03.15-3/24/95-01564

DEPARTMENT OF THE NAVY

ATLANTIC DIVISION, NAVAL FACILITIES ENGINEERING COMMAND

NAVAL STATION, NORFOLK, VIRGINIA

LANTDIV RAC Contract No.
N62470-93-R-3302

N62470-94-B-4800
NAVFAC Specification No. 05-94-4800
Appropriation: DERA

SOIL AND GROUNDWATER REMEDIATION
OPERABLE UNIT NO. 2
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

Design by:

BAKER ENVIRONMENTAL, INC.
AIRPORT OFFICE PARK, BUILDING 3
420 ROUSER ROAD
CORAOPOLIS, PENNSYLVANIA 15108

Specification Prepared by:

BAKER ENVIRONMENTAL, INC.

Specification Approved by:

Specification Branch Head: _____
M. D. Mutter, P.E.

Engineering and Design Division Director: _____
W. H. Crone, P.E.

Environmental Quality Division Director: _____
W. H. Russell, P.E.

Date: _____

PROJECT TABLE OF CONTENTS

SECTION 01010

GENERAL PARAGRAPHS

PART 1 GENERAL

1.1 REFERENCES

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

CORPS OF ENGINEERS (COE)

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

MILITARY STANDARDS (MIL STD)

MIL STD 461	(Rev C) (Notice 2) Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL STD 462	(Notice 6) Measurement of Electromagnetic Interference Characteristics

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	1989 Safeguarding Construction, Alteration, and Demolition Operations

1.2 PRECONSTRUCTION SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.2.1 SD-18, Records

a. Work Plan G

1.2.1.1 Work Plan

Within 60 days of issuance of the delivery order, submit a work plan consisting of the following elements.

a. Narrative

Provide a brief description of the project objectives, scheduling, sampling and analysis requirements, decontamination procedures, site work and excavation procedures, construction requirements, and storage, transportation, and removal requirements.

b. Technical Specifications

Provide, in an amendment format, any additions and modifications to

the contract specifications required to accurately describe the materials and work procedures envisioned to satisfy the requirements of the delivery order. Contact Code 406, Specifications Branch, Engineering and Design Division, LANTNAVFACENGCOM, (804)444-9906, for availability of guide specification sections for those sections required, but not included in the contract documents.

c. Shop Drawings

Shop drawings shall detail and describe all components of the project not currently indicated on the contract drawings such that the shop drawings and the contract drawings, when taken together, provide a complete representation of the project requirements. Shop drawings shall include, but not be limited to:

(1) an Erosion Control Plan in accordance with State and local regulations, consisting of site plans indicating locations of erosion control features during the various states of construction, details of erosion control features, and applicable notes;

(2) civil/structural drawings providing details of building and building foundations;

(3) treatment system equipment general arrangements showing appropriate elevation sections of the items depicted in the drawings;

(4) piping and mechanical drawings defining all pipe routing at the site, piping details such as instrument and valve locations, heat tracing and insulation, utility tie-in and discharge points (i.e., water, steam, etc.), details on drainage requirements (i.e, sumps, storm sewers, curbs, etc.), and details on HVAC for the building;

(5) instrument and control drawings defining control loops, motor connections (using point to point wiring diagrams), control panel details, all necessary ladder logic for control schemes, conduit routing cable/conduit schedules, and instrument installation/location details, electrical drawings defining building lighting and fixture;

(6) general building electrical requirements (i.e., 110 VAC outlets, telephone lines, etc.), details on electrical tie-points, and all necessary wiring schematics for motor control centers (MCCs).

d. Environmental Protection Plan

Within 15 days of issue of delivery order, meet with the Navy's Technical Representative (NTR) to discuss environmental protection requirements for the project. After meeting with the NTR, prepare, and submit an Environmental Protection Plan in accordance with Section C, Part 4.0, of the Basic Contract.

e. Site Health and Safety Plan

Provide a site specific Site Health and Safety Plan in accordance with Section C, Part 3.0, of the Basic Contract.

f. QC Plan

Provide a QC Plan in accordance with Section C, Part 6.0, of the Basic Contract.

(1) Submittal Register

As part of the QC Plan, submit a completed Submittal Register to document quality control for materials, inspection, and testing in accordance with Section C, Part 7.0 of the Basic Contract. A copy of the Submittal Register is provided in Attachment 01010-A.

(2) Testing Laboratory Qualifications

As part of the QC Plan, submit qualifications for each laboratory which will be used in accordance with Section C, Part 6.0, of the Basic Contract.

g. Sampling and Analysis Plan

Provide a Sampling and Analysis Plan describing all sampling and analyses requirements and procedures for the delivery order. The Plan shall contain a field sampling plan and a quality assurance plan.

1.2.2 Forwarding Preconstruction Submittals

Within 60 days of issuance of the delivery order, and before procurement, fabrication, or mobilization, submit to the Architect-Engineer: Baker Environmental, Inc., Airport Office Park, Building 3, 420 Rouser Road, Coraopolis, PA 15108, and to distribution as directed, the preconstruction submittals required in this specification. The Architect-Engineer for this project will review the Work Plan for the NTR to determine compliance of the Contractor's Work Plan with the requirements of the contract documents for this delivery order.

1.2.3 Review Comments

The Contractor's Work Plan will be reviewed. The NTR will compile and coordinate all Government review comments, and forward consolidated review comments to the Contractor. Review comments on the Work Plan shall be resolved, and submittals modified as required. After the correction of the submittals, submit one corrected final copy of the Work Plan to the NTR for final review. The Work Plan shall be approved prior to commencement of any other work associated with this delivery order.

1.3 SUBMITTALS

Submit the following in accordance with Section C of the Basic Contract.

1.3.1 SD-18, Records

a. As-Built Records G

b. Environmental Condition Report

c. Network Analysis Diagram

d. Status Reports

e. QC Meeting Minutes

f. Test Results Summary Report

g. Contractor Production Report

h. QC Report

i. Rework Items List

j. Permits

k. Contractor's Closeout Report

1.3.1.1 As Built Records

Maintain two sets of full size contract drawings and two sets of full size approved shop drawings marked to show any deviations which have occurred, including buried or concealed construction and utility features revealed during the course of construction. Record horizontal and vertical locations of buried utilities that differ from the contract drawings. Show the size, manufacturer's name, model number, capacity, and electrical power characteristics of the equipment installed. These drawings shall be available for review by the NTR at any time. At the completion of the work, deliver marked sets of the contract drawings to the NTR. Contractor shall incorporate all shop drawing deviations, and deliver one complete set of reproducible sepias of the shop drawings to the NTR.

1.3.1.2 Environmental Condition Report

Prior to starting work, perform a preconstruction survey with the NTR. Take photographs showing existing environmental conditions on and adjacent to the site. Prior to starting work, submit the results of the survey in an Environmental Condition Report to the NTR.

1.3.1.3 MIS Required Sorts

The MIS system shall be a system able to provide, as a minimum, the activities in sorts or groups as specified in the Basic Contract and any subsequent Delivery Orders.

a. Network Analysis Diagram

Within 30 days of approval of the Contractor's Work Plan, submit a Network Analysis Diagram in accordance with the Basic Contract and any

subsequent Delivery Orders.

b. Status Report

All Status Reports shall comply with the Basic Contract and any subsequent Deliver Orders. Submit a Technical Progress Report, Cost Performance Report, Modification Log, Time-Scaled Logic Diagram, Government Materials Tracking Report, Variance Analysis Report, and Waste Materials Report. Submit the first delivery order Status Report approximately 30 days after approval of the Contractor's Work Plan. Thereafter, submit Status Reports every 30 days. Status report periods shall be consistent with the invoice reporting periods.

