicated on the drawings. The rating, performance and service characteristics shall conform to the requirements of NEMA ICS 2 for contactors with continuous current ratings for the duty indicated. Contactors for motor control shall be rated for full-voltage starting (Class A controllers). Contactors shall be suitable for at least 200,000 complete operations under rated load without more than routine maintenance. The interruption arc and flame shall be minimized by suitable arc chutes or other means so that no damage will be done to other portions of the device. The arc chutes, if provided, shall be easily removable without removing or dismantling other parts. The contacts shall be easily removable. All current-carrying contact surfaces shall be silver-surfaced or of other approved material to prevent the formation of high resistance oxides. The contactor shall operate without chatter or perceptible hum while energized. Coils shall be suitable for continuous operation 480-volt ac circuits. Alternating-current contactors shall be three-pole, except where otherwise noted, and shall be insulated for 600 volts ac and of the electrically- operated, magnetically-held type.

2.5.3.2 Auxiliary Contacts

Each controller shall be provided with a minimum of three auxiliary contacts which can be easily changed from normally open to normally closed. Where indicated, a fourth auxiliary contact and red and green indicating lights shall be provided.

2.5.3.3 Overload Relays

Except as otherwise indicated, each controller shall be provided three NEMA Class 20 thermal overload relays with external manual reset. Prior to shipment of the control centers, the Contracting Officer will furnish the ratings of the heater elements to be installed in the relays by the Contractor.

2.5.3.4 Individual Control Transformers

Where 120 volt ac control of contactors is indicated or required, individual control transformer shall be provided on the line side of the unit disconnect. The control transformers shall be rated 480-120 volts and shall conform to the requirements for control transformers in NEMA ST 1. Control transformers shall have adequate volt-ampere capacity for the

control functions indicated. Transformers shall be installed with primary fuses. Primary fuses shall be Class J. Except as otherwise indicated on the drawings, each control transformer shall be provided with a fuse in one secondary lead and shall have the other secondary lead grounded.

2.5.3.5 Control Circuit Disconnects

Control circuit power shall disconnect when the unit compartment is opened.

2.5.4 Molded Case Circuit Breakers in Unit Compartments

Molded case circuit breakers for installation in unit compartments shall meet the requirements of paragraph MOLDED CASE CIRCUIT BREAKERS above.

2.5.5 Panelboards for Motor Control Centers

Panelboards shall meet the requirements of paragraph PANELBOARDS.

2.5.6 Wiring for Motor Control Centers

All wiring shall meet the requirements of paragraph WIRING above. Heavy-duty clamp type terminals shall be provided by the Contractor for terminating all power cables entering the control centers.

2.5.6.1 Contractor's Wiring

The Contractor's wiring shall be formed into groups, suitably bound together, properly supported and run straight horizontally or vertically. There shall be no splices in the wiring. The manufacturer's standard pressure-type wire terminations for connections to internal devices will be acceptable. Terminal blocks shall be added for wiring to devices having leads instead of terminals. Ring tongue indented terminals shall be used on all wires terminated on control terminal blocks for external or interpanel connections and at shipping splits. All stud terminals shall have contact nuts and either locking nuts or lockwashers.

2.5.6.2 External Connections

Power and control cables will enter the control centers at the bottom . Where power and control entry points are not shown, and terminal blocks are not given on the drawings, the Government will furnish this information to the Contractor after award of contract.

2.5.6.3 Terminal Blocks

Terminal blocks shall meet the requirements of paragraph TERMINAL BLOCKS above. In no case shall the terminals provided for circuit breakers or contactors accommodate less than the number or size of conductors shown on the drawings. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.5.7 Accessories and Control Devices

Control accessories shall be provided, and shall be suitable for mounting on the front of, or inside, the control centers as indicated on the drawings. Control accessories shall meet the applicable requirements of NEMA ICS 2. Relays and other equipment shall be so mounted that mechanical vibration will not cause false operation.

2.5.7.1 Control Stations

Push-button stations and selector switches shall conform to NEMA ICS 2, shall be of the heavy-duty, oil-tight type, rated 600 volts ac, and have a contact rating designation of A600. Switches shall be provided with escutcheon plates clearly marked to show operating positions. Sufficient contact blocks shall be provided to make up the electrically separate contacts required for lead-lag selector switches.

2.5.7.2 LED Indicating Lights

Red and green LED's shall be furnished where shown on the drawings, indicating contact "open" and "closed" position. The LED's shall be accessible and replaceable from the front of the control center through a finished opening in the compartment door. The LED assemblies shall be of the heavy duty oiltight, watertight, and dusttight type.

2.5.7.3 Control Relays

Control relays shall be of the electrically operated, magnetically held, self-reset, open type, suitable for mounting inside the starter compartments, and shall be 120-volt ac. Contacts shall be as indicated on the drawings and shall have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2.

2.5.7.4 Timing Relays

Timers shall be pneumatic type. They shall be suitable for mounting inside the control center and shall be rated 120 volts ac, 60 Hz. Instantaneous and time delay contacts shall be provided as indicated on the drawings, and shall have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2. Means shall be provided for manual adjustment over a range as indicated on the drawings.

2.5.7.5 Alternators For 25hp Motors At Bldg 3058

Alternators 120-volt, 60 Hz, single-phase, open type, suitable for mounting inside of control center as indicated. Alternators shall automatically cycle two motor starters in such a manner that No. 1 will lead and No. 2 will lag during the first cycle, and during the second cycle No. 2 will lead and No. 1 will lag, and the third cycle will repeat the first cycle. The duration of a cycle will be determined by an external device . Contacts shall have a minimum contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2.

2.5.7.6 Elapsed-Time Meters

Hour-indicating time meters shall have 6- digit registers with counter numbers at least 7 millimeters (1/4 inch) high. White numbers on black backgrounds shall provide hour indication with the last digit in contrasting colors to indicate tenths of an hour. The enclosure shall be 90 millimeters (3-1/2 inches) square and dust resistant. Operating voltage shall be 120 volts ac. They shall be of the nonreset type.

2.5.8 Feeder Tap Units

Feeder tap units shall be provided as indicated on the drawings.

2.5.9 Metering Section

Metering section shall be provided with instruments as indicated on the drawings.

2.5.9.1 Instrument Transformers

All transformers used for metering shall meet the requirements of IEEE C12.11 and IEEE C57.13. Voltage transformers shall be protected with removable primary and secondary fuses. Fuses shall be installed in each ungrounded lead and located adjacent to the transformers in an easily accessible place. If cable connections to current transformer primary are required, terminals of an approved solderless type and proper size shall be furnished. If current transformers are connected to buses, proper connections shall be furnished, complete with bolts, nuts, washers and other accessories.

2.5.9.2 Ammeters

Switchboard type ammeter shall be provided where indicated on the drawings. Ammeter, range 0 to 800 amperes, complete with selector switch having off position and positions to read each phase current. Meters shall be long scale 175 millimeters (6.8 inches), semiflush rectangular, indicating type mounted at eye level.

2.5.9.3 Voltmeters

Switchboard type voltmeter shall be provided where indicated on the drawings. Voltmeter, range 0 to 600 volts, complete with selector switch having off position and positions to read each phase to phase voltage. Meters shall be long scale 175 millimeters (6.8 inches), semiflush rectangular, indicating type mounted at eye level.

2.5.9.4 Watthour Meters

Watthour meters shall conform to IEEE C12.1 and IEEE C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the drawout switchboard type having a 15-minute, cumulative form, demand register meeting IEEE C12.4 and provided with not less than two and one-half stators.

2.5.9.5 Switches

All metering switches shall be of the rotary switchboard type with handles on the front and operating contact mechanisms on the rear of the panels. Control switches shall be suitable for operation on 600-volt AC or 250-volt DC circuits. All such switches shall be capable of satisfactorily withstanding a life test of at least 10,000 operations with rated current flowing in the switch contacts. Selector switches shall be maintained-contact type with the required number of positions, and shall have round notched, or knurled handles. Ammeter switches shall not open the secondary circuits of current transformers at any time. Instrument switches for potential selection shall have oval handles.

2.6 SWITCHBOARDS

The switchboards shall be dead-front switchboards conforming to NEMA PB 2 and labeled under UL 891. The switchboards shall be completely enclosed self-supporting metal structures with the required number of vertical panel

sections, buses, molded-case circuit breakers, as shown on the drawings. Switchboards shall be fully rated for a short-circuit current of 22,000 symmetrical amperes RMS AC.

2.6.1 Enclosure

Each switchboard enclosure shall be NEMA type 3R, built with selected smooth sheet steel panels of not less than 1.9 millimeters (No. 14 gage). Exposed panels on the front and ends shall have bent angle or channel edges with all corner seams welded and ground smooth. The front outside surfaces shall not be drilled or welded for the purpose of attaching wires or mounting devices if such holes or fastenings will be visible from the front. The front panels shall be made in sections flanged on four sides and attached to the framework by screws and arranged for ready removal for inspection or maintenance. Ventilating openings shall be provided as required and shall preferably be of the grille type. All ventilating openings shall be provided with corrosion-resistant insect-proof screens on the inside. Each switchboard shall be provided with a channel iron base at front, rear, and sides, with exposed ends covered by welded steel plates. Grout holes shall be provided. The switchboard sections shall be bolted to the base.

2.6.2 Bus

All buses shall be of copper and all bolted splices and connections between buses and for extensions or taps for equipment shall be tin or silver-plated. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187. All splices for field assembly shall be bolted with at least two bolts and shall employ the use of "Belleville" washers in the connection. Horizontal and vertical power buses have minimum current ratings as shown on the drawings. The buses shall be insulated for not less than 600 volts. Shop splices and tap connections shall be brazed, pressure-welded or bolted. All splices for field assembly shall be bolted. The buses shall be mounted on insulating supports of wet process porcelain, glass polyester, or suitable molded material, and shall be braced to withstand not less than 22,000symmetrical amperes ac.

2.6.3 Grounding Bus

A copper ground bus, rated not less than 300 amps, extending the entire length of the assembled structure, shall be mounted near the bottom of enclosure. A full clamp-type solderless copper or copper alloy lug for No. 2/0 AWG stranded copper cable shall be provided at each end of the bus for connection to the station grounding system.

2.6.4 Components

Each switchboard shall be equipped with molded-case circuit breakers conforming to paragraph MOLDED CASE CIRCUIT BREAKERS and with frame sizes, trip ratings, and terminal connectors for attachment of outgoing power cables as shown on the drawings. The circuit breakers shall be individually stationary mounted, as shown on the drawings, and shall be operable and removable from the front. Where shown on the drawings, circuit breakers shall be enclosed in individual compartments.

2.7 PANELBOARDS

Panelboards shall consist of assemblies of molded-case circuit breakers

with buses and terminal lugs for the control and protection of branch circuits to motors, heating devices and other equipment operating at 480 volts ac or less. Panelboards shall be UL 67 labeled. "Loadcenter" type panels are not acceptable. Panelboards shall be designed for installation in surface-mounted or flush-mounted cabinets accessible from the front only, as shown on the drawings. Panelboards shall be fully rated for a short-circuit current of 10,000 symmetrical amperes RMS ac.

2.7.1 Enclosure

Enclosures shall meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than 3.5 millimeters (No. 10 gage) if flush-mounted or mounted outdoors, and not less than 2.7 millimeters (No. 12 gage) if surface-mounted indoors, with full seam-welded box ends. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication. Outdoor cabinets shall be of NEMA 3R raintight and conduit hubs welded to the cabinet. Front edges of cabinets shall be form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 3 millimeters (1/8 inch). Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 15 millimeter (1/2 inch) clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 600 millimeters (24 inches) long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets. Enclosure shall have nameplates in accordance with paragraph NAMEPLATES. Directory holders, containing a neatly typed or printed directory under a transparent cover, shall be provided on the inside of panelboard doors.

2.7.2 Buses

All panelboards shall be of the dead-front type with buses and circuit breakers mounted on a plate or base for installation as a unit in a cabinet. All buses shall be of copper . Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187. The sizes of buses and the details of panelboard construction shall meet or exceed the requirements of NEMA PB 1. Suitable provisions shall be made for mounting the bus within panelboards and adjusting their positions in the cabinets. Terminal lugs required to accommodate the conductor sizes shown on the drawing, shall be provided for all branch circuits larger than No. 10 AWG. A grounding lug suitable for 1/0 AWG wire shall be provided for each panelboard.

2.7.3 Components

Each branch circuit, and the main buses where so specified or shown on the drawings, shall be equipped with molded-case circuit breakers having overcurrent trip ratings as shown on the drawings. The circuit breakers shall be of a type designed for bolted connection to buses in a panelboard assembly, and shall meet the requirements of paragraph MOLDED CASE CIRCUIT BREAKERS. Circuit breakers of the same frame size and rating shall be interchangeable.

2.8 PAINTING

Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Light Grey. All touch-up work shall be done with manufacturer's coatings as supplied under paragraph SPARE PARTS.

2.9 FACTORY TESTS

Each item of equipment supplied under this contract shall be given the manufacturer's routine factory tests and tests as specified below, to insure successful operation of all parts of the assemblies. All tests required herein shall be witnessed by the Contracting Officer unless waived in writing, and no equipment shall be shipped until it has been approved for shipment by the Contracting Officer. The Contractor shall notify the Contracting Officer a minimum of 14 days prior to the proposed date of the tests so that arrangements can be made for the Contracting Officer to be present at the tests. The factory test equipment and the test methods used shall conform to the applicable NEMA Standards, and shall be subject to the approval of the Contracting Officer. Reports of all witnessed tests shall be signed by witnessing representatives of the Contractor and Contracting Officer. The cost of performing all tests shall be borne by the Contractor and shall be included in the prices bid in the schedule for equipment.

2.9.1 Motor Control Centers Tests

2.9.1.1 Dielectric Tests

Each motor control center shall be completely assembled and given dielectric tests in accordance with NEMA ICS 1.

2.9.1.2 Operational Tests

The correctness of operation of each motor circuit protector and magnetic contactor and of all control devices, accessories and indicating lamps, shall be checked. These checks shall be made at rated voltage with power supplies to the main buses. All magnetic contactors shall also be checked for proper operation with power at 90 percent of rated voltage.

2.9.1.3 Short Circuit Tests

If the unit is not UL labeled for the specified short circuit, the contractor may submit design tests demonstrating that satisfactory short-circuit tests, as specified in NEMA ICS 2, have been made on a motor control center of similar type of construction and having the same available short circuit current at the motor terminals, including any motor contributions, as the motor control centers specified to be furnished under these specifications.

2.9.2 Switchboards Tests

2.9.2.1 Production Tests

Each switchboard shall be completely assembled and given applicable production tests for assembled switchgear as specified in NEMA PB 2.

2.9.2.2 Short Circuit Tests

If the unit is not UL labeled for the specified short circuit, the contractor may submit design tests demonstrating that satisfactory short-circuit tests have been made on a switchboard of similar type of construction and of the same short-circuit rating as the switchboards specified to be furnished under these specifications.

2.9.3 Panelboards Tests

Each panelboard shall be assembled with cabinet and front to the extent necessary to check the fit and provisions for installing all parts in the field. Each panelboard shall be given a dielectric test in accordance with NEMA PB 1. All circuit breakers shall be operated to check mechanical adjustments. All doors and locks shall be checked for door clearances and fits and the performance of lock and latches.

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 16410

AUTOMATIC TRANSFER SWITCH
07/01

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 basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.90.1	(1989; R 1994) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 602	(1996) Electric Systems in Health Care Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(1993) Industrial Controls and Systems
NEMA ICS 2	(1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 4	(1997) Industrial Control and Systems Terminal Blocks
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA ICS 10	(1999) Industrial Control and Systems: AC Transfer Switch Equipment - Part 2: Static AC Transfer Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 110	(1999) Emergency and Standby Power Systems

UNDERWRITERS LABORATORIES (UL)

UL 1008	(1996; Rev thru Feb 1999) Transfer Switch Equipment
UL 1066	(1997) Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Automatic Transfer Switch; G

Schematic, external connection, one-line schematic and wiring diagram of each ATS assembly. Interface equipment connection diagram showing conduit and wiring between ATS and related equipment. Device, nameplate, and item numbers shown in list of equipment and material shall appear on drawings wherever that item appears. Diagrams shall show interlocking provisions and cautionary notes, if any. Operating instructions shall be shown either on one-line diagram or separately. Unless otherwise approved, one-line and elementary or schematic diagrams shall appear on same drawing.

Equipment;
Installation;

Dimensioned plans, sections and elevations showing minimum clearances, weights, and conduit entry provisions for each ATS.

SD-03 Product Data

Material; G
Equipment; G

List of proposed equipment and material, containing a description of each separate item.

SD-06 Test Reports

Testing; G

A description of proposed field test procedures, including proposed date and steps describing each test, its duration and expected results, not less than 2 weeks prior to test date.

Certified factory and field test reports, within 14 days following completion of tests. Reports shall be certified and dated and shall demonstrate that tests were successfully completed prior to shipment of equipment.

SD-07 Certificates

Equipment; G
Material; G

Certificates of compliance showing evidence of UL listing and conformance with applicable NEMA standards. Such certificates are not required if manufacturer's published data, submitted and approved, reflect UL listing or conformance with applicable NEMA standards.

Switching Equipment;

Evidence that ATS withstand current rating (WCR) has been coordinated with upstream protective devices as required by UL 1008. Upon request, manufacturer shall also provide notarized letter certifying compliance with requirements of this specification, including withstand current rating.