1.3.1.4 QC Meeting Minutes

The QC Representative shall document all QC meetings by delivering copies of the minutes to the NTR within 3 calendar days after each QC meeting. The submittals shall comply with Section C, Part 6.0 of the Basic Contract.

1.3.1.5 Test Results Summary Report

A summary report of all field tests containing both "required" and "actual" results plus "passed" or "failed" for conforming, non-conforming and repeated test results shall be submitted to the NTR at the end of each month in accordance with Section C, Part 6.0 of the Basic Contract.

1.3.1.6 Contractor Production Report (CPR)

The CPR shall be prepared and submitted daily to the QC Representative in accordance with Section C, Part 6.0, of the Basic Contract.

1.3.1.7 QC Report

The QC Report shall be submitted by the QC Representative to the NTR every day work is performed, material is delivered, direction is pending, or a labor force is present in accordance with Section C, Part 6.0, of the Basic Contract.

1.3.1.8 Rework Items List

The QC Representative shall deliver a copy of the rework items list to the NTR on a monthly basis in accordance with Section C, Part 6.0, of the Basic Contract.

1.3.1.9 Permits

Fifteen days prior to beginning onsite work, submit draft copies of the following permits required for onsite activities:

a. Excavation Permit; from the Public Works Officer, Utilities Division

b. Welding and Burning Permit; from the Base Fire Marshall

1.3.1.10 Contractor's Closeout Report

Submit upon completion of the project. This report shall include: Introduction, Summary of Action, Final Health and Safety Report, Summary of Record Documents, Field Changes and Contract Modifications, Final Documents, summary of Chemical and Geotechnical Testing, Offsite Disposition of Materials, Groundwater Recovery Report, Summary of Final Testing Results, and QC Summary report.

1.3.2 Forwarding Submittals

As soon as practicable after award of the contract, and before procurement or fabrication, submit, except as specified otherwise, to the NTR, the submittals required in this specification. The Architect-Engineer for this project will review and provide surveillance for the NTR to determine if Contractor-approved submittals comply with the contract requirements, and will review and approve for the NTR those submittals not permitted to be Contractor approved to determine if submittals comply with the contract requirements. At each "Submittal" paragraph in the individual specification sections, a notation "G", following a submittal item, indicates the NTR is the approving authority for that submittal item. One copy of the transmittal form for submittals shall be forwarded to the NTR.

1.4 GENERAL INTENTION

It is the declared and acknowledged intention and meaning to provide and secure a groundwater extraction and treatment system, an in situ vacuum extraction system and a soil and debris removal action at Operable Unit No. 2, Marine Corps Base, Camp Lejeune, North Carolina.

1.5 GENERAL DESCRIPTION AND SITE LOCATION

a. The work includes installation of a groundwater treatment system and building, groundwater extraction wells, and incidental related work.

b. The work includes installation of an in situ vacuum extraction systems and building, vacuum extraction wells, and incidental related work.

c. The work includes removal and disposal of contaminated soil and debris from five (5) soil areas of concern (AOCs), and incidental related work.

d. Operable Unit (OU) No. 2 is located approximately 2 miles east of the New River and 2 miles south of State Route 24 on the main section of Marine Corps Base (MCB) Camp Lejeune, North Carolina. The OU is boardered by Holcomb Boulevard to the west, Sneads Ferry Road to the south, Piney Green Road to the east, and by Wallace Creek, which makes up the northern boundary. OU No. 2 covers an area of approximately 210 acres.

1.6 DESCRIPTION OF CONTAMINANTS PRESENT

Site investigation performed to date have identified the presence of volatile organic compounds (VOCs) in the shallow aquifer (less than 30 feet) and the Castle Hayne Aquifer (greater than 100 feet). The VOCs detected include chlorobenzene, chloromethane, 1,4-dichlorobenzene, 1,2-dichloroethane, 1,1-dichloroethane, total-1,2-dichloroethene, methylene chloride, tetrachloroethane, 1,1,2-trichloroethane, thrichloroehtene (TCE), vinyl chloride, benzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, ethylbenzene, toluene and total xylenes. Many of the VOCs detected exceed Federal Maximum Contaminant Levels (MCLs) for drinking water. Metals detected include aluminum, arsenic, barium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, vanadium, and zinc. In general, semi-volatile organic compounds are not considered contaminants of concern.

In addition to AOC 1, site investigations performed to date have identified the presence of surface and subsurface contamination at five (5) soil AOCs:

a. Soils in the ravine area (AOC 2) are contaminated with polynuclear aromatic hydrocarbons (PAHs), PCBs, and metals. In addition, AOC 2 contains various debris, including, but not limited to , empty and partially filled 55-gallon drums, 1 and 5 gallon pails, battery packs, and shell casings. The site also contains construction debris including, but not limited to, scrap metal, porcelain bathroom fixtures, metal lockers and furniture.

b. AOC 3 contains PCB contaminated soil

c. AOC 4 contains PCB contaminated soil.

d. AOC 5 contains pesticide contaminated soil.

e. AOC 6 contains PCB contaminated soil.

1.7 LOCATION

The work shall be located at Operable Unit No. 2, Marine Corps Base, Camp Lejeune, approximately as shown. The exact location will be indicated by the NTR.

1.8 PROJECT INFORMATION

1.8.1 Drawings, Maps and Specifications

Four sets of contract drawings, maps and specifications will be furnished to the Contractor without charge, except applicable publications incorporated into the technical provisions by reference. Additional sets will be furnished on request at no charge. The work shall conform to the following contract drawings and maps, all of which form a part of these specifications and are available in the office of the NTR.

EFD Drawing No.	NAVFAC Drawing No.	Title	Sheet No.
		Vicinity and Location Map and General Notes	T-1
		Overall Site Plan and New Piping Plan	C-1
		Soil AOC 1	C-2
		Soil AOC 2 and AOC 3	C-3
		Soil AOC 4 and 5	C-4
		Soil AOC 6	C-5
		Site Plan - Groundwater Treatment Plant	C-6
		Groundwater Recovery - New Piping Plan	C-7
		Groundwater Discharge - New Piping Plan	C-8
		Groundwater Treatment Plant - General Arrangement	C-9
		Recovery Well Details	C-10
		Details	C-11
		Process Flow Diagram - Pretreatment System	P-1
		Process Flow Diagram VOC Removal System	P-2
		P & ID Symbols & Legends	P-3
		P & ID - Extraction System Diagram	P-4
		P & ID - Pretreatment System Drawing 1	P-5
		P & ID - Pretreatment System Drawing 2	P-6
		P & ID - VOC Removal System	P-7
		Architectural Building Elevations	A-1
		Mechanical Systems Design Layout	M-1
		Symbol List & Legend	E-1
		Electrical Site Plan	E-2
		Lighting Plan	E-3
		Power Plan	E-4
		Main Distribution & Details	E-5
		Site Pump Single Line & Details	E-6

1.8.2 Reference Report

The following reference reports are available for examination in the office of the NTR and are intended only to show the existing conditions. The reports and drawings are the property of the Government and shall not be used for any purpose other than that intended by the specification.

Reports

Baker Environmental, Inc., 1993. Remedial Investigation Report for Operable Unit No. 2 (Sites 6,9, and 82), Final. August 1993.