SD-10 Operation and Maintenance Data

Switching Equipment;
Instructions;

Six copies of operating manual outlining step-by-step procedures for system startup, operation, and shutdown. Manual shall include manufacturer's name, model number, service manual, parts list, and brief description of equipment and basic operating features. Manufacturer's spare parts data shall be included with supply source and current cost of recommended spare parts. Six copies of maintenance manual listing routine maintenance, possible breakdowns, repairs, and troubleshooting guide. Manual shall include simplified wiring and control diagrams for system as installed.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Product

Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience use shall include applications in similar circumstances and of same design and rating as specified ATS. Equipment shall be capable of being serviced by a manufacturer-authorized and trained organization that is, in the Contracting Officer's opinion, reasonably convenient to the site.

1.3.2 Nameplate

Nameplate showing manufacturer's name and equipment ratings shall be made of corrosion-resistant material with not less than 1/8 inch tall characters. Nameplate shall be mounted to front of enclosure and shall comply with nameplate requirements of NEMA ICS 2.

1.4 SERVICE CONDITIONS

ATS shall be suitable for prolonged performance under following service conditions:

a. Altitude: 2500 feet above mean sea level.

b. Relative Humidity: 50 percent maximum, continuous.

c. Temperature: Minus 1 to 115 degrees F.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH (ATS)

ATS shall be electrically operated and mechanically held in both operating positions. ATS shall be suitable for use instandby systems described in NFPA 70. ATS shall be UL listed. ATS shall be manufactured and tested in accordance with applicable requirements of IEEE C37.90.1, IEEE C37.13, IEEE C62.41, IEEE Std 602, NEMA ICS 1, NEMA ICS 2, NEMA ICS 10, UL 1008 and UL 1066. ATS shall conform to NFPA 110. To facilitate maintenance, manufacturer's instruction manual shall provide typical maximum contact voltage drop readings under specified conditions for use during periodic maintenance. Manufacturer shall provide instructions for determination of contact integrity. ATS shall be rated for continuous duty at specified continuous current rating. ATS shall have following characteristics:

a. Voltage: 480 volts ac.

b. Number of Phases: Three.

c. Number of Wires: Four.

d. Frequency: 60 Hz.

e. Poles: Three switched and solid neutral .

f. ATS WCR: Rated to withstand short-circuit current of 25,000 amperes, RMS symmetrical.

g. Nonwelding Contacts: Rated for nonwelding of contacts when used with upstream feeder overcurrent devices shown and with available fault current specified.

h. Main and Neutral Contacts: Contacts shall have silver alloy composition. Neutral contacts shall have same continuous current rating as main or phase contacts.

2.1.1 Override Time Delay

Time delay to override monitored source deviation shall be adjustable from 0.5 to 6 seconds and factory set at 1 seconds. ATS shall monitor phase conductors to detect and respond to sustained voltage drop of 25 percent of nominal between any two normal source conductors and initiate transfer action to alternate source and start engine driven generator after set time period. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Dropout voltage shall be adjustable from 75 to 98 percent of pickup value and factory set at 85 percent of nominal.

2.1.2 Transfer Time Delay

Time delay before transfer to alternate power source shall be adjustable

from 0 to 5 minutes and factory set at 0 minutes. ATS shall monitor frequency and voltage of alternate power source and transfer when frequency and voltage are stabilized. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal and factory set at 90 percent.

2.1.3 Return Time Delay

Time delay before return transfer to normal power source shall be adjustable from 0 to 30 minutes and factory set at 30 minutes. Time delay shall be automatically defeated upon loss or sustained undervoltage of alternate power source, provided that normal supply has been restored.

2.1.4 Engine Shutdown Time Delay

Time delay shall be adjustable from 0 to 30 minutes and shall be factory set at 10 minutes.

2.1.5 Exerciser

Provide a generator exerciser timer. Run times shall be user programmable. The generator exerciser shall be selectable between load transfer and enginer run only, and shall have a fail-safe feature that will retransfer the ATS to normal during the exercise period.

2.1.6 Auxiliary Contacts

Two normally open and two normally closed auxiliary contacts rated at 15 amperes at 480 volts shall operate when ATS is connected to normal power source, and two normally open and two normally closed contacts shall operate when ATS is connected to alternate source.

2.1.7 Supplemental Features

ATS shall be furnished with the following:

a. Engine start contact.

b. Test switch to simulate normal power outage.

c. Voltage sensing. Pickup voltage adjustable from 85 to 100 percent of nominal; dropout adjustable from 75 to 98 percent of pickup.

d. Time delay bypass switch to override return time delay to normal.

e. Manual return-to-normal switch.

g. Means shall be provided in the ATS to insure that motor/transformer load inrush currents do not exceed normal starting currents. This shall be accomplished with either in-phase monitoring, time-delay transition, or load voltage decay sensing methods. If manufacturer supplies an in-phase monitoring system, the manufacturer shall indicate under what conditions a transfer cannot be accomplished. If the manufacturer supplies a time-delay transition system, the manufacturer shall supply recommendations for establishing time delay. If load voltage decay sensing is supplied, the load voltage setting shall be user programmable.

2.1.8 Operator

Manual operator conforming to UL 1008 shall be provided, and shall incorporate features to prevent operation by unauthorized personnel. ATS shall be designed for safe manual operation under full load conditions. If manual operation is accomplished by opening the door, then a dead-front shall be supplied for operator safety.

2.1.9 Override Switch

Override switch shall bypass automatic transfer controls so ATS will transfer and remain connected to alternate power source, regardless of condition of normal source. If alternate source fails and normal source is available, ATS shall automatically retransfer to normal source.

2.1.10 Green Indicating Light

A green indicating light shall supervise/provide normal power source switch position indication and shall have a nameplate engraved NORMAL.

2.1.11 Red Indicating Light

A red indicating light shall supervise/provide alternate power source switch position indication and shall have a nameplate engraved ALTERNATE.

2.2 ENCLOSURE

ATS and accessories shall be installed in wall-mountedor free-standing, floor-mounted, ventilated NEMA ICS 6, Type 1 , smooth sheet metal enclosure constructed in accordance with applicable requirements of UL 1066 and/or UL 1008. Intake vent shall be screened and filtered. Exhaust vent shall be screened. Door shall have suitable hinges, locking handle latch, and gasketed jamb. Metal gauge shall be not less than No. 14. Enclosure shall be equipped with at least two approved grounding lugs for grounding enclosure to facility ground system using No. 4 AWG copper conductors. Factory wiring within enclosure and field wiring terminating within enclosure shall comply with NFPA 70. If wiring is not color coded, wire shall be permanently tagged or marked near terminal at each end with wire number shown on approved detail drawing. Terminal block shall conform to NEMA ICS 4. Terminals shall be arranged for entrance of external conductors from bottom of enclosure as shown. Main switch terminals, including neutral terminal if used, shall be pressure type suitable for termination of external copperconductors shown.

2.2.1 Construction

Enclosure shall be constructed for ease of removal and replacement of ATS components and control devices from front without disconnection of external power conductors or removal or disassembly of major components.

2.2.2 Cleaning and Painting

Both the inside and outside surfaces of an enclosure, including means for fastening, shall be protected against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means. Protection is not required for metal parts that are inherently resistant to corrosion, bearings, sliding surfaces of hinges, or other parts where such protection is impractical. Finish shall be manufacturer's standard material, process,

and color and shall be free from runs, sags, peeling, or other defects. An enclosure marked Type 1 shall be acceptable if there is no visible rust at the conclusion of a salt spray (fog) test using the test method in ASTM B 117, employing a 5 percent by weight, salt solution for 24 hours.

2.3 TESTING

2.3.1 Factory Testing

A prototype of specified ATS shall be factory tested in accordance with UL 1008. In addition, factory tests shall be performed on each ATS as follows:

a. Insulation resistance test to ensure integrity and continuity of entire system.

b. Main switch contact resistance test.

c. Visual inspection to verify that each ATS is as specified.

d. Mechanical test to verify that ATS sections are free of mechanical hindrances.

e. Electrical tests to verify complete system electrical operation and to set up time delays and voltage sensing settings.

2.3.2 Factory Test Reports

Manufacturer shall provide three certified copies of factory test reports.

PART 3 EXECUTION

3.1 INSTALLATION

ATS shall be installed as shown and in accordance with approved manufacturer's instructions.

3.2 INSTRUCTIONS

Manufacturer's approved operating instructions shall be permanently secured to cabinet where operator can see them. One-line and elementary or schematic diagram shall be permanently secured to inside of front enclosure door.

3.3 SITE TESTING

Following completion of ATS installation and after making proper adjustments and settings, site tests shall be performed in accordance with manufacturer's written instructions to demonstrate that each ATS functions satisfactorily and as specified. Contractor shall advise Contracting Officer not less than 5 working days prior to scheduled date for site testing, and shall provide certified field test reports within 2 calendar weeks following successful completion of site tests. Test reports shall describe adjustments and settings made and site tests performed. Minimum operational tests shall include the following:

a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.

b. Power failure of normal source shall be simulated by opening

upstream protective device. This test shall be performed a minimum of five times.

c. Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.

d. Low phase-to-ground voltage shall be simulated for each phase of normal source.

e. Operation and settings shall be verified for specified ATS features, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.

f. Manual and automatic ATS functions shall be verified.

-- End of Section --

SECTION 16415A

ELECTRICAL WORK, INTERIOR
06/02

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 basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1	(1991; C78.1a; R 1996) Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
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 C78.1355	(1989) Electric Lamps - 150-Watt, 55-Volt S55 High-Pressure Sodium Lamps
ANSI C78.1375	(1996) 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1996) 1000-Watt, M47 Metal-Halide Lamps
ANSI C82.1	(1997) Specifications for Fluorescent Lamp Ballasts \$18.00$\F\X Addenda D & E
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(2000) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) \$31.00$\F

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA MG 1	(1998) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA PB 1	(1995) Panelboards
NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1998) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA WD 1	(1999) General Requirements for Wiring Devices
NEMA WD 6	(1997) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Life Safety Code
NFPA 70	(2002) National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 18	Industrial, Scientific, and Medical Equipment

UNDERWRITERS LABORATORIES (UL)

UL 1004	(1994; Rev thru Nov 1999) Electric Motors
UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1570	(1995; Rev thru Nov 1999) Fluorescent Lighting Fixtures
UL 1572	(1995; Rev thru Nov 1999) High Intensity Discharge Lighting Fixtures
UL 1660	(2000) Liquid-Tight Flexible Nonmetallic Conduit
UL 20	(1995; Rev thru Oct 1998) General-Use Snap Switches
UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486C	(1997; Rev thru Aug 1998) Splicing Wire Connectors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(1996; Rev thru Jan 1999) Attachment Plugs and Receptacles
UL 50	(1995; Rev thru Nov 1999) Enclosures for Electrical Equipment
UL 506	(1994; R Oct 1997) Specialty Transformers
UL 508	(1999) Industrial Control Equipment
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Cable and Conduit
UL 542	(1999) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 6	(1997) Rigid Metal Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev thru Apr 1998) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 67	(1993; Rev thru Oct 1999) Panelboards
UL 674	(1994; Rev thru Oct 1998) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(1995; Rev thru Mar 1999) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 83	(1998; Rev thru Sep 1999) Thermoplastic-Insulated Wires and Cables
UL 844	(1995; Rev thru Mar 1999) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1995; Rev thru Nov 1999) Motor Control Centers
UL 854	(1996; Rev Oct 1999) Service-Entrance Cables
UL 869A	(1998) Reference Standard for Service Equipment
UL 886	(1994; Rev thru Apr 1999) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 98	(1994; Rev thru Jun 1998) Enclosed and Dead-Front Switches

1.2 GENERAL

1.2.1 Rules

Bldgs 3002, 3019, 3046, 3058, and 3059, are covered by the contents of this specification. The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be carefully coordinated with mechanical or structural features prior to installation and positioned.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.2.3.2 Hazardous Locations

Hazardous locations are defined on the plans. All wiring inside these area shall comply with the NEC requirements.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 Nameplates

1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch High Letters	Minimum 1/8 inch High Letters
Panelboards	Control Power Transformers
Starters	Control Devices
Safety Switches	Instrument Transformers

Minimum 1/4 inch High Letters	Minimum 1/8 inch High Letters
Motor Control Centers	
Transformers	
Equipment Enclosures	
Motors	

Each panel, section, or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Interior Electrical Equipment; G.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

a. Transformers.

b. Motors

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and

conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Manufacturer's Catalog; G.

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

Material, Equipment, and Fixture Lists; G.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures; G.

Installation procedures for rotating equipment, and transformers. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

As-Built Drawings; G.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on

the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

Onsite Tests; G.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-06 Test Reports

Factory Test Reports; G.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Field Test Plan; G.

A detailed description of the Contractor's proposed procedures for onsite test submitted 30 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; G.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

h. Final position of controls and device settings.

SD-07 Certificates

Materials and Equipment; G.

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts,

and components.

2.1 CABLES AND WIRES

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, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.1.1 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 meet manufacturer's requirements.

2.1.2 Aluminum Conductors

Aluminum conductors shall not be used.

2.1.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW 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.

2.1.4 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.

2.1.5 Service Entrance Cables

Service entrance (SE) and underground service entrance (USE) cables, UL 854.

2.2 CIRCUIT BREAKERS

2.2.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489for circuit breakers. Circuit breakers may be installed in panelboards .

2.2.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external

handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.2.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.2.1.3 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection.

2.3 CONDUIT AND TUBING

2.3.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.3.2 Electrical Plastic Tubing and Conduit

NEMA TC 2.

2.3.3 Flexible Conduit, Steel

Liquid tight, UL 360, and UL 1660.

2.3.4 Rigid Metal Conduit

UL 6.

2.3.5 Rigid Plastic Conduit

NEMA TC 2, UL 651 and UL 651A.

2.4 CONDUIT AND DEVICE BOXES AND FITTINGS

2.4.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.4.2 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.4.3 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.4.4 Fittings for Conduit and Outlet Boxes

UL 514B.

2.4.5 Fittings For Use in Hazardous (Classified) Locations

UL 886.

2.4.6 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.5 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.6 CONNECTORS, WIRE PRESSURE

2.6.1 For Use With Copper Conductors

UL 486A.

2.7 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.7.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 8 feet in length of the sectional type driven full length into the earth.

2.8 ENCLOSURES

NEMA ICS 6 or UL 698 for use in hazardous (classified) locations unless otherwise specified.

2.8.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.8.2 Circuit Breaker Enclosures

UL 489.

2.9 LIGHTING FIXTURES, LAMPS, BALLASTS, EMERGENCY EQUIPMENT, CONTROLS AND ACCESSORIES

The following specifications are supported and supplemented by information and details on the drawings. Additional fixtures, if shown, shall conform to this specification. Lighting equipment installed in classified hazardous locations shall conform to UL 844. Lamps, lampholders, ballasts, transformers, electronic circuitry and other lighting system components shall be constructed according to industry standards. Equipment shall be tested and listed by a recognized independent testing laboratory for the expected installation conditions. Equipment shall conform to the standards

listed below.

2.9.1 Lamps

Lamps shall be constructed to operate in the specified fixture, and shall function without derating life or output as listed in published data. Lamps shall meet the requirements of the Energy Policy Act of 1992.

b. Fluorescent lamps shall be green-tipped and shall have color temperature 3,500degrees Kelvin. They shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used. Fluorescent lamps, including spares, shall be manufactured by one manufacturer to provide for color and performance consistency. Fluorescent lamps shall comply with ANSI C78.1. Fluorescent tube lamp efficiencies shall meet or exceed the following requirements.

T8, 32 watts	(4' lamp)	2800 lumens

(1) Linear fluorescent lamps, unless otherwise indicated, shall be 4 feet long 32 watt T8, 265 mA, with minimum CRI of 75. Lamps of other lengths or types shall be used only where specified or shown. Lamps shall deliver rated life when operated on rapid start ballasts .

c. High intensity discharge lamps, including spares, shall be manufactured by one manufacturer in order to provide color and performance consistency. High intensity discharge lamps shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used and shall have wattage, shape and base as shown. High intensity discharge lamps, unless otherwise shown, shall have medium or mogul screw base and minimum starting temperature of -20 degrees F. Metal halide lamps, unless otherwise shown, shall have minimum CRI of 65; color temperature of 4,300 degrees Kelvin; shall be -BU configuration if used in base-up position; and shall be -H or high output configuration if used in horizontal position. Lamps shall comply with all applicable ANSI C78.1350, ANSI C78.1351, ANSI C78.1352, ANSI C78.1355,ANSI C78.1375, and ANSI C78.1376.

2.9.2 Ballasts and Transformers

Ballasts or transformers shall be designed to operate the designated lamps within their optimum specifications, without derating the lamps. Lamp and ballast combinations shall be certified as acceptable by the lamp manufacturer.

b. Fluorescent ballasts shall comply with ANSI C82.1 and shall be mounted integrally within fluorescent fixture housing unless otherwise shown. Ballasts shall have maximum current crest factor of 1.7; high power factor; Class A sound rating; maximum operating case temperature of 77 degrees F above ambient; and shall be rated Class P. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture. A single

ballast may be used to serve multiple fixtures if they are continuously mounted, identically controlled and factory manufactured for that installation with an integral wireway.

(2) Electronic fluorescent ballasts shall comply with 47 CFR 18 for electromagnetic interference. Ballasts shall withstand line transients per IEEE C62.41, Category A. Ballasts shall have total harmonic distortion between 10 and 20%; minimum frequency of 20,000Hz; filament voltage between 2.5 and 4.5 volts; maximum starting inrush current of 20 amperes; and shall comply with the minimum Ballast Efficacy Factors shown in the table below. Minimum starting temperature shall be 50 degrees F. Ballasts shall carry a manufacturer's full warranty of three years, including a minimum $10 labor allowance per ballast.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL VOLTAGE	NUMBER OF LAMPS	MINIMUM BALLAST EFFICACY FACTOR
32W T8	rapid start linear & U-tubes	120 or 277 V	1	2.54
			2	1.44
			3	0.93
			4	0.73

c. High intensity discharge ballasts shall comply with UL 1029 and, if multiple supply types, with ANSI C82.4. Ballasts shall have minimum ballast factor of 0.9; high power factor; Class A sound rating; and maximum operating case temperature of 77 degrees F above ambient.

(1) Electronic high intensity discharge ballasts shall be constant wattage autotransformer type; shall have less than 10% ballast loss; shall have total harmonic distortion between 10 and 20%; and shall have a minimum starting temperature of 0 degrees F.

2.9.3 Fixtures

Fixtures shall be in accordance with the size, shape, appearance, finish, and performance shown. Unless otherwise indicated, lighting fixtures shall be provided with housings, junction boxes, wiring, lampholders, mounting supports, trim, hardware and accessories for a complete and operable installation. Extruded aluminum fixtures shall have minimum wall thickness of 0.125 inches. Plastic lenses shall be 100% virgin acrylic or as shown.

b. Fluorescent fixtures shall comply with UL 1570. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles. Housings shall be constructed to include grounding necessary to start the lamps. Medium bi-pin lampholders shall be twist-in type with positive locking position.

c. High intensity discharge fixture shall comply with UL 1572. Recessed ceiling fixtures shall comply with NEMA LE 4. Reflectors shall be anodized aluminum. Fixtures for horizontal lamps shall have position oriented lampholders. Lampholders shall be pulse-rated to 5,000 volts. Fixtures indicated as classified or rated for hazardous locations or special service shall be designed and independently tested for the environment in which they are installed. Ballasts shall be integral to fixtures and shall be accessible without the use of special tools. Remote ballasts shall be encased and potted. Lamps shall be shielded from direct view with a UV absorbing material such as tempered glass, and shall be circuited through a cut-off switch which will shut off the lamp circuit if the lens is not in place.

2.9.4 Lampholders, Starters, and Starter Holders

UL 542

2.10 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004for motors; NEMA MG 10 for energy management selection of polyphase motors; and UL 674 for use of motors in hazardous (classified) locations. In addition to the standards listed above, motors shall be provided with efficiencies as specified in the table "MINIMUM NOMINAL EFFICIENCIES" below.

2.10.1 Rating

The horsepower rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

2.10.2 Motor Efficiencies

All permanently wired polyphase motors of 1 hp or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 1 hp or more with open, drip proof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. Motor efficiencies indicated in the tables apply to general-purpose, single-speed, polyphase induction motors. Applications which require definite purpose, special purpose, special frame, or special mounted polyphase induction motors are excluded from these efficiency requirements. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

MINIMUM NOMINAL MOTOR EFFICIENCIES
OPEN DRIP PROOF MOTORS

kW	1200 RPM	1800 RPM	3600 RPM
0.746	82.5	85.5	80.0

MINIMUM NOMINAL MOTOR EFFICIENCIES

1.12	86.5	86.5	85.5
1.49	87.5	86.5	86.5
2.24	89.5	89.5	86.5
3.73	89.5	89.5	89.5
5.60	91.7	91.0	89.5
7.46	91.7	91.7	90.2
11.2	92.4	93.0	91.0
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6
37.3	94.1	94.5	93.6
44.8	95.0	95.0	94.1
56.9	95.0	95.0	94.5
74.6	95.0	95.4	94.5
93.3	95.4	95.4	95.0
112.0	95.8	95.8	95.4
149.0	95.4	95.8	95.4
187.0	95.4	96.2	95.8
224.0	95.4	95.0	95.4
261.0	94.5	95.4	95.0
298.0	94.1	95.8	95.0
336.0	94.5	95.4	95.4
373.0	94.5	94.5	94.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

kW	1200 RPM	1800 RPM	3600 RPM
0.746	82.5	85.5	78.5
1.12	87.5	86.5	85.5
1.49	88.5	86.5	86.5
2.24	89.5	89.5	88.5
3.73	89.5	89.5	89.5
5.60	91.7	91.7	91.0
7.46	91.7	91.7	91.7
11.2	92.4	92.4	91.7
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6
37.3	94.1	94.5	94.1
44.8	94.5	95.0	94.1
56.9	95.0	95.4	94.5
74.6	95.4	95.4	95.0
93.3	95.4	95.4	95.4
112.0	95.8	95.8	95.4
149.0	95.8	96.2	95.8
187.0	95.6	96.2	95.9
224.0	95.4	96.1	95.8
261.0	94.5	96.2	94.8
298.0	94.5	95.8	94.5
336.0	94.5	94.5	94.5
373.0	94.5	94.5	94.5

MINIMUM NOMINAL MOTOR EFFICIENCIES
OPEN DRIP PROOF MOTORS

TOTALLY ENCLOSED FAN-COOLED MOTORS

HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	80.0
1.5	86.5	86.5	85.5
2	87.5	86.5	86.5
3	89.5	89.5	86.5
5	89.5	89.5	89.5
7.5	91.7	91.0	89.5
10	91.7	91.7	90.2
15	92.4	93.0	91.0
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	93.6
60	95.0	95.0	94.1
75	95.0	95.0	94.5
100	95.0	95.4	94.5
125	95.4	95.4	95.0
150	95.8	95.8	95.4
200	95.4	95.8	95.4
250	95.4	96.2	95.8
300	95.4	95.0	95.4
350	94.5	95.4	95.0
400	94.1	95.8	95.0
450	94.5	95.4	95.4
500	94.5	94.5	94.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	78.5
1.5	87.5	86.5	85.5
2	88.5	86.5	86.5
3	89.5	89.5	88.5
5	89.5	89.5	89.5
7.5	91.7	91.7	91.0
10	91.7	91.7	91.7
15	92.4	92.4	91.7
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	94.1
60	94.5	95.0	94.1
75	95.0	95.4	94.5
100	95.4	95.4	95.0
125	95.4	95.4	95.4
150	95.8	95.8	95.4
200	95.8	96.2	95.8
250	95.6	96.2	95.9
300	95.4	96.1	95.8
350	94.5	96.2	94.8
400	94.5	95.8	94.5
450	94.5	94.5	94.5
500	94.5	94.5	94.5

2.11 MOTOR CONTROLS

2.11.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

2.11.2 Motor Starters

2.11.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.11.4 Low-Voltage Motor Overload Relays

2.11.4.1 General

Thermal overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70. Slow units shall be used for motor starting times from 8 to 12 seconds.

2.11.4.2 Construction

Manual reset type thermal relay shall be melting alloy or bimetallicconstruction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.11.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

2.11.5 Automatic Control Devices

2.11.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches)

which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepower rating.

2.11.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

2.11.5.3 Manual/Automatic Selection

a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.

b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.

c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

2.12 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.13 RECEPTACLES

2.13.1 Standard Grade

UL 498.

2.13.2 NEMA Standard Receptacle Configurations

NEMA WD 6.

a. Duplex, 20-Ampere, 125 Volt

20-ampere, non-locking: NEMA type 5-20R.

2.14 Service Entrance Equipment

UL 869A.

2.15 SPLICE, CONDUCTOR

UL 486C.

2.16 SNAP SWITCHES

UL 20.

2.17 TAPES

2.17.1 Plastic Tape

UL 510.

2.17.2 Rubber Tape

UL 510.

2.18 TRANSFORMERS

Single--phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated.

2.18.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation system for transformers rated 10 kVA and less, with temperature rise not exceeding 150degrees C under full-rated load in maximum ambient temperature of 40 degrees C.

a. 600 Volt or Less Primary:

NEMA ST 20, UL 506, general purpose, dry-type, self-cooled, unventilated. Transformers shall be provided in NEMA 3R enclosure. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.18.2 Average Sound Level

The average sound level in decibels (dB) of transformers shall not exceed the following dB level at 12 inches for the applicable kVA rating range listed unless otherwise indicated:

kVA Range	dB Sound Level
1-50	50

2.19 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, 2 additional rods not less than 6 feet on centersshall be driven with the first rod.

3.1.2 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in electrical metallic tubing when installed inside Bldg 3059. Galvanized rigid steel conduit and galvanized rigid steel conduit sweeps shall be used where underground PVC conduit begins to stup-up from below grade.. Provide galvanized, rigid steel conduit for all exposed, exterior conduit. Rigid PVC conduit shall be used for grounding electrode conductors.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Electrical metallic tubing (EMT) may be installed only within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

3.2.1.1 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor.

3.2.1.2 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel. Rigid steel conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

3.2.1.3 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

3.2.1.4 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.5 Supports

Metallic conduits and tubing,and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, threaded C-clamps, beam clamps. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. By toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. Raceways shall not be supported

using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.6 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.2 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.2.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.2.2 Use of Aluminum Conductors in Lieu of Copper

Aluminum conductors shall not be used.

3.2.2.3 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as

follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).
277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).
120/240-volt, 1-phase: Black and red.

b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.

c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways shall be listed for the intended use when located in normally wet locations, when flush or surface mounted on outside of exterior surfaces, or when located in hazardous areas. Boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel.

3.3.3 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of cast-metal. .Screws shall be of metal with countersunk heads, in a color to match the finish of the plate.

3.5 RECEPTACLES

3.5.1 Duplex, 20-ampere, 125 volt

Duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory to match color of switch handles in the same room and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke.

3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be ivory . Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere277-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red.

3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the enclosed molded-case circuit breaker type with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

3.8 PANELBOARDS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper. A loadcenter type panel is not acceptable.

3.8.1 Panelboards

Panelboards shall be circuit breaker equipped as indicated on the drawings.

3.9 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 5 feet beyond the building wall and 2 feet below finished grade, for interface with the exterior service lateral conduits. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements of Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

3.10 MOTORS

Each motor shall conform to the hp and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

3.11 MOTOR CONTROL

Each motor or group of motors requiring a single control and not controlled from a motor-control center shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control

circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.11.1 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.12 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. Switches shall disconnect all ungrounded conductors.

3.13 LIGHTING FIXTURES, LAMPS AND BALLASTS

This paragraph shall cover the installation of lamps, lighting fixtures and ballasts in interior or building mounted applications.

3.13.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15% of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. 10% spare lamps of each type, from the original manufacturer, shall be provided.

3.13.2 Lighting Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on the drawings. Illustrations shown on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved.

3.13.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

3.13.3 Ballasts

Remote type ballasts or transformers, where indicated, shall be mounted in a well ventilated, easily accessible location, within the maximum operating distance from the lamp as designated by the manufacturer.

3.14 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in wet locations.

3.14.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

3.15 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

3.16 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Government.

3.17 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 20 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.17.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.17.2 Ground-Resistance Tests

The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

3.17.3 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.17.3.1 Service Entrance Cable Tests

a. Continuity test.

b. Insulation resistance test.

3.17.4 Motor Tests

a. Phase rotation test to ensure proper directions.

b. Operation and sequence of reduced voltage starters.

c. High potential test on each winding to ground.

d. Insulation resistance of each winding to ground.

e. Vibration test.

f. Dielectric absorption test on motor and starter.

3.18 OPERATING TESTS

After the installation is completed, and at such time as the Contracting

Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

3.19 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 16900

INSTRUMENT INSTALLATION
08/95

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 basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A-269	(1990) Seamless and Welded Authentic Stainless Steel Tubing for General Service

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA RP 7.1	(1956) Pneumatic Control Circuit Pressure Test
ISA RP 60.9	(1981) Piping Guide for Control Centers

1.2 GENERAL REQUIREMENTS

This specification together with Technical Data Sheets (Appendix A), Instrument Lists, Location and Routing drawings, Installation Details and related drawings, provides the requirements for installation, inspection and testing of field instrumentation, air supply piping, transmission and control tubing, and instrument process piping, for an industrial plant.

Quantities of materials required for installation shall be determined from instrument drawings, specifications, standards, and field observation.

1.2.1 Hazardous Environment

System components located in fire or explosion hazard areas shall be rated and installed according to Chapter 5 of NFPA 70 and as shown.

1.2.2 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10%, and 60 Hz, plus or minus 2%.

1.2.3 Instrument Tags

Each instrument will be identified with a 316 SS instrument tag. Tags should be firmly attached with stainless steel wire. Tags to be labeled with 1/8" high lettering shwoing designated instrument tag number.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL

DESCRIPTIONS:

SD-08 Manufacturer's Instructions

Manufacturers' Recommendations; G.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be submitted prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Operation and Maintenance Instructions; G.

Instructions shall include the manufacturer's name, service manual, parts list, and a brief description of equipment, components, and their basic operating features. A copy of the maintenance instructions listing regular maintenance procedures, possible system failures, a troubleshooting guide for repairs, and simplified diagrams for the system as installed shall be provided where applicable.

Components with Technical Data Sheets (Appendix A); G

Manufacturer's operation and maintenance manuals And Verification Testing where applicable.

1.4 DELIVERY, HANDLING, AND STORAGE

The instruments and accessories shall be adequately and securely packed for shipment to the installation site.

Instruments and accessories shall be stored in the original shipping containers, above ground level, in bins or racks free from rain or water contact, in a clean dry sheltered area where ambient temperatures remain between 32F and 120F.

All identification tags shall be left securely attached to the instrument and shall not be removed during installation. Care shall be taken to assure that the miscellaneous accessories are stored with the instrument with which they are associated.

Control valves, relief valves, rotameters, level devices, and other instruments that will be installed in pipe lines or vessels are to be protected such that foreign matter cannot enter the end fittings, diaphragms, tubes or other internal parts of the instrument.

Tubing, pipe, fittings, and valves used in the installation of pneumatic instruments shall be kept free of moisture and foreign matter. All ends shall be kept sealed during storage to assure that moisture and foreign matter do not enter.

PART 2 PRODUCTS

2.1 COMPONENTS

The Technical Data Sheets (Appendix A) cover the technical requirements for engineering, design, manufacture, and performance of various instruments.

The equipment furnished according to this specification shall conform to

the requirements contained herein and as specified in the Technical Data Sheets.

2.2 CONDUIT, FITTINGS AND ENCLOSURES

Conduit shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR and Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown on the Instrument Installation Details.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Installation of Instruments

Instruments shall be mounted at the locations and elevations shown on the Piping Layout and Instrument Location or Electrical Drawings, giving easy access for maintenance and calibration so that test jacks, adjustments, and the like are reached from the top, front, or side and not from the bottom of the instrument.

Should the designated location or elevation of an instrument be found impractical or to result in interference with other equipment, Contractor shall select an alternate arrangement with Purchaser's approval.

Instruments and primary instrument lines shall be installed from the root valve as shown on the Instrument Installation Details. These details shall be used as a guide for modifying, revising, or developing new details for instruments and installations not included as part of these specifications.

Should the designated instrument connections on the piping layout drawings differ from those on the instrument, as furnished, the Contractor shall revise the connections to conform to the intent of the Instrument Installation Details.

Instruments shall be mounted plumb and level and in upright position unless otherwise indicated on the drawings. Impulse piping or electrical conduits shall not be used for support of instruments or accessories.

Field mounted instruments shall be mounted on racks, floor stands, structural steel, or masonry structures. Instruments shall be grouped together by systems wherever possible. Tubing runs greater than 50 feet should be avoided. Instruments shall not be mounted on vibrating equipment. Where instruments are to be mounted on fire-proofed members, the installer shall assure that the mounting hardware is in place prior to fire proofing. Mounting hardware attached to masonry shall be painted prior to mounting, to eliminate rust discoloration of the masonry.

Instrument cases shall be positioned such that doors may be fully opened, covers are fully removable, vent holes are not blocked, and adjustment screws, valves, wiring, and piping connections are accessible.

Instruments shall not be mounted adjacent to hot or vibrating equipment (except where directly attached to vessels) and shall not be mounted under drain points nor immediately above vent points.

Pressure gages, meters, transmitters, etc. shall be mounted for operating, calibration, and maintenance convenience near the equipment they serve. Pressure gages shall have a shut-off valve between the gage and the line as

detailed in the Instrument Installation Details. Gages on steam lines shall have a syphon installed ahead of the gage.

Pressure gages, switches, transmitters, etc. shall be installed as close as possible to the process connection with suitable block and bleed valves between the instrument and process tap. Pressure gages furnished with syphons or "pigtail" condensate seals, used for steam or other hot condensible vapors, shall be mounted above the process connection to allow for condensate drainage to the process. Pressure transmitters used in liquid or steam service shall be mounted below the process connection with all lines sloping towards the instrument to permit self venting. Transmitters that are remotely mounted from the process tap shall be provided with a block valve at the tap and another close to the instrument.

Orifice plates, control valves, and other in-line instruments shall not be installed until pipe lines have been pressure tested, flushed, and cleaned. Orifice plates shall be accurately centered in the pipe and installed with the sharp flat edge on the upstream side.