Baker Environmental, Inc., 1993. Feasibility Study for Operable Unit No. 2 (Sites 6, 9, and 82), Final. August 1993.

Baker Environmental, Inc., 1994. Project Plans, Contaminated Soil and Groundwater Remedial Design, Operable Unit No. 2,, Final. February 1994.

1.9 PROJECT SCHEDULE AND TIME CONSTRAINTS

The Contractor shall be required to (a) commence work under this contract within 10 calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 360 calendar days after the required notice to proceed. The time stated for completion shall include final cleanup of the premises. The time stated for completion does not include the maintenance period for the seeding of disturbed areas.

1.10 SAFETY PROGRAM

In addition to safety requirements in the Basic Contract, the Contractor shall implement a safety program conforming to the requirements of Federal, state, and local laws, rules and regulations as specifically related to contaminated soil removal and treatment operations. The program shall include, but is not limited to, the following:

a. Occupational Safety and Health Standards

b. COE EM-385-1-1

c. NFPA 241

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 FACILITIES AND SERVICES

3.1.1 Availability of Utilities Services

a. The Government shall supply potable and non-potable water required to perform work to the Contractor. The water source location is an 8-inch water main to be installed along Piney Green Road to a point approximately 1300 feet south of Building 651. Work shall be coordinated with the Base Utilities Branch (Mr. Carl Baker, 910-451-5024). The Contractor shall provide all piping, hoses, pumps, and connections to transport water to the desired locations on site. The Contractor shall also provide a backflow-prevention

device and metered connections to the water source. The Contractor shall be responsible for payment arrangements with base.

b. The Government shall supply reasonable amounts of temporary power to the Contractor. The Contractor shall provide all equipment and labor to the work. The Contractor shall make connections, including providing meters, and make disconnections.

c. The Contractor shall not operate nor disturb the setting of control devices in the base utilities system, including water, sewer, electrical and steam services. The Government will operate the control devices as required for normal conduct of the work. The Contractor shall notify the NTR giving 2 days advance notice when such operation is required.

d. The Contractor shall contact Base Telephone Services in writing to obtain telephone connection and payment information. Cost for telephone connection will be paid by the Contractor. The Contractor shall provide all equipment and labor necessary to connect the telephone service to the site. The Contractor shall make arrangements for connections and disconnections and payments.

3.1.2 Storage in Existing Buildings

Storage in existing buildings will not be allowed.

3.1.3 Open Site Storage Size and Location

The open site available for storage shall be confined to the areas indicated on the contract drawings.

3.1.4 Trailers, Storage, and Temporary Buildings

Locate these where directed. Trailers or storage buildings will be permitted, where space is available subject to the approval of the NTR. The trailers or buildings shall be in good condition, free from visible damage, rust and deterioration, and meet all applicable safety requirements. Trailers shall comply with all appropriate state and local vehicle requirements. Failure of the Contractor to maintain the trailers or storage buildings in good condition will be considered sufficient reason to require their removal. A sign not smaller than 24 inches by 24 inches shall be conspicuously placed on the trailer depicting the company name, business phone number, and emergency phone number. Trailers shall be anchored to resist high winds and must meet applicable state or local standards for anchoring mobile trailers.

3.1.4.1 Storage and Office Trailers

Provide a trailer of sufficient size for an office trailer work area and floor area for the exclusive use of the Contractor's Quality Control Representative. Also provide room in the same trailer for the Quality Control Records. Provide the Quality Control representative with a 4-foot by 8-foot plan table, a standard size office desk and chair, and telephone service. Quality control records shall be filed in the office and available at all times to the Government.

a. Trailers must meet state station requirements and must be in good condition.

b. Trailers shall be lockable and shall be locked when not in use.

c. Trailers shall have a sign in the lower left hand corner of left door of trailer with the following information: company name, address, registration number of trailer or vehicle identification number, location on base, duration of contract or stay on-base, contract number, local on-base phone number, off base phone number of main office, and emergency recall person and phone number.

3.2 RESTRICTIONS ON OPERATIONS

3.2.1 Scheduling

3.2.1.1 General Scheduling Requirements

The work areas will remain in operation during the entire construction period. The Contractor shall schedule the work as to cause the least amount of interference with Base operations. Work schedules shall be subject to the approval of the NTR. Permission to interrupt Base roads shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption.

3.2.1.2 Regular Work Hours

The regular work hours for the Marine Corps Base, Camp Lejeune, North Carolina, are 0730 to 1530, Monday through Friday.

3.2.1.3 Work Outside Regular Hours

If the Contractor desires to carry on work outside regular hours or on Saturdays, Sundays or holidays, the Contractor shall submit an application to the NTR. The Contractor shall allow ample time to enable satisfactory arrangements to be made by the Government for inspecting the work in progress. At night, the Contractor shall light the different parts of the work in an approved manner.

3.2.2 Security Requirements

Contractor shall comply with general security requirements in accordance with Section C of the Basic Contract. No employee or representative of the Contractor will be admitted to the work site without satisfactory proof of United States citizenship or is specifically authorized admittance to the work site by the NTR.

3.2.2.1 Extraordinary Security Requirements

The clause of the Contract Clauses entitled "Identification of Employees" and the following apply:

a. Contractor Registration: Register with the Pass Office located at the main gate.

b. Equipment Markings: Equipment owned or rented by the company will have the company name painted or stenciled on the equipment in a conspicuous location. Rented equipment is to be conspicuously marked with a tag showing who rented it. Register the equipment with the truck investigation team.

c. Procedure Information: For additional information regarding registration procedures, contact the Officer in Charge of Contractors at _____.

3.3 ACTIONS REQUIRED OF THE CONTRACTOR

The Contractor shall comply with all requirements stated in Section C, Part 2.0, of the Basic Contract.

3.3.1 Base Permits

Permits are required for, but not necessarily limited to, welding, digging, and burning. Allow 7 calendar days for processing of the application. One copy of all applicable permits shall be posted at the job site.

3.4 PUBLIC RELEASE OF INFORMATION

The Contractor shall comply with all requirements stipulated in Section C, Part 2.0, of the Basic Contract.

3.5 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined in Section C of the Basic Contract with additional requirements as follows.

3.6 REQUIRED INSURANCE

Insurance requirements from Section H of the Basic Contract are enforced in their entirety.

-- End of Section --

SUBMITTAL REGISTER (PART A)

Contract Number: 05944800 | Project Title: SOIL AND GROUNDWATER REMEDIATION - OU NO.