Control valve handwheels shall be positioned so that they are located on the accessible side of the valve. Positioners shall be mechanically free to operate with the instrument air turned on and the bypass closed.

Temperature sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.

3.1.2 Instrument Racks

Transmitters, current-pneumatic transducers, and other instruments located in close proximity to one another may be mounted on an instrument rack instead of separate supports. The rack shall be rigid and self supporting, framed with angle iron, primed, and painted with rust inhibitive paint. All instruments shall be piped to air supply manifolds and wired to terminal strips, as required. The rack shall be installed as close as possible to the process area so as to minimize the primary tube runs.

Instruments that require an air supply shall be supplied from a common manifold. The manifold shall be one inch with 1/2 inch takeoff to each user. Each takeoff shall have a 1/2 inch packless shut-off valve to isolate the instrument for service.

Wiring for electronic instruments shall be run in conduit or cable tray, and terminated at barrier type terminal strips. The barrier strips shall have screw terminals for No. 12 AWG wire minimum. Instrument wiring shall be cable tray rated No. 16 AWG twisted shielded pairs rated at 300 volts with PVC insulation. 120VAC control wiring shall be cable tray rated No. 14 AWG twisted pair, rated at 600 volts with PVC insulation.

3.1.3 Installation of Pneumatic Piping and Tubing

Instrument air piping shall include takeoff valves, filter regulators, and pressure indicators as required on projected drawings.

Piping for pneumatic primary measuring instruments and controls shall be arranged, routed, and installed in accordance with best engineering, efficient, functioning, and pleasing appearance without obstructing access for operation and maintenance. Where feasible, instrumentation and control piping shall be grouped and run together.

The installation of pneumatic piping and tubing shall conform to ISA RP 60.9 and the following requirements.

Lines in the air supply distribution system should be sized such that the maximum pressure drop from the air dryer to the most remote air user does not exceed 5 psi with 100 psig supply, when all users are taking air at approximately 2 to 5 SCFM. Branch piping to individual instrument shall be a minimum of 1/2 inch NPS. Air supply to individual instrument supplied from a common manifold or header may be either 1/4 or 3/8 OD stainless-steel tubing.

Header, branch, and sub-branch piping material for the Instrument Air System shall be in accordance with the applicable piping specification. Continuations from the sub-branch to the instrument shall be in accordance with the Instrument Installation Details.

Threaded fittings shall be made up using Teflon tape. Care shall be taken to assure that the tape is applied to the male thread only and does not enter the inside wall of the pipe.

Prior to connecting instrument air piping to the instrument or accessory, the lines shall be pneumatically blown free of moisture, loose scale, and foreign matter.

3.1.4 Installation of Transmission and Control Tubing

Instrument tubing shall be adequately supported with Unistrut type supports. Adequate support shall consist of supporting the tubing at the following spacings:

Vertical: Maximum 36" centers
Horizontal: Maximum 24" centers

Tubing shall be installed with sufficient flexibility to prevent undue stresses in tubing and at end connections caused by thermal expansion or vibration. Tubing shall not be fastened directly to concrete.

Where tubing requires bending, bends shall be made using a bender sized for the tubing being bent, and according to tubing manufacturer's instructions. Care shall be taken to assure that a reasonable bending radius is maintained and tubing is not flattened or pinched.

Cutting of tubing shall be done with a commercial tubing cutter. Ends shall be cut 90 to the wall of the tubing and shall be reamed to the original inside diameter of the tube. All chips or shavings shall be removed.

Tubing fittings for transmission and control tubing shall be as specified herein. Tubing fittings shall be made up using teflon tape. Thread compound shall not be used. Fittings shall be made up and checked according to fitting manufacturer's instructions.

Prior to tightening the tubing collar to the fitting, care shall be taken to assure that the tubing end is square, inserted fully through the ferrule into the tube fitting, and is properly aligned with the fitting. Tightening of the collar shall be done with the proper sized wrench.

Wherever possible, single tubes shall be grouped and run together in small

carrier channels. Coiled tubing shall be fully straightened before installation.

Routing of single tubes and groups of single tubes shall be determined in the field. Care shall be taken in planning the installation that tubes are orderly grouped and their carrier channels are routed as directly as possible to the instruments.

Tubing bends shall be made with an approved tubing bender, and terminations shall be made as discussed under bundled tubing installations above.

Carrier channels shall be rigidly mounted to permanent structural members and shall not be bracketed to equipment, which may be removed for maintenance purposes.

Tubing shall be securely clamped to the carrier assuring that the tube is not pinched or damaged when clamped in place.

Where cutting of the carrier channel is required, raw edges shall be painted or coated with a material equal to the original finish.

3.1.5 Installation of Instrument Process and Sampling Piping (or Tubing)

The extent and arrangement of process piping or tubing beyond the primary block valve shall be as indicated on the Instrument Installation Details. Materials of construction for impulse piping or tubing and associated valves and fittings are indicated on the Instrument Installation Details and specified herein.

All process connecting lines shall be pneumatically blown free of moisture, loose scale, and foreign matter prior to connecting to the primary side of the instrument.

Where process connecting lines are indicated to be of rigid pipe construction, care shall be taken to assure that no stresses or strains are exerted on the instrument, due to improperly aligned or poorly supported piping. Impulse piping to remote located instruments shall be securely bracketed to existing members to relieve any vibration at the instrument.

Threaded fittings for impulse lines of rigid pipe or tubing shall be made up using Teflon tape. Where temperatures exceed 450F, thread compounds suitable for high temperature service shall be used.

Where tubing and tube fittings of the nonflare compression type are used, care shall be taken to assure that the tubing is inserted fully into the fitting prior to tightening.

Process connecting lines shall be sloped in accordance with the Instrument Installation Details.

Wherever thermal expansion movement is indicated, the primary line shall be installed so that this movement is taken into consideration. The usual procedure is to provide either a 6 in. "Vee" bend at the point of expansion, or a 3-ring loop (6 in. diam min) on the line at the point of expansion.

Wherever vibration is indicated, a coil of two or three loops shall be provided in a horizontal plane in the primary line at the pressure source connection. Rubber inserts of 1/8 in. thick gasket material shall be

placed between each tube clamp and tubing at all points affected by vibration.

3.1.6 Materials for Instrument Piping and Tubing

3.1.6.1 Primary Instrument and Sampling Tubing

All tubing for this service shall have a minimum outside diameter of «-inch (except where noted) and shall conform to the following requirements:

ASTM A-269 Grade TP316
Seamless Stainless Steel
Cold Drawn Fully Annealed
Dimensions:

Actual O.D. Inches	Wall Thickness Inches
3/8	0.065
1/2	0.065

The supplier of the tubing shall verify that all requirements of the material specifications have been complied with and that the tubing meets these requirements.

Weld repairs shall not be allowed on the tubing.

3.1.6.2 Instrument Air Supply and Pneumatic Control Tubing

All tubing for this service shall conform to the following requirements:

ASTM A-269, Grade TP316
Seamless Stainless Steel
Cold Drawn Fully Annealed
Dimensions:

Actual O.D. Inches	Wall Thickness Inches
1/4	0.035
3/8	0.035
1/2	0.049
5/8	0.049
3/4	0.065
1	0.065

The supplier of the tubing shall verify that requirements of the material specification have been complied with and that the tubing meets these requirements.

3.1.6.3 Stainless Steel Fittings

Compression Type Fittings: Fittings for those joints, where connection of a primary sensing line or a sampling line is made, shall be furnished in accordance with the following specifications:

Tube Size, O.D. inches: 1/4, 3/8, 1/2, 3/4
Type: Compression
Rating: 5500 psi @ 72F; 3200 psi @ 1000F

Material: 316 Stainless Steel

The supplier of the compression type fittings shall certify that the fittings are suitable for use with 316 stainless-steel tubing that is fabricated per ASTM A-269 with a maximum Rockwell Hardness of Rb90.

3.1.6.4 Brass Fittings

Compression Type Fittings: Fittings for those joints, where connection of an air supply line or a pneumatic control line to an instrument, or an air supply regulator is made, shall be furnished in accordance with the following specifications:

Tube Size, O.D. inches: 1/4, 3/8, 1/2
Type: Compression
Material: Brass

3.1.6.5 Globe Valves

The valves applicable to this section are the instrument valve, the test valve, and the backup root valve (when specified). The valves for these applications shall be furnished in accordance with the following specifications:

Rating: 6,000 psi @ 100F, 3000 psi @ 1,000F
Body Design: Globe
Body Material: 316 Stainless Steel
Construction: Screwed Bonnet, 316 Stainless Steel
Plug and Stem: Stainless Steel
Seat: Stainless Steel
Packing: Grafoil or equal
End Connections: Threaded
Sizes in inches: 1/4, 3/8, 1/2, 5/8, 3/4

Weld repair of defects on the pressure boundaries of a valve body shall not be allowed.

3.1.6.6 Needle Valves

The valves applicable to this section are the sample regulating valves. These valves shall be furnished in accordance with the following specifications:

Rating: 4,000 psi @ 100F, 2,500 psi @ 700F
Body Design: Needle
Body Material: 316 Stainless Steel
Construction: Screwed bonnet, 316 stainless steel
Plug and Stem: Stainless Steel
Seat: Stainless Steel
Packing: Teflon
Sizes: 1/4, 3/8, 1/2
End Connections: Threaded

3.1.6.7 Brass Valves

Instrument Air Supply: The valves applicable to this section may be the individual instrument air supply shut-off valves where brass is specified, they shall be furnished in accordance with the following specifications:

Working Pressure: 3,500 psi @ 72F
Body Material: Brass
Construction: Screwed Bonnet
Stem: Stainless Steel
Sizes: 1/4, 3/8, 1/2 inch
End Connections: Pipe to Pipe, Pipe to Tube, Tube to Tube

3.2 FIELD QUALITY CONTROL

3.2.1 Flushing, Purging, and Testing

Pneumatic piping and tubing shall be cleaned of all foreign material by pressurizing one end with clean, dry, oil free 20 psig air. The air shall flow freely out of the other end to indicate that the line is not plugged. Lines showing evidence of grease or oil shall be solvent cleaned.

Piping and tubing for instrument pressure leads to process mains and headers shall be cleaned of all foreign material by pressure flushing or by blowing with clean, dry, oil free compressed air.

Where required, piping and tubing for instrument air supply and process sensing lines shall be tested in accordance with ISA RP 7.1. Signal air lines shall be pressure tested with clean, dry, oil free air and checked for leaks by applying a soap and water solution to all joints. There shall be no leaks. Lines shall be further tested for leaks by blocking in the system under pressure for a 15-minute period. The line will be considered satisfactory if the drop in pressure at the conclusion of the test period does not exceed 10%. Instruments shall not be directly connected to lines under test.

Piping and tubing for instrument pressure leads to process mains and headers shall be tested in accordance with requirements for pressure testing the line to which they are connected. If testing procedures would subject the instruments to pressures exceeding the range of the instruments, the instruments shall be isolated from the line under test.

Where instrument impulse lines are connected to process and utility piping, the impulse line shall be disconnected from the instrument and capped prior to system pressure testing. Pressure testing of instrument impulse lines shall be in accordance with the applicable piping test procedures.

Fragile devices such as pH electrodes, conductivity probes, or other highly sensitive components shall be removed from the lines or vessels prior to systems pressure testing.

Where instruments are connected to vessels such as level gage glasses, ball floats, or displacement level units, care shall be taken to assure that the design pressure rating of the instrument is above the proposed test pressures.

All control valves and damper operators shall be cleared of dirt and debris and exercised/stroked for satisfactory operation. This includes checkout for rigid and correct mounting of limit switches, position transmitters, solenoid valves, air supply regulators, current-to-pneumatic converters, positioners, air cylinders, motor drives, and connecting linkage.

3.2.2 Preoperational Tests and Calibration

Preoperational tests and calibration shall be performed on all instruments,

control loops, and systems. All loop components, pneumatic drives, control valves, piping, tubing, and wiring shall have been permanently mounted and testing shall have been completed before the preoperational tests and calibration of instrument installations are initiated. All electrical wiring shall have been rung out and tested for continuity and integrity of connections and subjected to all other tests specified for that wiring. The tests and calibration shall be performed by the Contractor.

The calibrating equipment used shall be NIST traceable, calibrated prior to and after use, and the reports furnished to the buyer so to validate the test equipment. All instruments calibrated using a piece of test equipment found to be defective at the post-use NIST calibration shall be re-calibrated.

3.2.2.1 Preoperational/Loop Tests

For purposes of preoperational checkout, all instrumentation shall be considered to fall into one of two groups:

1. Single-Element Installations--Such as pressure gages, thermometers, self-contained control valves, etc.

2. Instrument Loops--Consisting of two or more separate devices. There are two kinds of instrument loops:

a. Functionally Closed Loops--Loops without inputs to, or outputs from, other loops or devices. Such loops normally consist of one or more primary measuring devices, such as process-sensing transmitters, switches, etc., operating one or more final elements such as valves, indicators, recorders, etc. Between these primary and final elements there may be one or more intermediate devices such as power supplies, controllers, signal-actuated switches, air solenoid valves, electrical relays, and the like.

b. Functionally Open Loops--Loops with inputs to, or outputs from, other control loops which must, for practical reasons, be checked out as separate control entities.

Each loop shall be checked as needed to verify that each and every component, mechanical and electrical, is undamaged and functional, and to verify loop integrity with respect to signal ranges and directions, as well as direction of action of final control elements; this shall be done without calibrating devices or making quantitative settings. The final loop checks shall include the following:

1. Functionally closed loops should be checked by manipulating the primary sensing device(s) and observing response to the final control element(s). Where this is not practical, the loop shall be divided into two or more overlapping sections, and all devices of each section operated in concert to verify integrity of control action within that section.

2. Functionally open loops vary so widely in character that no single procedure can be specified for all cases, but the following criteria shall be followed as applicable:

a. Inputs from thermocouples shall be checked for reasonable "ball-park" magnitudes while warming or cooling the sensor to positively identify the correct leads. Other analog inputs shall be similarly checked while manipulating their source devices.

b. Switching devices shall be checked by manipulating that device and verifying that it actuates the correct relay in the correct direction.

c. Alarm circuits shall be checked by manipulating the switching device to sound the alarm and light up the correct display window through whatever circuitry and/or relays have been provided in the permanent installation.

d. Analog or on-off inputs from, or outputs to other loops shall be checked by manipulating the sending device and verifying correct action by the receiving device, preferably while operating all loop components in concert.

The foregoing loop tests shall generally be made with increasing and decreasing signal inputs at approximately 0%, 10%, 30%, 50%, 80%, and 100% of the full process variable range (head, level, pressure, etc.).

These procedures shall be supplemented with the Manufacturer's instruction manual information covering functional testing of individual instruments and integrated instrument systems and services of manufacturers specialist engineers as required.

When the instrument or instrument loop has been checked out and readied for calibration, the event shall be recorded on a document bearing the date of verification and the signature(s) of the Contractor's representative who performed the inspection.

No instrument shall be calibrated to function at any range other than manufacturer's recommended range, nor shall it be subjected to loads of pressure, voltage, etc., beyond those for which the manufacturer has rated it.

All switching devices actuated by process variables, electrical variables, or analog signals shall be set to open and close at the specified values of increase or decrease and then cycled repeatedly over full range to verify repeatability.

All control loop instruments shall be adjusted for zero, linerity, and span across full range. Their smooth performance shall be verified by cycling across full range a minimum of three times. All instruments shall be adjusted to their full design accuracy.

Every instrument shall be individually calibrated by applying measured inputs and measuring the outputs. In no case shall two or more instruments be gang calibrated, e.g., by feeding measured pressure into a transmitter and then adjusting the receiver gage to agree. This verification shall be known as the calibrated loop check.

After several instruments of a loop have been individually calibrated, they shall be cycled repeatedly in concert by applying a series of measured dummy inputs to the primary device(s), and all loop elements shall be thus verified for quantitative agreement, correct action, and prompt response.

Final control elements such as control valves, damper drives, motor-operated valves, and other power movers, shall be timed while stroking them full cycle at the fastest rate attainable through their permanent control systems, from shut to wide open and from wide open to shut. The stroking times shall be logged as part of the permanent record of calibration.

After an instrument has been calibrated, all pertinent valves and switches shall be positioned and tagged as needed for protection, and a distinctive tag or label shall be affixed to the instrument to indicate that it has been calibrated.

All instruments shall be calibrated in place with all mounting fasteners, piping, and wiring permanently attached and with all supports, ties, and fasteners for both piping and wiring permanently installed and fully tightened. Devices which have been shop-calibrated prior to erection shall be subjected to full recheck after installation as needed to verify that installation and handling have not upset accuracy or functional integrity. No instrument shall be released as calibrated until it has been either calibrated in place or fully rechecked in place.

All calibrated loop checks shall be performed in place with all loop elements permanently mounted, piped, and wired. No loop component shall be considered finally calibrated until this loop check has been completed and the satisfactory interaction of all loop components has been thus verified.

Purchaser shall have full access to all calibrating equipment and records for purposes of inspection; shall be free to fully witness all calibrating equipment and records for purposes of inspection; and shall be free to fully witness all calibrating procedures at any time and without previous notice or application.

Every instrument calibration shall be logged in writing at the time the calibration work is performed on a printed form developed by the Contractor for the purpose. The information thus logged shall include all applicable portions of the following:

1. Instrument tag number, service, and input/output range

2. Date of final calibration and/or calibrated loop check

3. Description of the procedure used

4. Shop numbers of all calibrating equipment used

5. All figures needed to describe settings, input/output values, and the points of range which have been checked.

6. Any appropriate notes and remarks

7. Signature of the technician performing the work, and the name(s) of all personnel assisting him.

If an instrument or loop has been calibrated and checked, but is subsequently recalled for repairs or changes, the Contractor shall amend all pertinent calibration records to record the event.

Upon completion of the preoperational tests and calibration work, the Contractor shall submit a complete report of that work (including calibration data logs for each instrument/loop) to Purchaser. The Contractor shall also submit progress reports to Purchaser during the installation work at regular intervals.

-- End of Section --

Appendix A

Technical Data Sheets

Line C . . . . . Pages A12-A34

NOTE: ALL REFERENCES TO 3056 NOT IN CONTRACT

PRESSURE INDICATOR

HAZARDOUS WASTE TANKS - LINE C TANKS

RADFORD ARMY AMMUNITION PLANT

STONE & WEBSTER ENGINEERING CORP.

PRESSURE GAGES

NO	BY	DATE	REVISION

SHEET A-12 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-15-95
REQ. P.O.	
BY / CHK'D	APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver ☐ Other ____
2. Mounting: Surface ☐ Local ■ Flush ☐
3. Dial: Diameter 4-6 IN. Color MFR. STD
4. Case: Cast Iron ☐ Aluminum ☐ Phenol ☐ Other MFR. STD
5. Ring: Screwed ☐ Hinged ☐ Slip ☐ Std ■ Other ____
6. Blow-out Protection None ☐ Back ■ Disc ☐ Solid Front ☐ Other ____
7. Lens: Glass ☐ Plastic ☐ MFR. STD ■
8. Options: Syphon ☐ Material Snubber ☐ ____ Pressure Limit Valve ☐ ____ Movement Damping ☐ ____
9. Nominal Accuracy Required ± 0.5 % OF SPAN
10. MFR. & Model No. ____
11. Press. Element: Bourdon ■ Bellows ☐ Other ____
12. Element Mtl: Bronze ☐ Steel ■ 316 SS Other ____
13. Socket Mtl: Bronze ☐ Steel ■ 316 SS Other ____
14. Connection-NPT: ¼ in. ☐ ½ in. ■ Other ____ Bottom ■ Back ☐
15. Movement: Bronze ☐ SS ☐ Nylon ☐ Other MFR. STD
16. Diaphragm Seal MFG. ____ Type ____ Wetted Part Mtl. ____ Other Mtl. ____ Fill Fluid ____ Process Conn. ____ Gage Conn. ____

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
	PI 201	0 - 100 psi	60 psi	SETTLING PIT 3056 PUMP SEAL FILTERED WATER SUPPLY

Notes:

ISA FORM S20.41a

PRESSURE INDICATOR WITH DIAPHRAGM SEAL
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

PRESSURE GAGES

NO	BY	DATE	REVISION

SHEET A-13 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT	DATE
5962896	4-15-95
REQ.	P.O.
BY	CHK'D	APPR.

1. Type: Direct Rdg ■ 3-15 lb Receiver ☐ Other
2. Mounting: Surface ☐ Local ■ Flush ☐
3. Dial: Diameter 4-6 IN. Color MFR. STD
4. Case: Cast Iron ☐ Aluminum ☐ Phenol ☐ Other MFR. STD
5. Ring: Screwed ☐ Hinged ☐ Slip ☐ Std ■ Other
6. Blow-out Protection None ☐ Back ■ Disc ☐ Solid Front ☐ Other
7. Lens: Glass ☐ Plastic ☐ MFR. STD ■
8. Options: Sylphon ☐ Material Snubber ☐ Pressure Limit Valve ☐ Movement Damping ☐
9. Nominal Accuracy Required ±0.5% OF SPAN
10. MFR. & Model No.
11. Press. Element: Bourdon ■ Bellows ☐ Other
12. Element Mtl: Bronze ☐ Steel ■ 316 SS Other
13. Socket Mtl: Bronze ☐ Steel ■ 316 SS Other
14. Connection-NPT: ¼ in. ☐ ½ in. ■ Other Bottom ■ Back ☐
15. Movement: Bronze ☐ SS ☐ Nylon ☐ Other MFR. STD
16. Diaphragm Seal MFG. Type Wetted Part Mtl. 316 SS Other Mtl. 316 SS Fill Fluid MFR. STD Process Conn. 1/2 IN. Gage Conn. 1/2 IN.

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
	PI206	0-160 psi	77 psi	SETTLING PIT PUMP 3056-P3 DISCHARGE
	PI210	0-100 psi	77 psi	SETTLING PIT PUMP 3056-P4 DISCHARGE
	PI213	0-60 psi	43 psi	SETTLING PIT PUMP 3056-P1 DISCHARGE
	PI215	0-60 psi	43 psi	SETTLING PIT PUMP 3056-P2 DISCHARGE
	PI216	0-60 psi	43 psi	SETTLING PIT PUMP 3056-P1 & P2 DISCHARGE
	PI218	0-30 psi	23 psi	SETTLING PIT PUMP 3056-P5 DISCHARGE
	PI224	0-100 psi	77 psi	FORCE MAIN TO BLDG 3057
	PI313	0-30 psi	21 psi	PUMP TANK PUMP 3058-P1 DISCHARGE
	PI316	0-30 psi	21 psi	PUMP TANK PUMP 3058-P2 DISCHARGE
	PI318	0-100 psi	62 psi	PUMP TANK INLINE BOOSTER PUMP 3058-P3 DISCHARGE

Notes: 1. GAGES SHALL BE FURNISHED WITH SEAL AND FILL FLUID.

ISA FORM S20.41a

D

FLOW SWITCH

HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

FLOW SWITCHES

NO	BY	DATE	REVISION

SHEET A-14 OF 54	
SPEC. NO. 16900	REV. 0
CONTRACT 5962896	DATE 4-15-95
REQ. · P.O.	
BY / CHK'D	APPR.

GENERAL

1. Type: Press ☐ Vacuum ☐ FLOW ■ Comp. ☐ Diff. Press. ☐
2. Setting: Set in Field ☐ Factory Set ■ Internal ☐ External ☐ Dial ☐
3. Dead Band: Fixed ■ Adj. ☐ Min. ☐

ELEMENT

4. Type: Diaphragm ☐ Bourdon ☐ Bellows ☐ Other PISTON
5. Material: Bronze ☐ 316 SS ■ Alloy St. ☐ Other
6. Connection: MFR STD ☐ Other Size 1/4 IN. NPT Bottom ☐ Back ☐ INLINE ■
7. Mounting: Local ■ Surface ☐ Flush ☐

SWITCH

8. Type: Mercury ☐ Snap ☐ Other MFR. STD
9. Quantity: Single ■ Dual ☐
10. Form: SPST ☐ SPDT ■ DPDT ☐ Other
11. Rating: 2 Amps ___ V ___ Hz Other
12. Load: Inductive ☐ Non-Inductive ☐
13. Enclosure: General Purpose ☐ Weather proof ■ None ☐ Explosion proof ■ Class SEE NOTE 2
14. Conduit Connection: MFR STD ☐ Other 1/2 IN. NPT

Manufacturer & Model No.

Rev.	Tag. No.	Process Condition	Adj. Range	Set Point Process	Set Point Signal	Operating Temp.	Operating Press.	Service	Notes
	FSL205	LOW FLOW		0.5 GPM		AMB	60 psi	3056-P3 SEAL WATER	1
	FSL 209	LOW FLOW		0.5 GPM		AMB	60 psi	3056-P4 SEAL WATER	1
	FSL 212	LOW FLOW		0.5 GPM		AMB	60 psi	3056-P1 SEAL WATER	1
	FSL214	LOW FLOW		0.5 GPM		AMB	60 psi	3056-P2 SEAL WATER	1
	FSL217	LOW FLOW		0.5 GPM		AMB	60 psi	3056-P5 SEAL WATER	1
	FSL311	LOW FLOW		0.5 GPM		AMB	60 psi	3058-P1 SEAL WATER	1
	FSL314	LOW FLOW		0.5 GPM		AMB	60 psi	3058-P2 SEAL WATER	1
	FSL317B	LOW FLOW		0.5 GPM		AMB	60 psi	3058-P3 SEAL WATER	1

Notes: 1. SETPOINT ACCURACY ± 10%

2. Explosion Proof requirements are Class I & II, Groups C, D, E, F, & G

ISA FORM S20-42a

FLOW SWITCH
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

FLOW SWITCHES

NO	BY	DATE	REVISION

SHEET A-15 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT	DATE
REQ. · P.O.	
BY / CHK'D	APPR.

GENERAL

1. Type: Press ☐ Vacuum ☐ FLOW ■ Comp. ☐ Diff. Press. ☐
2. Setting: Set in Field ☐ Factory Set ■ Internal ■ External ☐ Dial ☐
3. Dead Band: Fixed ■ Adj. ☐ Min. ☐

ELEMENT

4. Type: Diaphragm ☐ Bourdon ☐ Bellows ☐ Other VANE ACTUATED
5. Material: Bronze ☐ 316 SS ■ Alloy St. ☐ Other
6. Connection: MFR STD ☐ Other Size 2 IN. NPT Bottom ■ Back ☐
7. Mounting: Local ■ Surface ☐ Flush ☐

SWITCH

8. Type: Mercury ☐ Snap ☐ Other MFR-STD
9. Quantity: Single ■ Dual ☐
10. Form: SPST ☐ SPDT ☐ DPDT ■ Other
11. Rating: 2 Amps ___ V ___ Hz Other
12. Load: Inductive ☐ Non-Inductive ☐
13. Enclosure: General Purpose ☐ Weather proof ■ None ☐ Explosion proof ■ Class SEE NOTE 2
14. Conduit Connection: MFR STD ☐ Other 3/4 IN. NPT

Manufacturer & Model No.

Rev.	Tag. No.	Process Condition	Adj. Range	Set Point Process	Set Point Signal	Operating Temp.	Operating Press.	Service	Notes
	FSL317A	LOW FLOW		300 GPM		AMB		PUMP TANK 3058	1

Notes: 1. SWITCH TO BE INSTALLED IN 8 INCH LINE.
2. Explosion Proof requirements are Class I & II, Groups C, D, E, F, & G

ISA FORM S20-42a

TEMPERATURE INDICATOR
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

TEMPERATURE INSTRUMENTS (FILLED SYSTEM)

NO	BY	DATE	REVISION

SHEET A-16 OF 54
SPEC. NO. 5962896 REV. 4-15-95
CONTRACT DATE
REQ. · P.O.
BY CHK'D APPR.

	1	Tag No. SEE NOTE 1	Service SEE NOTE 1
GENERAL	2	Function	Record ☐ Indicate ■ Control ☐ Blind ☐ Trans ☐ Other
	3	Case	MFR STD ■ Nom Size 4 1/2 IN. Color: MFR STD ■ Other
	4	Mounting	Flush ☐ Surface ■ Yoke ☐ Other
	5	Enclosure Class	General Purpose ☐ Weather proof ■ Explosion proof ☐ Class; For Use in Intrinsically Safe System ☐ Other
	6	Power Supply	117 V 60Hz ☐ Other ac ____ dc ☐ ____ Volts
	7	Chart	Strip ☐ ____ Roll ☐ ____ Fold ☐ ____ Circular ____ Time Marks ____
	8	Chart Drive	Speed ____ Power ____
	9	Scales	Type DIAL; Range 1 20-240 °F 2 ____ 3 ____ 4 ____
XMTR	10	Transmitter Output	4-20 mA ☐ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other; For Receiver See Spec. Sheet
CONTROLLER	11	Control Modes	P=Prop (Gain), I=Integral (Auto Reset), D=Derivative (Rate), Sub: s = Slow f = Fast; P ☐ PI ☐ PD ☐ PID ☐ If ☐ Df ☐ Is ☐ Ds ☐ Other
	12	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	13	Auto-Man Switch	None ☐ MFR STD ☐ Other
	14	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other
	15	Manual Reg.	None ☐ MFR STD ☐ Other
	16	Output	4-20 mA ☐ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other
ELEMENT	17	Fill	SAMA Class III A Compensation FULL
	18	Process Data	Temp: Normal 140 °F Max 200 °F Max. Press.
	19	Range	Fixed ☐ Adj. Range ____ Set At; Overrange Protection to
	20	Bulb	Type FIXED UNION Mtl. 316SS Extension: Length ____ Type; Size: Diameter MFR. STD Length 3 IN Insertion; Conn: 1/2 IN. NPT Location ____ Ft. Above ☐ Below ☐ Instr.
	21	Capillary	MFR STD ■ Length 15 FT Mtl. 316SS Armor
	22	Well	Mtl. ____ Insertion ____ Lag Ext. ____ Conn; Const: Drilled ☐ Built-Up ☐ Other
	23	Alarm Switches	Quantity ____ Form ____ Rating
	24	Function	Temp ☐ Deviation ☐ Contacts To ____ On Temp. Increase
	25	Options	Filt-Reg. ☐ Sup. Gage ☐ Output Gage ☐ ____ Charts; Other
	26	Mfr. & Model No.	

Notes: 1. TI208 - SETTLING PIT 3056
TI301 - PUMP TANK 3058-A
TI302 - PUMP TANK 3058-B

ISA FORM S20.11a

RED WARNING BEACON AND HORN HARARDOUS WASTE TANKS - LINE & TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP.	RED WARNING BEACON AND HORN				SHEET A-17 OF 54	
	NO	BY	DATE	REVISION	SPEC. NO. 16900	REV. 0
					CONTRACT 5962896	DATE 6/30/95
					REQ. - P.O.	
					BY / CHK'D	APPR.

TAG NUMBER: UA207

RED WARNING BEACON:
- 120VAC OPERATION
- MINIMUM 75 WATT LAMP
- LAMP ON CONTINUOUSLY (ROTATING IS NOT ACCEPTABLE)
- ELECTRICAL CONNECTION 1/2" NPT
- NEMA 4 ENCLOSURE

HORN:
- 120VAC OPERATION
- MINIMUM DECIBAL OUTPUT IS 95DB @ 10 FT.
- ELECTRICAL CONNECTION 1/2" NPT
- NEMA 4 ENCLOSURE

ISA Form S20.3b

PUSH BUTTON SWITCH HAZARDOUS WASTE TANKS - LINE C TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP.	PUSH BUTTON SWITCHES			SHEET A-18 OF 54	
	NO	BY	DATE	REVISION	SPEC. NO. 16900	REV. 0
					CONTRACT 5962896	DATE 4-15-95
					REQ. · P.O.	
					BY / CHK'D	APPR.

- MAINTAINED CONTACT WITH MANUAL RESET, RATED AT 5 AMPS, 120 VAC
- WITH SINGLE GANG BOX, 3/4 IN. NPT
- REFERENCE E2400 DRAWING SERIES FOR LEGEND AND CONTACT FUNCTION

TAG NO.	EXPLOSION PROOF Class I & II, Groups C, D, E, F & G	CONTACTS
HS205B	YES	1-NO
HS209B	YES	1-NO
HS217B	YES	1-NO
HS311B	YES	1-NO
HS314B	YES	1-NO
HS317B	YES	1-NO

ISA Form S20.3b

(A) START/STOP
PUSH BUTTON STATION
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

PUSHBUTTON STATION

NO	BY	DATE	REVISION

SHEET A-19 OF 54	
SPEC. NO. 16900	REV. 0
CONTRACT 5962896	DATE 4-15-95
REQ. · P.O.	
BY / CHK'D	APPR.

- CONTACTS, RATED AT 5 AMPS, 120VAC
- WITH SINGLE GANG BOX, 3/4 IN. NPT
- REFERENCE E2400 DRAWING SERIES FOR LEGEND AND CONTACT FUNCTION

TAG NO.	PUSHBUTTONS	EXPLOSION PROOF Class I & II, Groups C,D,E,F&G	CONTACTS
HS 212	1- START, 1-STOP	YES	SPDT PER P.B.
HS 214	1- START, 1-STOP	YES	SPDT PER P.B.

ISA Form S20.3b

DUAL DISPLACER TYPE LEVEL SWITCH
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

LEVEL INSTRUMENTS (DISPLACER or FLOAT)

NO	BY	DATE	REVISION

SHEET A-21 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-15-95
REQ. - P.O.	
BY / CHK'D	APPR.