SPEC SECTION NO.	SD NO, AND TYPE OF SUBMITTAL MATERIAL OR PRODUCT	SPEC PARA NO.	CLASSIF/ APPR BY CO *	GOVT OR A/E REVIEWER	TRANS CONTROL NO.	PLANNED SUBMITTAL DATE
(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 01010	SD-18, Records	1.3.1				
2)	As-Built Records		G			
3)	Environmental Condition Report	1.3.1.2				
4)	Network Analysis Diagram	1.3.1.3				
5)	Status Reports					
6)	QC Meeting Minutes	1.3.1.4				
7)	Test Results Summary Report	1.3.1.5				
8)	Contractor Production Report					
9)	QC Report	1.3.1.7				
10)	Rework Items List	1.3.1.8				
11)	Permits	1.3.1.9				
12)	Contractor's Closeout Report	1.3.1.10				
13) 01430	SD-08, Statements	1.2.1				
14)	Sample Log					
15) 01430	SD-12, Field Test Reports	1.2.2				
16)	Confirmatory Sample Analysis					
17)	Results					
18)	Waste Characterization Sample					
19)	Analysis Results					
20) 01560	SD-08, Statements	1.3.1				

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

* NASA Notes:
Approved by:
Blank: Contracting Officer

* Army Notes:
Classification:
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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Class I ODS prohibition	1.4	G			
2)	MSDS	1.6	G			
3) 01560	SD-18, Records	1.3.2				
4)	Solid waste disposal permit					
5)	Disposal permit for hazardous	1.3.2.1	G			
6)	waste					
7) 02050	SD-08, Statements	1.4.1				
8)	Demolition plan					
9) 02220	SD-04, Drawings	1.3.1				
10) 02220	SD-08, Statements	1.3.2				
11)	Dewatering					
12) 02220	SD-12, Field Test Reports	1.3.3				
13)	Fill and backfill					
14)	Density tests					
15) 02223	SD-08, Statements	1.2.1				
16)	Treatment Facility Permit	1.2.1.1				
17) 02223	SD-18, Records	1.2.2				
18)	Shipment manifests	1.2.2.1				
19)	Delivery and disposal	1.2.2.2				
20)	certificates					

* Navy Notes:
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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Disposal Site Decontamination	1.2.2.3				
2)	certificate					
3)	Work Site Decontamination	1.2.2.4				
4)	certificate					
5) 02510	SD-05, Design Data	1.2.1				
6)	Job-mix formula	1.2.1.1				
7) 02510	SD-13, Certificates	1.2.2				
8)	Tack coat	2.1.3				
9)	Stone base course	2.1.2				
10)	Paint	2.1.4				
11) 02735	SD-02, Manufacturers Data	1.2.1				
12)	Bentonite seal					
13) 02735	SD-04, Drawings	1.2.2				
14) 02831	SD-02, Manufacturer's Catalog Data	1.2.1				
15)	Chain-link fencing	2.1				
16)	Accessories	2.1.3				
17) 02900	SD-02, Manufacturer's Data	1.3.1				
18)	Well Casing					
19)	Well Screen					
20)	Filter Pack Gradation Analysis					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Groundwater Recovery Equipment,					
2)	Complete					
3)	Manhole Sections, Slabs, Steps,					
4)	Frames and Cover					
5)	Groundwater Recovery Well					
6)	Building, complete					
7)	Casing Pipe					
8)	Carrier Pipe					
9) 02900	SD-12, Field Test Reports	1.3.2				
10)	performance of each recovery					
11)	well installed					
12) 02900	SD-13, Certificates	1.3.3				
13)	Certified Professional					
14)	Engineer's Statements, Designs, Plans and Reports					
15)	Certified Professional					
16)	Geologist's Plans and Reports					
17)	Laboratory Tests					
18) 02900	SD-19, Operation and Maintenance	1.3.4				
19)	Groundwater Recovery Equipment	2.5				
20) 02901	SD-02, Manufacturer's Catalog Data	1.2.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Programmable Logic Controller					
2)	Instrument Specifications and					
3)	Data Sheets					
4) 02901	SD-04, Drawings	1.2.2				
5)	Piping Design/Layout Drawings					
6)	(Plans and Elevations)					
7)	Instrument Loop Drawings					
8)	Control System Ladder Logic					
9)	Diagram					
10)	Cable/Conduit Layout Drawings					
11)	Control Panel Layout Drawings					
12)	Cable/Conduit Schedule (if					
13)	required)					
14)	MCC/Power Distribution					
15)	Schematics					
16) 02901	SD-19, Operations and Maintenance	1.2.3				
17)	Groundwater Treatment System					
18) 02902	SD-02, Manufacturer's Catalog Data	1.2.1				
19)	Piping and Fittings					
20)	PVC Solvent Cement					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Valves					
2)	Treatment System Control Panel					
3) 02902	SD-12, Field Test Reports	1.2.2				
4)	Vacuum Extraction System Test					
5)	Carbon Contactors					
6) 02902	SD-19, Operations and Maintenance	1.2.3				
7)	Vacuum Extraction System					
8) 03302	SD-13, Certificates	1.3.1				
9)	Cement					
10)	Aggregates					
11)	Admixtures					
12)	Reinforcement					
13)	Expansion-joint filler					
14)	Joint sealant					
15) 04230	SD-02, Manufacturer's Catalog Data	1.2.1				
16)	Anchors, ties	2.5				
17)	Wire reinforcement	2.5.1				
18)	Movement joints	2.8				
19) 04230	SD-04, Drawings	1.2.2				
20)	Details of steel reinforcement	1.2.2.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Lintels	2.6.6				
2) 04230	SD-08, Statements	1.2.3				
3)	Cold weather installation	3.2.1				
4)	Hot weather installation	3.2.2				
5) 04230	SD-10, Test Reports	1.2.4				
6)	Unit strength method	1.2.4.1				
7)	Prism test	1.2.4.2				
8)	Mortar properties	2.3.1				
9)	Grout	2.4				
10) 04230	SD-11, Factory Test Reports	1.2.5				
11)	Concrete masonry units	2.1				
12)	Clay or shale bricks	2.2				
13)	admixtures	1.2.5.1				
14) 04230	SD-12, Field Test Reports	1.2.6				
15)	Grout strength	3.6.2				
16)	Mortar strength and properties	3.6.1				
17) 04230	SD-13, Certificates	1.2.7				
18)	Concrete masonry units	2.1				
19)	Clay or shale bricks	2.2				
20)	Movement joints	2.8				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Masonry inspector	3.1				
2) 04230	SD-14, Samples	1.2.8				
3)	Concrete masonry units	2.1	G			
4)	Brick units	1.2.8.1	G			
5)	Colored mortar	2.3.2.4	G			
6) 04230	SD-16, Sample Panels	1.2.9				
7)	Sample panel	1.3.2				
8) 05500	SD-02, Manufacturer's Catalog Data	1.2.1				
9)	Handrails	2.4				
10)	Ladders	3.8				
11)	Structural steel door frames					
12)	Window guards					
13) 05500	SD-04, Drawings	1.2.2				
14)	structural steel door frames					
15)	Access doors and panels,					
16)	installation					
17)	Cover plates and frames,					
18)	installation					
19)	Handrails, installation					
20)	Ladders, installation					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Window guards, installation					
2)	angles and plates, installation					
3) 05500	SD-13, Certificates	1.2.3				
4)	Certificate	1.2.3.1				
5) 05500	SD-14, Samples	1.2.4				
6)	Aluminum surfaces	2.2.6				
7) 11300	SD-02, Manufacturer's Catalog Data	1.3.1				
8)	Groundwater Feed					
9) 11300	SD-04, Drawings	1.3.2				
10)	Conical tank roof					
11)	Vent					
12)	External connections					
13)	Liquid level controls mounting					
14)	brackets					
15)	Anchor bolt sizing and placement					
16)	Tank finish					
17)	Tank grounding					
18)	Tank foundation/support					
19)	requirements					
20) 11300	SD-19, Operation and Maintenance M	1.3.3				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Groundwater Feed Tank control					
2)	system					
3) 11302	SD-02, Manufacturer's Catalog Data	1.3.1				
4) 11302	SD-04, Drawings	1.3.2				
5)	Flanged and dished bolt down					
6)	cover					
7)	Vent					
8)	External connections					
9)	Liquid level controls mounting					
10)	brackets					
11)	Anchor bolt sizing and placement					
12)	Tank finish					
13)	Tank grounding					
14)	Tank foundation/support					
15)	requirements					
16) 11302	SD-06, Instructions	1.3.3				
17)	installation procedures					
18) 11302	SD-19, Operation and Maintenance M	1.3.4				
19)	Initial and Final pH Adjust					
20)	Tanks controls and Chemical Feed Systems/Controls					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 11303	SD-02, Manufacturer's Catalog Data	1.3.1				
2)	polymer feed system					
3) 11303	SD-04, Drawings	1.3.2				
4)	polymer feed system					
5) 11303	SD-06, Instructions	1.3.3				
6)	installation procedures					
7) 11303	SD-19, Operation and Maintenance M	1.3.4				
8)	polymer feed system					
9) 11304	SD-02, Manufacturer's Catalog Data	1.3.1				
10)	Tank mixers					
11)	Inclined plate clarifier					
12) 11304	SD-04, Drawings	1.3.2				
13)	Mixing chamber					
14)	Flocculation chamber					
15)	Bolt down cover					
16)	Plate packs					
17)	Vents					
18)	External connections					
19)	Anchor bolt sizing and placement					
20)	Tank finish					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Tank grounding					
2)	Tank mixers					
3)	Tank foundation/support					
4)	requirements					
5) 11304	SD-06, Instructions	1.3.3				
6)	procedures					
7) 11304	SD-19, Operation and Maintenance M	1.3.4				
8)	inclined plate clarifier mixers					
9)	and control equipment					
10) 11305	SD-02, Manufacturer's Catalog Data	1.2.1				
11)	sand filter units					
12) 11305	SD-04, Drawings	1.2.2				
13)	Contractor vessels					
14)	Filter media					
15) 11305	SD-06, Instructions	1.2.3				
16)	sand filter installation					
17)	procedures					
18) 11305	SD-19, Operation and Maintenance M	1.2.4				
19)	Sand Filter System					
20) 11307	SD-02, Manufacturer's Catalog Data	1.3.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	air stripper					
2) 11307	SD-04, Shop Drawings	1.3.2				
3)	air stripper, air stripper					
4)	effluent holding tank					
5) 11307	SD-06, Instructions	1.3.3				
6)	air stripper and holding tank					
7)	installation procedures					
8) 11307	SD-19, Operation and Maintenance M	1.3.4				
9)	Air Stripper					
10) 11308	SD-02, Manufacturer's Catalog Data	1.3.1				
11)	cartridge filter units					
12) 11308	SD-04, Drawings	1.3.2				
13)	cartridge filter units					
14) 11308	SD-06, Instructions	1.3.3				
15)	installation procedures					
16) 11309	SD-02, Manufacturer's Catalog Data	1.4.1				
17) 11309	SD-04, Drawings	1.4.2				
18) 11309	SD-06, Instructions	1.4.3				
19)	installation procedures					
20) 11309	SD-19, Operation and Maintenance M	1.4.4				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Liquid-Phase Carbon Adsorption					
2)	system					
3) 11310	SD-02, Manufacturer's Catalog Data	1.3.1				
4) 11310	SD-04, Drawings	1.3.2				
5)	External connections					
6)	Liquid level controls mounting					
7)	bracket					
8)	Anchor bolt sizing and placement					
9)	Tank finish					
10)	Tank grounding					
11)	Tank foundation/support					
12)	requirements					
13) 11310	SD-06, Instructions	1.3.3				
14)	installation procedures					
15) 11310	SD-19, Operation and Maintenance M	1.3.4				
16)	spent backwash holding tank					
17) 11311	SD-02, Manufacturer's Catalog Data	1.3.1				
18)	Treated Effluent					
19) 11311	SD-04, Drawings	1.3.2				
20)	Conical bolt down cover					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Vent					
2)	External connections					
3)	Liquid level controls mounting					
4)	brackets					
5)	Anchor bolt sizing and placement					
6)	Tank finish					
7)	Tank grounding					
8)	Tank foundation/support					
9)	requirement					
10) 11311	SD-06, Instructions	1.3.3				
11)	installation procedures					
12) 11311	SD-19, Operation and Maintenance M	1.3.4				
13)	Treated Effluent Tank control					
14)	system					
15) 11313	SD-02, Manufacturer's Catalog Data	1.3.1				
16)	sludge thickening tank, level					