	1	Tag Number		LSHL 203		LSHL 309		LSHL 310	
	2	Service		SETTLING PIT 3056		PUMP TANK 3058-A		PUMP TANK 3058-B	
	3	Line No./Vessel No.		PIT 3056		TANK 3058-A		TANK 3058-B	
BODY/CAGE	4	Body or Cage Mtl		SS		SS		SS	
		Rating							
	5	Conn Size & Location Upper		2 1/2 IN. NPT		2 1/2 IN. NPT		2 1/2 IN. NPT	
		Type		TOP		TOP		TOP	
	6	Conn Size & Location Lower							
		Type							
	7	Case Mounting		TOP		TOP		TOP	
		Type							
	8	Rotatable Head							
	9								
	10	Orientation							
	11	Cooling Extension							
	12								
DISPLACER OR FLOAT	13	Dimensions		MFR. STD		MFR. STD		MFR. STD	
	14	Insertion Depth							
	15	Displacer Extension		12 FT		12 FT		12 FT	
	16	Disp. or Float Material		SS		SS		SS	
	17	Displacer Spring/Tube Mtl		SS		SS		SS	
	18								
	19								
XMTR/CONT.	20	Function		SWITCH		SWITCH		SWITCH	
	21	Output							
	22	Control Modes							
	23	Differential							
	24	Output Action: Level Rise							
	25	Mounting		INTEGRAL		INTEGRAL		INTEGRAL	
	26	Enclosure Class		NEMA 4		NEMA 7/9, *		NEMA 7/9, *	*EXPLOSION PROOF
	27	Elec. Power or Air Supply		N/A		N/A		N/A	
	28								
SERVICE	29	Upper Liquid							
	30	Lower Liquid		WATER		WATER		WATER	
	31	sp. gr.: Upper	Lower		1.00		1.00		1.00
	32	Press. Max.	Normal	AMB	AMB	AMB	AMB	AMB	AMB
	33	Temp. Max.	Normal	120°F	AMB	120°F	AMB	120°F	AMB
	34								
	35								
OPTIONS	36	Airset / Supply Gage							
	37	Gage Glass Connections							
	38	Gage Glass Model No.							
	39	Contacts: No.	Form	2	DPDT	2	DPDT	2	DPDT
	40	Contact Rating		24VDC @ 2A		24VDC @ 2A		24VDC @ 2A	
	41	Action of Contacts		SEE NOTE 1		SEE NOTE 1		SEE NOTE 1	
	42								
	43								
	44								
	45								
	46	Manufacturer							
	47	Model Number							
	48								

Notes: 1. INSTRUMENT REQUIRES TWO SWITCH MECHANISMS AND TWO SEPARATE DISPLACERS.
SW1 - CC INC LEVEL
SW2 - CC DEC LEVEL

ISA FORM S20.26

DISPLACER TYPE LEVEL SWITCH
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

LEVEL INSTRUMENTS (DISPLACER or FLOAT)

NO	BY	DATE	REVISION

SHEET A-22 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-15-95
REQ. · P.O.	
BY	CHK'D	APPR.

	1	Tag Number	LSHH 303	LSHH 304		
	2	Service	PUMP TANK 3058-A	PUMP TANK 3058-B		
	3	Line No./Vessel No.	TANK 3058-A	TANK 3058-B		
BODY/CAGE	4	Body or Cage Mtl	SS	SS		
		Rating				
	5	Conn Size & Location Upper	2 1/2 IN NPT	2 1/2 IN NPT		
		Type	TOP	TOP		
	6	Conn Size & Location Lower				
		Type				
	7	Case Mounting	TOP	TOP		
		Type				
	8	Rotatable Head				
	9					
	10	Orientation				
	11	Cooling Extension				
	12					
DISPLACER OR FLOAT	13	Dimensions	MFR STD	MFR. STD		
	14	Insertion Depth				
	15	Displacer Extension	6 FT	6 FT		
	16	Disp. or Float Material	SS	SS		
	17	Displacer Spring/Tube Mtl	SS	SS		
	18					
	19					
XMTR/CONT.	20	Function	SWITCH	SWITCH		
	21	Output				
	22	Control Modes				
	23	Differential				
	24	Output Action: Level Rise				
	25	Mounting	INTEGRAL	INTEGRAL		
	26	Enclosure Class	NEMA 4	NEMA 4		
	27	Elec. Power or Air Supply	N/A	N/A		
	28					
SERVICE	29	Upper Liquid				
	30	Lower Liquid	WATER	WATER		
	31	Sp. gr.: Upper / Lower	1.00	1.00		
	32	Press. Max. / Normal	AMB / AMB	AMB / AMB		
	33	Temp. Max. / Normal	120°F / AMB	120°F / AMB		
	34					
	35					
OPTIONS	36	Airset / Supply Gage				
	37	Gage Glass Connections				
	38	Gage Glass Model No.				
	39	Contacts: No. / Form	1 / DPDT	1 / DPDT		
	40	Contact Rating	24VDC @ 2A	24VDC @ 2A		
	41	Action of Contacts	CC INC LEVEL	CC INC LEVEL		
	42					
	43					
	44					
	45					
	46	Manufacturer				
	47	Model Number				
	48					

Notes:

ISA FORM S20.26

pH INDICATING TRANSMITTER AND ELECTRODE

HAZARDOUS WASTE TANKS - LINE C TANKS

RADFORD ARMY AMMUNITION PLANT

STONE & WEBSTER ENGINEERING CORP.

pH INSTRUMENTS

NO	BY	DATE	REVISION

SHEET A-23 OF 54

SPEC. NO. 16900 REV. 0

CONTRACT 5962896 DATE 4-15-95

REQ. P.O.

BY CHK'D APPR.

	1	Tag No.	SEE NOTE 1 — Service SEE NOTE 1
GENERAL	2	Function	Record ☐ Indicate ■ Control ☐ Blind ☐ Trans ■ Other
	3	Case	MFR STD ■ Nom Size ____ Color: MFR STD ■ Other
	4	Mounting	Flush ☐ Surface ☐ Yoke ☐ Other PIPE MOUNT
	5	Enclosure Class	General Purpose ☐ Weather proof ■ Explosion proof ☐ Class ____ For Use In Intrin. Safe System ■ Other
	6	Power Supply (NOTE 2)	117V 60Hz ☐ Other ac ____ dc ____ Volts
	7	Chart	____ Strip ☐ ____ Roll ☐ ____ Fold ☐ Circular ____ Time Marks ____ Range ____ Number ____
	8	Chart Drive	Speed ____ Power ____
	9	Scales	Type DIAL OR DIGITAL (MIN 3½ DIGITS) Range 1 0-14 pH 2 ____ 3 ____ 4 ____
XMTR	10	Transmitter Output (NOTE 3)	4-20 mA ■ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other ____ For Receiver See Spec Sheet ____
CONTROLLER	11	Control Modes	P=Prop (Gain) I=Integral (Auto-Reset) D=Derivative (Rate) Sub: s=Slow f=Fast P ☐ PI ☐ PD ☐ PID ☐ If ☐ Df ☐ Is ☐ Ds ☐ Other
	12	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	13	Auto-Man Switch	None ☐ MFR STD ☐ Other
	14	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other
	15	Manual Reg.	None ☐ MFR STD ☐ Other
	16	Output	4-20mA ☐ 10-50mA ☐ 21-103 kPa (3-15 psig) ☐ Other
ELEMENT	17	Service	Gage Press. ☐ Vacuum ☐ Absolute ☐ Compound ☐ pH ■
	18	Element Type	Diaphragm ☐ Helix ☐ Bourdon ☐ Bellows ☐ Other ELECTRODE
	19	Material	316 SS ☐ Ber. Copper ☐ Other SEE NOTE 4
	20	Range	Fixed ■ Adj. Range ____ Set at ____ Overrange protection to ____
	21	Process Data	Press/Temp: Normal AMB / AMB Max AMB / 120°F Element Range 0-14 pH
	22	Process Conn.	¼ in. NPT ☐ ½ in. NPT ☐ Other ____ Location: Bottom ☐ Back ☐ Other
	23	Alarm Switches	Quantity ____ Form ____ Rating ____
	24	Function	Press ☐ Deviation ☐ Contacts To ____ on Inc Press.
OPTIONS	25	Options	Filt-Reg. ☐ Sup Gage ☐ Output Gage ☐ ____ Charts Diaph Seal ☐ Type ____ Diaph ____ Bot Bowl ____ Conn ____ Capillary: Length ____ Mtl. ____ Other ELEMENT FURNISHED WITH PVC ELECTRODE PROTECTIVE SLEEVE, CABLE END SUBMERSION ADAPTER, MINIMUM 40 FT. INTEGRAL CABLE
	26	MFR & Model No.	

Notes:

1. AIT306/AE306 - PUMP TANK 3058-A
   AIT307/AE307 - PUMP TANK 3058-B
2. LOOP POWERED 28VDC SUPPLY.
3. ACCURACY: ±0.1% OF SPAN, ELECTRICAL CONNECTION: ½ IN. NPT
4. CONSULT SELECTED VENDOR FOR VARIOUS ELEMENT MATERIALS.
5. ELEMENT SHALL BE FURNISHED WITH AUTOMATIC TEMPERATURE COMPENSATION.

ISA Form S20.40a

pH INDICATING RECORDER/ALARM
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

RECEIVER INSTRUMENTS

NO	BY	DATE	REVISION

SHEET A-24 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-15-95
REQ. P.O.	
BY / CHK'D / APPR.	

	1	Tag No. AIR308/ASH308	Service PUMP TANK 3058
GENERAL	2	Function	Record ■ Indicate ■ Control ☐ Blind ☐ Integ ☐ DIGITAL ■ Deviation ☐ Other
	3	Case	MFR STD ■ Nom Size ____ Color: MFR STD ■ Other
	4	Mounting	Flush ■ Surface ☐ Rack ☐ Multi-Case ☐ Other PANEL MOUNT For Multiple Case, See Spec. Sheet
	5	Enclosure Class	General Purpose ■ Weather Proof ☐ Explosion-Proof ☐ Class ____ For Use in Intrinsically Safe System. ☐ Other
	6	Power Supply	117 V 60Hz ■ Other ac ____ dc ☐ ____ Volts
	7	Chart MFR. STD ■	____ Strip ☐ ____ Roll ☐ ____ Fold ☐ Circular ____ Time Marks ____ Range MFR. STD Number MFR. STD
	8	Chart Drive	Speed MFR. STD Power
	9	Scales	Type MIN 4½ DIGITS MIN 4½ DIGITS Range 1 0-14 pH 2 0-14 pH 3 ____ 4 ____
CONTROLLER	10	Control Modes	P = Prop (Gain), I = Integral (Auto Reset), D = Derivative (Rate), Sub: s = Slow, f = Fast P ☐ PI ☐ PD ☐ PID ☐ If ☐ Df ☐ Is ☐ Ds ☐ Other
	11	Action	On Meas. Increase Output: Increases ☐ Decreases ☐
	12	Auto-Man Switch	None ☐ MFR STD ☐ Other
	13	Set Point Adj.	Manual ☐ External ☐ Remote ☐ Other
	14	Manual Reg	None ☐ MFR STD ☐ Other
	15	Output	4-20 mA ☐ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other
INPUTS	16	Input Signals	4-20 mA ■ 10-50 mA ☐ 21-103 kPa (3-15 psig) ☐ Other
	17	No. of Inputs	1 ☐ 2 ■ 3 ☐ 4 ☐
	18	Power for XMTRS	External ☐ This Inst ☐ No. of Independent Supplies ____ For Transmitters, See Spec Sheet.
ALARMS	19	Alarm Switches	Quantity 2 Form SPDT Rating 2A
	20	Function	Meas. Var. ■ Deviation ☐ Contacts To ____ On Meas ____ Other SEE NOTE 1
	21	Options	Filter-Reg ☐ Supply Gage ☐ Charts ☐ Int. Illumination ☐ Other
	22	MFR & Model No.	

Notes: 1. ALARM CONTACTS REQUIRED TO MONITOR HIGH/LOW pH INPUTS 1 & 2.

ISA Form S20.1a

SWITCH TYPE INTRINSIC BARRIER HAZARDOUS WASTE TANKS - LINE C TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP.	INTRINSIC BARRIER				SHEET A-25 OF 54		
	NO	BY	DATE	REVISION	SPEC. NO. 16900		REV. 0
					CONTRACT 5962896		DATE 4-15-95
					REQ. · P.O.		
					BY	CHK'D	APPR.

TAG NUMBER: IB3, IB4, IB6

A 2-CHANNEL SHUNT-DIODE SAFETY BARRIER WITH BUILT-IN ELECTRONIC OVERVOLT PROTECTION. INTENDED FOR SAFEGUARDING A HAZARDOUS-AREA SWITCH CONTROLLING A SAFE-AREA LOAD FROM AN UNREGULATED DC SUPPLY IN THE SAFE AREA.

CIRCUIT SUPPLY VOLTAGE: 28 VDC
SUPPLY CURRENT LIMIT: 50 mA

ISA Form S20.3b

CONTROLLER TYPE INTRINSIC BARRIER HAZARDOUS WASTE TANKS - LINE C TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP.	INTRINSIC BARRIER				SHEET A-26 OF 54		
	NO	BY	DATE	REVISION	SPEC. NO. 16900		REV. 0
					CONTRACT 5962896		DATE 4-15-95
					REQ. · P.O.		
					BY	CHK'D	APPR.

TAG NUMBER: IB2, IB5

A SAFETY BARRIER WHERE THE OUTPUT CURRENT OF A CONTROLLER FLOWS DIRECTLY TO ITS "0V" RAIL AND THE RAIL CAN BE EARTHED AT THE BUSBAR.

CIRCUIT SUPPLY VOLTAGE: 28 VDC
HAZARDOUS AREA LOAD: I/P CONVERTER, MINIMUM 500 OHMS
MAXIMUM END TO END RESISTANCE: 400 OHMS

ISA Form S20.3b

TRANSMITTER TYPE INTRINSIC BARRIER
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

INTRINSIC BARRIER

NO	BY	DATE	REVISION

SHEET A-27 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-15-95
REQ. P.O.	
BY / CHK'D	APPR.

TAG NUMBER: IB1, IB7, IB8

A 1-CHANNEL SHUNT-DIODE SAFETY BARRIER, WITH BUILT-IN ELECTRONIC OVERVOLT PROTECTION, FOR ENERGISING A 2-WIRE 4/20 mA TRANSMITTER IN A HAZARDOUS AREA. POWERED FROM A POSITIVE SUPPLY OF 28 VDC AND DELIVERS A 4/20 mA SIGNAL INTO AN EARTHED LOAD IN THE SAFE AREA.

CIRCUIT SUPPLY VOLTAGE: 28 VDC
TRANSMITTER CURRENT: 4-20 mA
SAFE AREA LOAD RESISTANCE: 600 OHMS MAXIMUM
OUTPUT IMPEDANCE TO LOAD: > 1 MEGAOHM
CALIBRATED ACCURACY: 0.05% OF MAXIMUM OUTPUT
ZERO TEMPERATURE DRIFT: < 0.005% OF MAXIMUM OUTPUT PER °C
SPAN TEMPERATURE DRIFT: < 0.005% OF MAXIMUM OUTPUT PER °C

ISA Form S20.3b

(31) CURRENT-TO-CURRENT 'CONVERTER' HAZARDOUS WASTE TANKS-LINE C TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP	CURRENT CONVERTER/ TRANSMITTER				SHEET A-28 OF 54		
	NO	BY	DATE	REVISION	SPEC. NO. 16900		REV. 0
					CONTRACT 5962896		DATE 4-18-95
					REQ. · P.O.		
					BY LDH	CHK'D	APPR.

TAG NUMBER: IY202

CURRENT-TO-CURRENT CONVERTER

INPUT POWER - 24VDC ±10%, 5 WATTS NOMINAL

INPUT SIGNAL - 4-20mA DC INTO 50Ω NOMINAL

OUTPUT SIGNAL - 4-20mA DC INTO 1200Ω LOAD

INSTRUMENT TO HAVE ZERO ADJUSTMENT AND SPAN ADJUSTMENT ON FRONT PANEL

NOTE: THIS DEVICE SERVES AS A BOOSTER ON THE LT202 CURRENT LOOP AS THE TRANSMITTER THROUGH THE INTRINSIC BARRIER CANNOT DRIVE THE LOOP IMPEDANCE WITH VALVES LV220 AND LV222 CONNECTED.

ISA Form S20.3b

(1) CURRENT SWITCH HAZARDOUS WASTE TANKS - LINE C TANKS RADFORD ARMY AMMUNITION PLANT STONE & WEBSTER ENGINEERING CORP	CURRENT SWITCH				SHEET A-29 OF 54	
	NO	BY	DATE	REVISION	SPEC. NO. 16900	REV. 0
					CONTRACT 5962896	DATE 4-18-95
					REQ. · P.O.	
					BY KDH	CHK'D / APPR.

TAG NUMBER: LSHL202

CURRENT SWITCH

POWER 24VDC ± 10%, 5 WATTS NOMINAL

INPUT 4-20 mADC @ 50 Ω

OUTPUT TWO SEPARATE, ADJUSTABLE SPDT ALARM CONTACTS RATED 5A @ 28VDC

TRIP POINT REPEATABILITY - ±0.1% FULL SPAN
DEADBAND - 1% OF SPAN

INPUT AND OUTPUT CIRCUITS TO BE FULLY ISOLATED

ISA Form S20.3b

HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP

SOLENOID VALVES

NO	BY	DATE	REVISION

SHEET A-30 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-18-95
REQ. P.O.	
BY LDH	CHK'D / APPR.