17)	control equipment and floating skimmer assemblies					
18) 11313	SD-04, Drawings	1.3.2				
19)	Bolt down cover					
20)	Vent					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	External connections					
2)	Liquid level controls mounting					
3)	bracket					
4)	Anchor bolt sizing and placement					
5)	Tank finish					
6)	Tank grounding					
7)	Tank foundation/support					
8)	requirements					
9)	Floating skimmer assembly					
10) 11313	SD-06, Instructions	1.3.3				
11)	installation procedures					
12) 11313	SD-19, Operation and Maintenance M	1.3.4				
13)	sludge thickening tank, control					
14)	equipment and floating skimmer assemblies					
15) 11314	SD-02, Manufacturer's Catalog Data	1.3.1				
16)	dewatering press and related					
17)	control equipment					
18) 11314	SD-04, Drawings	1.3.2				
19)	dewatering press layout and					
20)	installation					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 11314	SD-06, Instructions	1.3.3				
2)	installation procedures					
3) 11314	SD-19, Operation and Maintenance M	1.3.4				
4)	Dewatering Press and control					
5)	systems					
6) 11315	SD-19, Operation and Maintenance M	1.3.3				
7)	centrifugal pump systems					
8) 11316	SD-02, Manufacturer's Catalog Data	1.3.1				
9)	Materials and Equipment					
10) 11316	SD-04, Drawings	1.3.2				
11)	Positive Displacement Pump					
12)	System					
13) 11316	SD-19, Operation and Maintenance M	1.3.3				
14)	air operated double-diaphragm					
15)	pumps					
16) 13121	SD-02, Manufacturer's Catalog Data	1.5.1				
17)	materials	2.1				
18) 13121	SD-03, Manufacturer's Standard Col	1.5.2				
19)	Factory color finish	2.9.2	G			
20) 13121	SD-04, Drawings	1.5.3				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Preengineered framing					
2)	anchor bolts	1.5.4.1				
3)	Structural connections					
4)	Roofing connections					
5)	Roof penetrations and flashings					
6)	Accessories					
7) 13121	SD-05, Design Data	1.5.4				
8)	Building	1.5.4.1				
9)	Foundation loads	1.2.3				
10)	Anchor bolts	1.5.4.1				
11)	Purlins and girts					
12)	Bracing					
13) 13121	SD-11, Factory Tests	1.5.5				
14)	Factory Color Finish	2.9.2				
15)	Insulation					
16) 13121	SD-13, Certificates	1.5.6				
17)	materials	2.1				
18) 13121	SD-19, Operation and Maintenance M	1.5.7				
19)	Preengineered Building	1.5.3.1				
20) 15116	SD-04, Drawings	1.3.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Welding pressure piping					
2) 15116	SD-08, Statements	1.3.2				
3)	Welding procedures qualification					
4) 15116	SD-18, Records	1.3.3				
5)	Weld identifications	1.3.3.1				
6) 15250	SD-02, Manufacturers Catalog Data	1.3.1				
7)	Duct insulation and jacket	2.2				
8)	Equipment insulation and jacket					
9) 15400	SD-02, Manufacturer's Catalog Data	1.4.1				
10)	Pipe and fittings	2.1				
11)	Valves	2.2.2				
12)	Plumbing fixtures					
13)	Water heaters					
14)	Pipe hangers and supports					
15)	Drains					
16)	Backflow preventers	2.2.6				
17)	Electric water coolers					
18) 15400	SD-19, Operation and Maintenance M	1.4.2				
19)	Water heaters					
20)	Electric water coolers					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 15401	SD-02, Manufacturer's Catalog Data	1.4.1				
2)	Pipe and fittings					
3)	Valves					
4)	Plumbing fixtures					
5)	Pipe hangers and supports					
6)	Pressure gages					
7)	Water meters					
8)	Water hammer arresters					
9)	Backflow preventers					
10) 15402	SD-02, Manufacturer's Catalog Data	1.4.1				
11)	Pipe and fittings					
12)	Valves					
13)	Plumbing fixtures					
14)	Pipe hangers and supports					
15)	Backflow preventers					
16) 15403	SD-02, Manufacturer's Catalog Data	1.4.1				
17)	Pipe and fittings					
18)	Valves					
19)	Plumbing fixtures					
20)	Pipe hangers and supports					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Backflow preventers					
2) 15404	SD-02, Manufacturer's Catalog Data	1.4.1				
3)	Pipe and fittings					
4)	Valves					
5)	Plumbing fixtures					
6)	Pipe hangers and supports					
7)	Pressure gages					
8) 15405	SD-02, Manufacturer's Catalog Data	1.4.1				
9)	Pipe and fittings					
10)	Valves					
11)	Fixtures					
12)	Pipe hangers and supports					
13)	Pressure gages					
14) 15487	SD-02, Manufacturer's Catalog Data	1.3.1				
15)	Air Compressor					
16)	Receiver					
17)	Alternator Panel and Pressure					
18)	Controls					
19)	Pipe and fittings					
20)	Valves					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Drain traps					
2)	Intake filters					
3)	Silencer					
4)	Compressor Motor					
5)	Refrigerated Dryer					
6) 15487	SD-04, Shop Drawings	1.3.2				
7)	Air Compressor					
8)	Receiver					
9)	Alternator Panel and Pressure					
10)	Controls					
11)	Pipe and fittings					
12)	Valves					
13)	Drain traps					
14)	Intake filters					
15)	Silencer					
16)	Compressor Motor					
17)	Refrigerated Dryer					
18) 15487	SD-13, Certificates of Compliance	1.3.3				
19)	Pipe and fittings					
20)	Valves					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Coatings					
2)	Welding and brazing					
3) 15487	SD-19, Operation and Maintenance M	1.3.4				
4)	Air compressor, Data Package 4					
5)	Air dryer, Data Package 4					
6) 15492	SD-02, Manufacturer's Catalog Data	1.3.1				
7)	Pipe and fittings	2.2				
8)	Hangers and supports	2.7				
9)	Pressure regulator	2.3.3				
10)	Gas equipment connectors	2.4				
11)	Valves	2.3				
12)	Warning and identification tape	2.6				
13)	Risers	2.2.3				
14)	Transition fittings	2.2.4				
15)	LPG containers and accessories	2.13				
16) 15492	SD-06, Instructions	1.3.2				
17)	PE pipe and fittings	2.2.2				
18) 15492	SD-08, Statements	1.3.3				
19)	Welder's qualifications	1.4.1				
20)	PE welder's qualifications	1.4.2				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Welder's identification symbols	1.4.1				
2) 15492	SD-13, Certificates	1.3.4				
3)	PE pipe and fittings	2.2.2				
4)	Transition fittings	2.2.4				
5)	LPG containers and accessories	2.13				
6) 15620	SD-02, Manufacturer's Catalog Data	1.3.1				
7)	Unit heaters	2.1				
8) 15620	SD-19, Operation and Maintenance M	1.3.2				
9)	Unit heaters	2.1				
10) 15780	SD-02, Manufacturer's Catalog Data	1.3.1				
11)	Room air conditioners	2.1				
12) 15780	SD-04, Drawings	1.3.2				
13)	Control system wiring diagrams					
14) 15780	SD-06, Instructions	1.3.3				
15)	Room air conditioners	2.1				
16) 15780	SD-11, Factory Test Reports	1.3.4				
17)	Salt-spray tests	2.6.1				
18) 15780	SD-12, Field Test Reports	1.3.5				
19)	Start-up and initial	3.2.1				
20)	operational tests					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 15780	SD-18, Records	1.3.6				
2)	Posted operating instructions					
3) 15780	SD-19, Operation and Maintenance M	1.3.7				
4)	Room air conditioners	2.1				
5) 15850	SD-02, Manufacturer's Catalog Data	1.3.1				
6)	Central station air handlers	2.2				
7)	Fans	2.1				
8)	Roof curbs	2.4				
9)	Filter Sections	2.2.4				
10)	Manometers	2.2.4				
11) 15850	SD-10, Test Reports	1.3.2				
12)	Corrosion protection	1.4				
13) 15850	SD-12, Field Test Reports	1.3.3				
14)	Preliminary tests	3.3.2				
15)	Air handling and distribution	3.3.3				
16)	equipment tests					
17)	Dampers					
18) 15850	SD-13, Certificates	1.3.4				
19)	Central station air handlers	2.2				
20)	Fans	2.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 15850	SD-19, Operation and Maintenance M	1.3.5				
2)	Central station air handlers	2.2				
3)	Fans	2.1				
4)	Filter sections	2.2.4				
5) 15871	SD-02, Manufacturer's Catalog Data	1.3.1				
6)	Fans	2.1				
7)	Dampers					
8)	Flexible connectors	2.4.3				
9)	Gaskets	2.4.4				
10)	Protective coating materials	2.4.5				
11)	Sealants	2.4.6				
12)	Access ports	2.5.1				
13)	Damper regulators	2.5.2				
14)	Supports and hangers	2.6				
15)	Vibration isolators	2.6.5				
16)	Steel ducts					
17)	Fiberglass ductwork	2.7				
18) 15871	SD-04, Drawings	1.3.2				
19)	Industrial ventilation and	1.3.2.1				
20)	exhaust systems					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 15871	SD-08, Statements	1.3.3				
2)	Welding procedures	1.4.2				
3)	Welding test agenda	3.1.8				
4)	Welding test procedures	1.4.2				
5)	Welders' identification	1.3.3.1				
6)	Work plan	1.3.3.2				
7)	Fiberglass fan servicer	1.3.3.3				
8)	experience information					
9) 15871	SD-10, Test Reports	1.3.4				
10)	Fan tests	2.1.1				
11) 15871	SD-12, Field Test Reports	1.3.5				
12)	start-up tests	1.3.5.1				
13)	Sound level tests	3.2.6				
14) 15871	SD-18, Records	1.3.6				
15)	Posted operating instructions	1.5				
16) 15871	SD-19, Operation and Maintenance M	1.3.7				
17)	Fans	2.1				
18)	Industrial ventilation and	1.3.2.1				
19)	exhaust systems					
20) 15895	SD-02, Manufacturer's Catalog Data	1.4.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Dampers	2.6				
2)	Flexible ducts and connectors					
3)	Insulation and vapor barrier					
4)	Louvers	2.6				
5)	Bird screens	2.6.3.1				
6)	Diffusers, registers, and					
7)	grilles					
8)	Metal ducts	2.1				
9)	Test holes					
10) 15895	SD-04, Drawings	1.4.2				
11)	test holes					
12)	Duct hangers and supports	3.1.2				
13) 15895	SD-05, Design Data	1.4.3				
14)	Duct span versus reinforcement	1.4.3.1				
15)	schedule					
16) 15895	SD-06, Instructions	1.4.4				
17)	Ductwork and ductwork	1.4.4.1				
18)	accessories					
19) 15895	SD-07, Schedules	1.4.5				
20)	Diffusers, registers, and					