	1.	Tag Number	LY222A	
	2.	Service	AIR	
	3.	Line No./Vessel No.	VALVE LV222	
	4.	Quantity	1	
VALVE BODY	5.	Type	3 WAY	
	6.	Size – Body/Port	1/4"	
	7.	Rating & Type Conn.	200 PSI/SCREWED	
	8.	Material – Body	316 SS	
	9.	Material – Seat	MFR. STD.	
	10.	Material – Diaphragm	MFR. STD.	
	11.	Operation Direct/Pilot	DIRECT	
	12.	Packless or Type Packed		
	13.	Manual Re-Set	NO	
	14.	Manual Operator	NO	
	15.			
	16.			
WHEN DE-ENERGIZED	17.	2-Way Valve Opens/Close		
	18.	3-Way		
	19.	Vent Port Opens/Close	OPENS	
	20.	Press Port Opens/Close	CLOSES	
	21.	4-Way		
	22.	Press to Cyl. 1/Cyl 2		
	23.	Exh. from Cyl 1/Cyl 2		
	24.			
	25.			
SOLENOID	26.	Enclosure	WATERTIGHT	
	27.	Voltage/Hz	28 VDC	
	28.	Style of Coil	MFR. STD.	
	29.	Single or Double Coil	SINGLE	
	30.			
	31.			
SERVICE CONDITIONS	32.	Fluid	AIR	
	33.	Qty. Maximum	25 CFM	
	34.	Oper. Diff. Min/Max	20 PSI / 70 PSI	
	35.	Allow. Diff. Min/Max		
	36.	Temp. Norm/Max.	AMB. / AMB	
	37.	Oper. sp. gr.		
	38.	Oper. Viscosity		
	39.	Required Cv		
	40.	Valve Cv		
	41.			
	42.			
	43.			
	44.			
	45.	Manufacturer		
	46.	Model Number		

Notes:

Field to install this solenoid on value LV222 in field.

ISA Form S20.55

RELIEF VALVES
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

PRESSURE RELIEF VALVES

NO	BY	DATE	REVISION

SHEET A-31 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-21-95
REQ. · P.O.	
BY / CHK'D	APPR.

GENERAL	1.	Tag Number		PSV225		PSV312		PSV315		PSV319	
	2.	Service		PUMP 3056-P4		PUMP 3058-P1		PUMP 3058-P2		PUMP 3058-P3	
	3.	Line No./Vessel No.		103		207		203		210	
	4.	Full Nozzle/Semi Nozzle		*		*		*		*	
	5.	Safety or Relief		RELIEF		RELIEF		RELIEF		RELIEF	
	6.	Conv., Bellows, Pilot Op.		CONV.		CONV.		CONV.		CONV.	
	7.	Bonnet Type		*		*		*		*	
CONN.	8.	Size: Inlet	Outlet	3 IN.	3 IN.	2 IN.	2 IN.	2 IN.	2 IN.	2 IN.	2 IN.
	9.	Flange Rating or Screwed		SCREWED	FNPT	SCREWED	FNPT	SCREWED	FNPT	SCREWED	FNPT
	10.	Type of Facing									
MATERIALS	11.	Body and Bonnet		*		*		*		*	
	12.	Seat and Disc		*		*		*		*	
	13.	Resilient Seat Seal		*		*		*		*	
	14.	Guide and Rings		*		*		*		*	
	15.	Spring		*		*		*		*	
	16.	Bellows		*		*		*		*	
	17.										
OPTIONS	18.	Cap: Screwed or Bolted		*		*		*		*	
	19.	Lever: Plain or Packed		PACKED		PACKED		PACKED		PACKED	
	20.	Test Gag									
	21.										
	22.										
	23.										
BASIS	24.	Code									
	25.	Fire									
	26.										
	27.										
FLUID DATA	28.	Fluid and State		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM	
	29.	Required Capacity		* 700 GPM		* 250 GPM		* 250 GPM		* 300 GPM	
	30.	Mol. Wt.	Oper. sp. gr.								
	31.	Oper. Press.	Set Press.	70 PSIG	88 PSIG	15 PSIG	22 PSIG	15 PSIG	22 PSIG	70 PSIG	78 PSIG
	32.	Oper. Temp.	Rel. Temp.	100 °F	*	100 °F	*	100 °F	*	100 °F	PSIG
	33.	Back Pressure	Constant								
	34.		Variable								
	35.		Total								
	36.	% Allowable Overpressure									
	37.	Overpressure Factor									
	38.	Compressibility Factor									
	39.	Latent Heat of Vaporization									
	40.	Ratio of Specific Heats									
	41.	Operating Viscosity									
	42.	Barometric Pressure									
	43.										
	44.										
	45.	Calc. Area sq. in.		*		*		*		*	
	46.	Selected Area		*		*		*		*	
	47.	Orifice Designation		*		*		*		*	
	48.	Manufacturer									
	49.	Model No.									

Notes: * FINAL CONFIGURATION TO BE PER MANUFACTURERS RECOMMENDATIONS, WHICH SHALL BE OBTAINED ON DATA FROM THE SELECTED PUMP.
NOTE: WHERE SIZES/CAPACITIES ARE LISTED, THEY ARE FOR ESTIMATING ONLY, FINAL VALUES TO BE BASED ON SELECTED PUMP DATA.

ISA Form S20.53

RELIEF VALVES
HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

PRESSURE RELIEF VALVES

NO	BY	DATE	REVISION

SHEET A-32 OF 54

SPEC. NO.	REV.
16900	0
CONTRACT 5962896	DATE 4-21-95
REQ. - P.O.	
BY / CHK'D	APPR.

GENERAL	1.	Tag Number		PSV211		PSV219		PSV221		PSV223
	2.	Service		PUMP 3056-P1		PUMP 3056-P5		PUMP 3056-P2		PUMP 3056-P3
	3.	Line No./Vessel No.		108		102		105		107
	4.	Full Nozzle/Semi Nozzle		*		*		*		*
	5.	Safety or Relief		RELIEF		RELIEF		RELIEF		RELIEF
	6.	Conv., Bellows, Pilot Op.		CONV.		CONV.		CONV.		CONV.
	7.	Bonnet Type		*		*		*		*
CONN.	8.	Size: Inlet	Outlet	2 IN.	2 IN.	2 IN.	2 IN.	2 IN.	2 IN.	3 IN. 3 IN.
	9.	Flange Rating or Screwed		SCREWED	FNPT	SCREWED	FNPT	SCREWED	FNPT	SCREWED FNPT
	10.	Type of Facing								
MATERIALS	11.	Body and Bonnet		*		*		*		*
	12.	Seat and Disc		*		*		*		*
	13.	Resilient Seat Seal		*		*		*		*
	14.	Guide and Rings		*		*		*		*
	15.	Spring		*		*		*		*
	16.	Bellows		*		*		*		*
	17.									
OPTIONS	18.	Cap: Screwed or Bolted		*		*		*		*
	19.	Lever: Plain or Packed		PACKED		PACKED		PACKED		PACKED
	20.	Test Gag								
	21.									
	22.									
	23.									
BASIS	24.	Code								
	25.	Fire								
	26.									
	27.									
FLUID DATA	28.	Fluid and State		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM		ACIDIC WASTE STREAM
	29.	Required Capacity		* 300 GPM		* 300 GPM		* 300 GPM		* 700 GPM
	30.	Mol. Wt.	Oper. sp. gr.							
	31.	Oper. Press.	Set Press.	40 PSIG	60 PSIG	20 PSIG	28 PSIG	40 PSIG	60 PSIG	70 PSIG 88 PSIG
	32.	Oper. Temp.	Rel. Temp.	100 °F	*	100 °F	*	100 °F	*	100 °F *
	33.	Back Pressure	Constant							
	34.		Variable							
	35.		Total							
	36.	% Allowable Overpressure								
	37.	Overpressure Factor								
	38.	Compressibility Factor								
	39.	Latent Heat of Vaporization								
	40.	Ratio of Specific Heats								
	41.	Operating Viscosity								
	42.	Barometric Pressure								
	43.									
	44.									
	45.	Calc. Area sq. in.		*		*		*		*
	46.	Selected Area		*		*		*		*
	47.	Orifice Designation		*		*		*		*
	48.	Manufacturer								
	49.	Model No.								

Notes: * FINAL CONFIGURATION TO BE PER MANUFACTURERS RECOMMENDATIONS, WHICH SHALL BE OBTAINED ON DATA FROM THE SELECTED PUMP.
NOTE: WHERE SIZES/CAPACITIES ARE LISTED, THEY ARE FOR ESTIMATING ONLY, FINAL VALUES TO BE BASED ON SELECTED PUMP DATA.

ISA Form S20.53

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CONTROL VALVE DATA SHEET

Second Printing

PROJECT HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.

ITEM
CONTRACT 5962896
•MFR. SERIAL

DATA SHEET A-33 of 54
SPEC 16900 REV. 0
TAG LV [redacted] 100A & 100B
DWG
SERVICE [redacted] Bldg 3058

1 Fluid ACIDIC WATER — Crit Press PC

SERVICE CONDITIONS	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
2 Flow Rate	GPM	*	*	*	—
3 Inlet Pressure	PSI	*	*	*	*
4 Outlet Pressure	PSI	*	*	*	*
5 Inlet Temperature	°F	AMB	AMB	AMB	AMB
6 Spec Wt/Spec Grav/Mol Wt	-	1.00	1.00	1.00	—
7 Viscosity/Spec Heats Ratio	lbf-sec/ft²	2.05 x 10⁻⁵	2.05 x 10⁻⁵	2.05 x 10⁻⁵	—
8 Vapor Pressure P_v	lbf/ft²	48.9	48.9	48.9	—
9 *Required C_v					—
10 *Travel	%				0
11 Allowable/*Predicted SPL	dBA	/	/	/	—
12					

LINE
13 Pipe Line Size & Schedule — In 8 IN. SCH-10 S.S.
14 Out 8 IN. SCH-10 S.S.
15 Pipe Line Insulation

VALVE BODY/BONNET
16 *Type BUTTERFLY
17 *Size 8" ANSI Class 150
18 Max Press/Temp 100 / 150 °F
19 *Mfr & Model VALTEK VALDISK 150
20 *Body/Bonnet Matl 316 SS
21 *Liner Material/ID N/A
22 End Connection — In *
23 Out *
24 Flg Face Finish ANSI B16.5-81
25 End Ext/Matl N/A
26 *Flow Direction SHAFT DOWNSTREAM
27 *Type of Bonnet STD
28 Lub & Iso Valve Lube
29 *Packing Material PTFE
30 *Packing Type V-RING SINGLE
31

TRIM
32 *Type ECCENTRIC-CAMMED DISK
33 *Size 8" Rated Travel 90 Deg
34 *Characteristic EQUAL PERCENT
35 *Balanced/Unbalanced N/A
36 *Rated C_v * F_L X_T
37 *Plug/Ball/Disk Material 316 SS
38 *Seat Material PFA VITON
39 *Cage/Guide Material N/A
40 *Stem Material 17 - 4 PH
41
42

SPECIALS/ACCESSORIES
43 NEC Class Group Div
44 TAG: LV [redacted] 100A&B Air Open Valve
45 I/P TRANSDUCER
46
47 * TO BE DETERMINED AFTER
48 FINAL SETTLING PIT PUMPS
49 SELECTION
50
51
52

ACTUATOR
53 *Type SPRING - CYLINDER
54 *Mfr & Model VALTEK VR CYLINDER
55 *Size 50 STD Eff Area 50 SQ IN
56 On/Off Modulating X
57 Spring Action Open/Close OPEN
58 *Max Allowable Pressure 150 PSI
59 *Min Required Pressure 60 PSI
60 Available Air Supply Pressure:
61 Max Min
62 *Bench Range /
63 Actuator Orientation
64 Handwheel Type
65 Air Failure Valve OPENS Set at
66

POSITIONER
67 Input Signal 4-20 mA
68 *Type ELECTRO - PNEUMATIC
69 *Mfr & Model VALTEK XL I/P
70 *On Incr Signal Output Incr/Decr INCR.
71 Gauges YES By-pass N/A
72 *Cam Characteristic MODIFIED EP
73

SWITCHES
74 Type PROX Quantity 2
75 *Mfr & Model GO - SWITCH 75-13523-A
76 Contacts/Rating
77 Actuation Points OPEN / CLOSED
78

AIR SET
79 *Mfr & Model VALTEK COALESCING
80 *Set Pressure
81 Filter N/A Gauge N/A
82

TESTS
83 *Hydro Pressure
84 ANSI/FCI Leakage Class
85
86

Rev	Date	Revision	Orig	App

*Information supplied by manufacturer unless already specified.

ISA FORM S20.50, Rev. 1

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CONTROL VALVE DATA SHEET

Second Printing

PROJECT HAZARDOUS WASTE TANKS - LINE C TANKS
RADFORD ARMY AMMUNITION PLANT
STONE & WEBSTER ENGINEERING CORP.
ITEM
CONTRACT 5962896
•MFR. SERIAL

DATA SHEET A-34 of 54
SPEC 16900 REV. 0
TAG LV~~220~~ 100
DWG
SERVICE SETTLING PIT ~~3056~~ 3020

1 Fluid ACIDIC WATER — Crit Press PC

SERVICE CONDITIONS	Units	Max Flow	Norm Flow	Min Flow	Shut-Off
2 Flow Rate	GPM	*	*	*	—
3 Inlet Pressure	PSI	*	*	*	*
4 Outlet Pressure	PSI	*	*	*	*
5 Inlet Temperature	°F	AMB	AMB	AMB	AMB
6 Spec Wt/Spec Grav/Mol Wt	-	1.00	1.00	1.00	—
7 Viscosity/Spec Heats Ratio	lbf-sec/ft²	2.05x10⁻⁵	2.05x10⁻⁵	2.05x10⁻⁵	—
8 Vapor Pressure P_v	lbf/ft²	48.9	48.9	48.9	—
9 *Required C_v					—
10 *Travel	%				0
11 Allowable/*Predicted SPL	dBA	/	/	/	—
12					

LINE

13 Pipe Line Size & Schedule — In [redacted] 12 IN. SCH-10 S.S.
14 Out [redacted] 12 IN. SCH-10 S.S.
15 Pipe Line Insulation

VALVE BODY/BONNET

16 *Type BUTTERFLY
17 *Size ____ ANSI Class 150
18 Max Press/Temp 100 / 150 °F
19 *Mfr & Model VALTEK VALDISK 150
20 *Body/Bonnet Matl 316 SS
21 *Liner Material/ID N/A
22 End Connection In *
23 Out *
24 Flg Face Finish ANSI B16.5-81
25 End Ext/Matl N/A
26 *Flow Direction SHAFT DOWNSTREAM
27 *Type of Bonnet STD
28 Lub & Iso Valve ____ Lube ____
29 *Packing Material PTFE
30 *Packing Type V-RING SINGLE
31

TRIM

32 *Type ECCENTRIC-CAMMED DISK
33 *Size 10" Rated Travel 90 Deg
34 *Characteristic EQUAL PERCENT
35 *Balanced/Unbalanced N/A
36 *Rated C_v * F_L ____ X_T ____
37 *Plug/Ball/Disk Material 316 SS
38 *Seat Material PFA VITON
39 *Cage/Guide Material N/A
40 *Stem Material 17 - 4 PH
41
42

SPECIALS/ACCESSORIES

43 NEC Class ____ Group ____ Div ____
44 TAG: LV[redacted] 100 Fail Open Valve
45 I/P TRANSDUCER
46
47 * TO BE DETERMINED AFTER
48 FINAL SETTLING PIT PUMP
49 SELECTION
50
51
52

ACTUATOR

53 *Type SPRING - CYLINDER
54 *Mfr & Model VALTEK VR CYLINDER
55 *Size 50 EXT Eff Area ____
56 On/Off ____ Modulating X
57 Spring Action Open/Close OPEN
58 *Max Allowable Pressure 150 PSI
59 *Min Required Pressure 60 PSI
60 Available Air Supply Pressure:
61 Max ____ Min ____
62 *Bench Range ____ / ____
63 Actuator Orientation STD
64 Handwheel Type N/A
65 Air Failure Valve OPENS Set at ____
66

POSITIONER

67 Input Signal 4-20 mA
68 *Type ELECTRO - PNEUMATIC
69 *Mfr & Model VALTEK XL I/P
70 *On Incr Signal Output Incr/Decr INCR.
71 Gauges YES By-pass ____
72 *Cam Characteristic MODIFIED EP
73

SWITCHES

74 Type PROX Quantity 2
75 *Mfr & Model GO - SWITCH 75-13523-A
76 Contacts/Rating ____
77 Actuation Points OPEN / CLOSED
78

AIR SET

79 *Mfr & Model VALTEK COALESCING
80 *Set Pressure N/A
81 Filter YES Gauge N/A
82

TESTS

83 *Hydro Pressure ____
84 ANSI/FCI Leakage Class ____
85
86

Rev	Date	Revision	Orig	App

*Information supplied by manufacturer unless already specified.

ISA FORM S20.50, Rev. 1

Appendix B

Pump Operating Sequence

All References to 3056 NIC

C Line Hazardous Waste Tanks Pump Operating Sequence

[redacted]

All power for controls off motor starter 480 V XFMR

These pumps are manually started and will run so long as the seal water flow switches and on delay relay contacts remain made. I presume that the intent of electrical schematic is to show maintained Start/Stop for these, making the seal-in contacts redundant. A maintained Start/Stop is the only way to ensure an automatic re-start after power loss. The auto re-start occurs after the power has been restored for 20 seconds.

B. 3056 P-5 (1000 GPM, 40 PSI) Controlled off LT 202

Controls dependent on 480 VAC XFMR and CP2 120 VAC, assorted flow switches, level transmitters, level switches and associated relays.

LT 202: 1 - 6.5 ft = 4-20 mA

Trip points: 5 mA (1.34 ft) - Stop P-5 on fall
5.5 mA (1.52 ft) - Start P-5 on rise
12 mA (3.75 ft) - Stop P-3 or P-4 on fall (15 sec delay), Start P-5
12.5 mA (3.9125 ft) - Activate P-3 or P-4 on Rise, Stop P-5 (15 sec delay)

Note: LV 220 is ranged 0% (Closed) to 100% (Open) for 4-12 mA
LV 222 is ranged 0% (Closed) to 100% (Open) for 8-20 mA

LS 203: LSL at 0.5 ft, LSH at 7.0 ft. Contacts open at trip points.