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	grilles					
2) 15895	SD-08, Statements	1.4.6				
3)	Certified personnel list					
4) 15895	SD-10, Test Reports	1.4.7				
5)	Automatic dampers					
6)	Sound pressure level rating	1.4.7.2				
7)	Louvers	2.6				
8) 15895	SD-12, Field Test Reports	1.4.8				
9)	Air duct leakage tests	3.2.1				
10)	Testing and balancing of air					
11)	systems					
12)	Sound level tests					
13) 15971	SD-02, Manufacturers Catalog Data	1.5.1				
14)	Actuators	2.2				
15)	Valves	2.3				
16)	Dampers	2.4				
17)	Fire protection devices	2.5				
18)	Sensors	2.6				
19)	Thermostats	2.8				
20)	Sunshields	2.9				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Pressure switches	2.10.1				
2)	Indicating devices	2.11				
3)	Controllers	2.13				
4)	Pressure gages	2.12				
5)	Control Panels	2.15				
6)	Air Compressor	2.16.1				
7)	Compressed air station	2.16.2				
8)	specialties					
9) 15971	SD-04, Drawings	1.5.2				
10)	Control system diagram	1.5.2.1				
11)	Ladder diagram	1.5.2.2				
12)	Operating parameters	1.5.2.3				
13)	Automatic control valve	1.5.2.4				
14)	schedules					
15)	Damper schedules	1.5.2.5				
16)	Sequence of operation	1.5.2.8				
17)	Arrangement drawing	1.5.2.9				
18)	Wiring diagram	1.5.2.6				
19)	Compressed air station schematic	1.5.2.7				
20)	Control panel schematics	1.5.2.7				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 15971	SD-12, Field Test Reports	1.5.3				
2)	Commissioning procedures	1.5.3.2				
3)	Calibration adjustment and	1.5.3.3				
4)	commissioning reports					
5)	Site testing procedures	1.5.3.1				
6)	Performance verification test	3.3.5				
7) 15971	SD-13, Certificates	1.5.4				
8)	Tube and fittings	2.17.1				
9)	Valves	2.3				
10)	Smoke detectors					
11)	Compressed air storage tank	2.16.1				
12) 15971	SD-18, Records	1.5.5				
13)	Air compressor	2.16.1				
14)	Refrigerated air dryer	2.16.2				
15)	Air filtration system	2.16.2				
16)	Training course documentation	3.4.1				
17)	Qualified service organization	3.5				
18)	list					
19)	Certification of completion	3.3.4				
20) 15971	SD-19, Operation and Maintenance M	1.5.6				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Space temperature control system	1.5.6.1				
2) 15996	SD-08, Statements	1.4.1				
3)	Independent TAB agency	1.4.1.1				
4)	personnel qualifications					
5)	Design review report	1.4.1.2				
6)	Pre-field DALT preliminary	1.4.1.3				
7)	notification					
8)	Advanced notice for DALT field	1.4.1.4				
9)	work					
10)	Advanced notice for Season 1	1.4.1.4				
11)	TAB field work					
12)	Check out list for Season 1	1.4.1.5				
13)	Pre-final DALT report	3.1.2				
14)	certified DALT report	1.4.2.1				
15) 15996	SD-12, Field Test Reports	1.4.2				
16)	Certified DALT report	1.4.2.1				
17)	Certified TAB report for Season					
18)	1					
19) 15997	SD-08, Statements	1.3.1				
20)	Work plan	1.3.1.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Qualifications of installer	1.3.1.2				
2)	List of test instruments	1.3.1.3				
3) 15997	SD-12, Field Test Reports	1.3.2				
4)	Preliminary review report	1.3.2.1				
5)	Smoke tests report	1.3.2.2				
6)	Fan operating points report	1.3.2.3				
7)	Static pressure report	1.3.2.4				
8)	Volume and velocity flow rates	1.3.2.5				
9)	report					
10)	Pitot traverse report	1.3.2.6				
11) 16370	SD-01, Data	1.4.1				
12)	Calculations	1.4.1.1				
13) 16370	SD-02, Manufacturer's Catalog Data	1.4.2				
14)	Conductors	2.6				
15)	Insulators	2.5				
16)	Pole top switch	2.17				
17)	Recloser					
18)	Sectionalizer					
19)	Cutouts	2.13				
20)	Transformer	2.16				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Metering equipment	2.18				
2)	Meters	2.18.3				
3)	Surge arresters	2.12				
4)	Guy strand	2.8				
5)	Anchors	2.10				
6) 16370	SD-08, Statements	1.4.3				
7)	Qualifications of cable splicer	1.5.1				
8) 16370	SD-10, Test Reports	1.4.4				
9)	Wood poles	2.2				
10)	Wood crossarms	2.3				
11) 16370	SD-09, Reports	1.4.5				
12)	Routine and other transformer	2.21.2				
13)	tests					
14)	Design tests	2.21.3				
15) 16370	SD-12, Field Test Reports	1.4.6				
16)	Ground rod tests	3.2.1				
17)	High voltage cable test	3.2.5				
18)	Transformer field tests	3.2.2				
19)	Large overhead systems test	3.2.6				
20)	Design tests	2.21.3				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1) 16370	SD-18, Records	1.4.7				
2)	Transformer test schedule	2.21.1				
3) 16375	SD-02, Manufacturer's Catalog Data	1.4.1				
4)	Conduit	2.1.1				
5)	Fittings	2.1.2				
6)	Insulating tape	2.1.3.1				
7)	600 volt wires and cables	2.1.5				
8)	Cable lubricants	3.1.5.1				
9)	Ground rods	2.1.8				
10)	Precast concrete structures	3.1.7.1	G			
11)	Frames and covers	2.1.9.2	G			
12)	Frames and covers	3.1.7.2	G			
13)	Sealing material	3.1.7.1	G			
14)	precast sectional underground		G			
15)	duct bank					
16)	Cable Tags					
17) 16375	SD-04, Drawings	1.4.2				
18)	Precast handhole	1.4.2.1	G			
19)	Pulling-in irons		G			
20) 16402	SD-02, Manufacturer's Catalog Data	1.3.1				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Receptacles	2.9	G			
2)	Circuit breakers	2.10.2	G			
3)	Switches	2.8	G			
4)	Conduit and fittings	2.2				
5)	Ground rods	2.18				
6)	Device plates	2.7				
7)	Wires and cables	2.5				
8)	Outlet boxes and covers	2.3				
9)	Transformers	2.13	G			
10)	Junction boxes	2.4				
11)	Splices and termination	2.6				
12)	components					
13)	Enclosed circuit breakers	2.11	G			
14)	Motor controllers	2.15	G			
15)	Combination motor controllers		G			
16) 16402	SD-04, Drawings	1.3.2				
17)	Panelboards	2.10	G			
18)	Transformers	2.13	G			
19)	Busway		G			
20)	Cable trays		G			