Trip points: At 0.5 ft stop P-3, P-4 and P-5 via AR 203B & CR 203
At 0.5 ft generate alarm at 3056, 3019, 3046
At 7.0 ft Initiate LY 202C to swap pumps
At 7.0 ft generate alarm at 3056, 3019, 3046

P-5 Manual operation: If everything is working as designed P- 5 can be run in Hand position so long as seal water flow switch FSL 217 is made, the Stop push button HS 217 B is not activated, and LSL 203 is satisfied (level > 0.5 ft).

P-5 Automatic operation: If everything is working as designed P-5 will start automatically at an increasing level of 1.52 ft in the tank so long as seal water flow switch FSL 217 is made, the Stop push button HS 217 B is not activated, and LSL 203 is satisfied (level > 0.5 ft).

If the tank level falls (outflow > inflow) the pump will continue to run until the level drops below 1.34 ft. Since the valve position is proportional to level the valve will be mostly closed off when the pump shuts off.

If the tank level rises (inflow > outflow) the pump will continue to run, and the control valve FV 220 will open in an attempt to maintain an equilibrium level. The valve position is controlled off

[redacted]

the valve will close. This will result in a low level at low flows, a high level at high flows. (No set point control).

If the inflow exceeds the pump's capacity the level will exceed 3.9 ft (12.5 mA) and LS 202 will trip the HI alarm point which will start sequencer KY 202A & 202B, which starts either P-3 or P-4 will be started by lead/lag alternator GY 202. If the level stays above 3.9 ft for 15 sec P-5 will be stopped. If the level drops below 3.9 ft for over 15 sec the P-3 or P-4 will then stop.

C. P-3 and P-4 (3000 GPM, 77 PSI) Controlled off LT 202, LS 203

Controls dependent on 480 VAC XFMR and CP2 120 VAC, and various relays.

P-3 and P-4 Hand Operation: If everything is working as designed P-3 and P-4 may be run in Hand position so long as seal water flow switches FSL 205/209 are made, the Stop Pushbuttons HS 205/209 B are not activated, and LSL 203 is satisfied (level > 0.5 ft).

P-3/P-4 Automatic Operation: In Auto these pumps are alternated off sequencer GY 202. These will run so long as seal water flow switches FSL 205/209 are made, the Stop push buttons HS 205/209 B are not activated, and LSL 203 is satisfied (level > 0.5 ft). GY 202 is the pump alternator which should run one pump one cycle, the other pump the next, the cycles based on level in the tank being above 3.9 ft (12.5 mA).

If the tank level rises the pump will continue to run, and the control valve FV 222 will open in an attempt to maintain an equilibrium level. The valve position is controlled off the level with a gain of 2.0. As the level rises due to increased flow the valve will open, as it falls the valve will close. Since P-3 or P-4 has excess capacity, the tank level will eventually start to fall and LT 202 will drop below 12 mA. At this point P-5 will be re-started and P-3 or P-4 will be stopped after 15 sec.

If the inflow exceeds pump/valve output the level will continue to rise.

At 7.0 ft level and P-3 or P-4 running, solenoid LY 222A is actuated which fully opens FV 222 (Vents actuator which is air to close).

D. 3058 P-1 and P-2 (500 GPM), Controlled off LS 309, LS 310.

Controls dependent on 480 VAC XFMR and CP2 120 VAC, and various relays

P-1 and P-2 Hand Operation: If everything is working as designed P-1 and P-2 may be run in Hand position so long as seal water flow switches FSL 311/314 are made, and the Stop push buttons HS 311/314 B are not activated.

P-1 and P-2 Auto Operation: In Auto mode the pumps are activated when the pit level reaches the 8 ft 4 in level in the selected pit. The selected pump remains on so long as seal water flow switches FSL 311/314 are made, and the Stop push buttons HS 311/314 B are not activated and until the level falls below 1 foot level.

E. 3058 P-3 (500 GPM), Controlled off FSL 317A.

Controls dependent on 480 VAC XFMR and CP2 120 VAC, and various relays

P-3 Hand Operation: If everything is working as designed P-3 may be run in Hand position so long as seal water flow switch FSL 317 is made, and the Stop Pushbutton HS 317B is not activated.

P-3 Auto Operation: In Auto mode the P-3 is activated only if P-1 or P-2 is running and the low flow switch FSL 317A detects low flow for 20 seconds. The pump remains on so long as seal water flow switch FSL 317 is made, and the Stop Pushbutton HS 317B is not activated and until P-1 and P-2 are both stopped.

SECTION 16902

CONTROL PANELS
08/95

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

This specification, together with the contract control panel drawings, covers the technical requirements for engineering, design, and fabrication of control panels.

The equipment furnished according to this specification shall conform exactly to the requirements contained herein, unless modified in writing by the Contractor.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Preconstruction Submittals

Documents to be Furnished with Proposal; G.

Contractor's proposal shall include:

1. Catalogs, brochures, and/or data sheets for Contractor furnished equipment.

2. Total shipping weight and weight of each section.

Documents to be Furnished after Purchase

The Contractor shall submit all drawings, sketches, and schematics prepared for the fabrication and wiring of the panels.

The drawings submitted shall include the following:

1. Instrument general arrangement and graphic display.

2. Fabrication and dimensional drawings for setting panels in place.

3. Wiring and schematic diagrams.

4. Point to point wiring drawings showing field and panel terminal connections.

5. Rear panel equipment arrangement.

1.3 DELIVERY, STORAGE, AND HANDLING

Panels quoted shall be F.O.B. jobsite. The control panel sections shall be crated using a heavy skid and shall be cushioned to protect the finish of

the instruments and panel face. Instruments mounted in cases or shelves shall be removed and boxed in their original shipping cartons with shipping stops in place prior to transporting the panel.

Panels shall be capable of being shipped upright in an "air ride" van. They shall be lifted using removable lugs without causing frame distortion when raised.

PART 2 PRODUCTS

2.1 WORK, MATERIALS, AND SERVICES PROVIDED BY THE CONTRACTOR

Design and fabrication of a complete control panel assembly.

Instruments and components as specified.

Install and wire supplied instruments and components.

Install and wire supplied panel inserts, if any.

Shop tests of the assembled panel.

Packaging and shipping panel to site.

Documentation and drawings.

Panel front layout drawings.

Panel inserts, layout, and wiring diagrams.

Receiving, unpacking, inspection, and storage of panel sections at site.

Installation of panel including mounting and connection of field wiring.

Control room arrangement.

Elementary and loop diagrams.

Instrument list of furnished instrument items.

Field testing of panel as installed.

2.1.1 ADDITIONAL PANELS FOR BLDGS 3002, 3019, and 3046

1. Contractor shall supply a new annunciator panel at Buildings 3002, 3019, and 3046 (total of 3) as specified as follows.

2. Contractor shall work with the contracting officer as to the location of the annunciator panel in each building and as to the location of the 120 V power supply for each panel.

3. Annunciators shall be solid state, integral architecture, powered from external 120 V AC with internal power supply providing 24 VDC for field contact interrogating voltage, dry contact input (field adjustable for normally open or normally closed) complete with horn, horn relay, TEST -ACKNOWLEDGE pushbuttons, and alarm windows all in a NEMA 4 surface mount enclosure.

4. Annunciator windows shall be in a 2 x 2 configuration, each window approximately 3 inches by 3 inches, with white background and black 114 inch lettering.

5. Annunciator sequence shall be ISA sequence A with the following features:

- Acknowledge and test pushbuttons
- Alarm audible device
- Lock-in of momentary alarms until acknowledged
- The audible device is silenced and the flashing stops when acknowledged
- Automatic reset of acknowledged alarm indication when process condition returns to normal
- Operational test

Annunciator engraving for Building 3002 shall be as follows:

- Master Nameplate: BUILDING 3002 ANNUNCIATOR
- Window 1-1: LAHH305B -PUMP TANKS 3058A or 3058B LEVEL HI HI
- Window 1-2: AHH308B -PUMP TANKS 3058A or 3058B pH HI HI
- Window 2-1: (Blank)
- Window 2-2 (Blank)

Annunciator engraving for Building 3019 shall be as follows:

- Master Nameplate: BUILDING 3019 ANNUNCIATOR
- Window 1-1: LAHH305C -PUMP TANK 3058A or 3058B LEVEL HI HI
- Window 1-2: AHH308C -PUMP T ANK 3058A or 3058B pH HI HI
- Window 2-1: LA204C -SETTLING PIT OVERFLOW CHAMBER 3056 LEVEL HI HI
- Window 2-2: (Blank)

Annunciator engraving for Building 3046 shall be as follows:

- Master Nameplate: BUILDING 3046 ANNUNCIATOR
- Window I-I: LAHH305D -PUMP TANK 3058A or 3058B LEVEL HI HI
- Window 1-2: AHH308D -PUMP TANK 3058A or 3058B pH: HI HI
- Window 2-1: LA204D - SETTLING PIT OVERFLOW CHAMBER 3056 LEVEL HI HI
- Window 2-2: (Blank)

2.2 CONSTRUCTION

The control panel front mounting surface shall be fabricated of hot rolled steel with a minimum thickness of 3/16 inch. All other panel sides shall be 11 gauge minimum. The panels shall be of NEMA 12 indoor construction suitably reinforced to provide sturdy, freestanding, rigid units. The panel shall be arranged for floor mounting with bottom or top cable entry, as specified.

Vibration dampeners shall be furnished, with a load capacity to limit the normal deflection to within 1/8 inch.

Internal fluorescent lighting and 120V, 20-amp utility receptacles shall be provided for each panel.

Panel dimensions shall conform to the overall dimensions shown on the contract control panel drawings. Multiple sections shall be furnished when the panel length exceeds 10 feet or when the overall length is excessive for shipping, handling, and installation.

Removable lifting lugs shall be provided on top of the panel to allow for four point lifting.

Rack mounted accessory items, relay cabinets, conduit, wireways, and other equipment mounted on the rear of the panel shall be supported by the rear steel framework. Panel face, removable panels, doors, etc. shall not be used to provide support structures. Panel structural steel or additional members shall not interfere with or otherwise hinder the accessibility of all instruments for maintenance or ease of removal.

2.3 PANEL WIRING

Panel wiring shall be provided to inter-connect electronic loop components, alarms, relays, annunciator, power supplies, switches, indicating lights, and other control devices within the control panel.

The wiring will consist of electronic signal (4 to 20 maDC), control (120V AC), low level signal (millivolt) and power supply (24V DC, 120V AC). Each type of wiring shall be run in separate conduit or wireways, grouped, and separated to eliminate electrical interference. Power or control wiring shall be separated from signal wiring by at least 6 inches. If the power wiring has to cross the signal wiring, the crossing shall be as close to right angles as possible.

Electrical wiring shall be arranged so that all conductors entering or leaving the control panel are terminated on barrier type terminal strips, located at the rear of individual panels. Separate terminal strips shall be provided for connecting electronic signal, low level signal, control AC and DC power supply wiring. Parallel terminal strips shall be separated by a minimum of 6 inches.

Instrument input/output, switches, contacts, indicating lights, and other components shall be individually wired to permit removal and testing without disconnecting other components in the same control loop or circuit. "Daisy chain" wiring between instruments, neutrals, or grounds between different control circuits is not permitted.

All wiring connections shall be terminated with lugs and not more than two wires shall be connected to one terminal.

Terminal strips shall be phenolic with screw terminals suitable for No. 12 AWG wire as a minimum. Twenty percent spare terminals shall be provided for each row of terminal strips. Terminal strips shall be furnished with fanning strips and termination designations. A sleeve type wire marker, engraved with wire number, shall be permanently affixed to each wire at both ends.

Wire and cables shall be routed through conduit or plastic covered wireways. Wiring ducts shall be provided for incoming cables. Branch wiring shall be grouped and tied with tie wraps for neatness. Sufficient lengths of wire and cable shall be provided to permit removal of instruments and accessories without disconnecting component from the board wiring.

Panel wiring shall have stranded conductors with type of insulation, wire gauge, and rating as follows:

Service	Wire Size	Rating	Insulation
Instrument and Low Level Signal	No. 16 AWG	600 volt	SIS
Control Circuit and Power	No. 14 AWG	600 volt	SIS
SIS Incoming Power (120VAC)	No. 12 AWG	600 volt	XHHW

2.4 GROUND AND NEUTRAL BUS

A copper isolated instrument ground bus, 1/4" by 1", shall be furnished to ground signal shields, signal common, and instrument power supply common. A solderless lug connector shall be furnished at the end of the panel for a 4/0 stranded cable.

A copper isolated neutral bus, 1/4" by 1", shall be furnished to terminate the common AC neutral wires.

2.5 COMPONENTS

2.5.1 Pushbuttons and Indicating Lights

Pushbuttons, switches, and indicating lights shall be heavy duty, oil tight type. The pushbuttons and selector switches may have momentary or maintained contacts depending on circuit design. Contacts shall be rated at 5 amperes, 120V AC or 5 ampere, and 24V DC, continuously.

Indicating lights shall be single lens low voltage type with built-in dropping resistor for 6 volt lamp.

Unless otherwise specified, the color lens shall indicate the following:

Red Motor Running
Device Energized
Valve or Damper Open (On-Off)
Normal Path (3-Way Valve)
Power - On

Blue Supervisory or automatic indication

Green System Ready indication
Circuit Breaker Open
Valve or Damper Closed (On-Off)
Branch Flow Path (3-Way Valve)

Amber Permissive

White Alarm indication

2.5.2 Relays

Relays used for interlocks and alarms shall be of the industrial type, rated at 600 volts. Contacts shall be convertible type, rated at 10 amperes, with molded coil to operate at the voltage specified on the applicable drawings. Contact form and quantity for each relay shall be as called for on the elementary and loop diagrams.

2.6 POWER SUPPLY DISTRIBUTION

Power supply circuits shall be furnished for each panel section as follows:

120V AC - From UPS for instrument power supply
120V AC - For miscellaneous AC control circuits and panel power
120V AC - Lighting and convenience receptacles

All instruments related to the same control loop shall be serviced from the same power supply circuit. Multi-loop and individual power supplies furnished with instruments shall be mounted and fused.

A fused circuit breaker shall be furnished for each power supply and individual control circuit.

24 volt DC instrument power supply wiring shall be run in wireways separate from AC power. A common wireway may be used if they are separated by a barrier.

2.7 PAINTING AND FINISHING

Panel shall be free of rust, scale, distortion, and warpage. Surface shall be sandblasted with No. 00 grit, and shall be painted with two coats of rustproof primer and two coats of semi-gloss air dried lacquer. Panel color shall be as specified. Panel interior shall be primed and painted white.

2.8 INSTRUMENT NAMEPLATES

A nameplate shall be furnished for each instrument located on the front of the panel. They shall measure in accordance with dimensions on panel drawings or nameplate list.

Nameplates shall be manufactured of 3/32 inch thick white laminate having a black core and engraved with the inscription listed on the panel drawings or nameplate list. The characters shall be arranged symmetrically about the plate's vertical center line and formed by cutting through the laminate into the black core.

PART 3 EXECUTION

3.1 PANEL INSPECTION

Test instrumentation, personnel, and facilities shall be provided for shop tests of the panel. Panel inspection shall consist of checking general appearance, workmanship, and conformance with the contract drawings. Nameplates, wire tags, and similar markings shall be checked for proper location and identification.

3.2 SHOP TESTS

The panel shall be completely tested and checked out to assure a trouble-free, working installation in the field. Contractor shall be responsible for all testing, repair, and re-testing as outlined in this specification.

Complete records shall be kept of all tests and test reports. These shall be made available for inspection and approval.

Shop demonstration may be witnessed. At least two (2) weeks notice prior to testing is required in order that representatives may witness such tests

at their discretion.

Point to point wiring continuity checks shall be performed prior to energizing the panel.

Shop tests shall consist of initial tests of all components and sub-assemblies along with, to the extent reasonably possible, a full functional test of the complete system and all auxiliary equipment. This test shall be performed with all equipment connected in the same manner as it will be in the field to permit verification of proper system operation. After complete assembly, each circuit shall be tested to ground, rung out, and functionally tested under simulated service conditions. All wiring shall be checked by actual operating tests for accurate conformity to wiring diagrams and for continuity. This scope is not intended to include internal PLC functions or software.

Contractor shall supply testing and calibration facilities along with all dummy inputs and outputs necessary to simulate field conditions.

Functional and operational tests shall be performed for all devices such as recorders, annunciators, indicators and lights. All indication, alarm, and interlock circuits shall be tested to ensure proper operation. Recorder pens shall be set at zero, half scale, and full scale using suitable test inputs. Alarm set points shall be adjusted to values provided and actuated to alarm their corresponding annunciator points.

Control packages, which are furnished as panel inserts, do not require calibration or functional testing.

Test procedures and type of test equipment shall be submitted for information.

Supplied components, which are found to be defective or damaged, shall be replaced without cost. If any furnished component is found to be faulty, the supplier shall be notified for disposition.

3.3 FIELD ACCEPTANCE

Field acceptance tests for the control panel and all the devices mounted thereon will be performed for installation and connection of all external wiring.

Services of an engineer may be required to provide technical direction for installation and field acceptance testing.

-- End of Section --