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	Motor control centers		G			
2)	Wireways		G			
3) 16402	SD-08, Statements	1.3.3				
4)	Fuses	2.12	G			
5) 16402	SD-09, Reports	1.3.3.1				
6)	Transformer design and	1.3.3.2	G			
7)	prototype tests					
8) 16402	SD-12, Field Test Reports	1.3.4				
9)	600-volt wiring test	3.2.2	G			
10)	Grounding system test	3.2.5	G			
11)	Transformer tests	3.2.3	G			
12)	GFCI receptacle test	3.2.4	G			
13) 16402	SD-19, Operation and Maintenance M	1.3.5				
14)	Electrical Systems	1.3.5.1				
15) 16510	SD-02, Manufacturer's Catalog Data	1.4.1				
16)	Fluorescent lighting fixtures	2.1				
17)	Fluorescent lamps	2.1.1				
18)	Fluorescent core and coil	2.1.2				
19)	ballasts					
20)	High-Intensity-Discharge (HID)	2.2				

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(a)	(b)	(c)	(d)	(e)	(f)	(g)
1)	lighting fixtures					
2)	HID Ballasts	2.2.1				
3)	HPS lamps	2.2.2				
4)	Incandescent lighting fixtures	2.3				
5)	Incandescent lamps	2.3.1				
6)	Lighting contactor	2.6				
7)	Photocell switch	2.7				
8)	Emergency lighting equipment	2.9				
9)	Support hangers for lighting	2.10				
10)	fixtures in suspended ceilings					
11)	Exit signs	2.8				

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SECTION 01430

WASTE SAMPLING REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

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

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA)

EPA/540/P-91/008	Compendium of ERT Waste Sampling Procedures, 1991
EPA SW-846	Test Methods for Evaluating Solid Wastes (Nov. 1986)

NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY (NEESA)

NEESA 20.2-047B	Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program (June 1988)

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.2.1 SD-08, Statements

a. Sample Log

1.2.2 SD-12, Field Test Reports

a. Confirmatory Sample Analysis Results

b. Waste Characterization Sample Analysis Results

1.3 DEFINITIONS

1.3.1 Contractor Generated Wastes

Contractor generated wastes shall include all materials which become contaminated with wastes as defined in the Basic Contract as a result of Contractor activity at the site after the commencement of contract work.

1.3.2 Government Generated Wastes

Government generated wastes shall include all debris, incidental soils, drum, and container contents existing at the site prior to the commencement of contract work.

1.3.3 Confirmation Sampling

Confirmation sampling shall include all sampling conducted in the open excavations during the post-removal stage to confirm the removal of all contaminated soil.

1.3.4 Waste Characterization Sampling

Waste characterization sampling shall include all sampling of the excavated soils to characterize the soils for disposal.

1.4 DESCRIPTION OF WORK

1.4.1 Contractor Generated Wastes

Collect and analyze environmental samples from each Contractor generated waste stream to determine applicable transportation and disposal requirements.

1.4.2 Government Generated Waste

Collect and analyze environmental samples from the excavated area after Government generated waste has been removed to confirm the removal of all contaminated soil.

1.5 QUALITY ASSURANCE

1.5.1 Waste Sampling

Adhere to all sample acquisition, handling, custody documentation, decontamination, and quality assurance/quality control (QA/QC) requirements and procedures as required by federal, state and local regulations.

1.5.2 Analytical Laboratory

The Contractor shall be solely responsible for the execution and accuracy of the waste stream analyses. The Contractor shall use a NEESA-certified laboratory for all soil and waste analyses. All analytical standard methods shall meet, at a minimum, NEESA 20.2-047B QA/QC Level C requirements for confirmation sampling and Level C requirements for waste characterization sampling and shall also be in accordance with federal, local and state regulations.

1.5.3 Data Validation

An independent firm shall be subcontracted for data validation. Samples collected shall be evaluated using Level C quality control. Data review procedures specified by NEESA 20.2-047B and the Functional Guidelines established by EPA Region IV shall be followed to ensure that raw data are not altered and that an audit trail is developed for those data which require reduction. Specific Quality Assurance/Quality Control (QA/QC) procedures shall be included in the Sampling and Analysis Plan indicated in Section 01010. Data validation results shall be provided in the Contractor's Closeout Report indicated in Section 01010.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 GENERAL

Supply all personnel, equipment, and facilities to collect and analyze the environmental samples required to characterize the wastes.

3.1.1 Sample Acquisition

Sampling procedures shall be consistent with NEESA 20.2-047B Guidelines.

After the excavation has been completed:

a. Visually inspect the area for stained or discolored soil.

b. Field screen the area using an organic vapor analyzer.

c. If no stained or discolored soil is visible, and the organic vapors are below 50 ppm, collect one confirmation sample for every part of or 500 square feet of excavation, and one sample for any portion of or every 50 linear feet of each sidewall of the excavation along the perimeter of the site.

d. Place the sample in an appropriate sample container for shipment for off-site confirmation analyses.

e. If stained soils are visible, or if organic vapor levels are greater than 50 ppm, or if contamination is suspected, notify the Navy's Technical Representative.

3.1.1.1 Confirmation Samples

Confirmation samples shall be collected from the walls and the bottom of the open excavations. One sample for every 500 square feet or fraction thereof of soil along the bottom of the excavation and one sample for every 50 linear feet or fraction thereof of soil along each wall of the excavation shall be collected

Confirmation samples form AOCs 3,4, and 6 shall be analyzed for PCBs by EPA Method 8080. The confirmation samples from AOC 5 shall be analyzed for pesticides by EPA Method 8080.

If detected PCB and/or 4,4'-DDT concentration exceed 10 and 60 ppm respectively, notify the Navy's Technical Representative. If PCB and 4,4'-DDT concentrations are less than 10 and 60 ppm respectively, no further excavation is required.

3.1.1.2 Waste Characterization Samples

Waste characterization samples shall be collected for the purpose of determining handling, transportation, and disposal requirements and for

determining personal and environmental protection and monitoring requirements.

Characterization samples shall be collected from the soils from each AOC (3,4,5, and 6). One thoroughly mixed composite sample shall be collected for every 25 cubic yards or fraction thereof of material.

The composite sample shall consist of six (6) grab samples representative of the material being sampled. The grab samples shall thoroughly mixed to obtain a relatively homogenous mixture.

The characterization samples shall be analyzed for the following parameters:

1. TCLP Metals - EPA Methods 6010, 7060, 7080, 7131, 7191, 7421, 7470, 7760, 7740
2. TCLP Volatiles - EPA Method 3550/EPA Method 8240
3. TCLP Semi-Volatiles - EPA Method 3550/EPA Method 8270
4. TCLP Pesticides - EPA Method 3550/EPA Method 8080
5. TCLP Herbicides - EPA Method 3550/EPA Method 8080
6. TCL PCBs - EPA Method 8080
7. RCRA Characteristics - SW-846 9010, 1010, 9012, 9030
8. Moisture Content - ASTM D 2216

The soil shall contain no free liquid as demonstrated by EPA SW-846 Method 9095, paint filter liquids test.

3.1.1.3 Contractor Generated Waste Samples

Collect samples from Contractor generated waste to determine applicable transportation and disposal requirements. Analyze Contractor generated waste samples for the following parameters:

1. TCLP Metals - EPA Methods 6010, 7060, 7080, 7131, 7191, 7421, 7470, 7760, 7740
2. TCLP Volatiles - EPA Method 3550/EPA Method 8240 3. TCLP Semi-Volatiles - EPA Method 3550/EPA Method 8270
4. TCLP Pesticides - EPA Method 3550/EPA Method 8080
5. TCLP Herbicides - EPA Method 3550/EPA Method 8080
6. TCL PCBs - EPA Method 8080
7. RCRA Characteristics - SW-846 9010, 1010, 9012, 9030

3.1.2 Sample Handling

Sampling, sample handling, and sampling containers must be consistent with the chemicals expected, the matrix of the sample, and planned analytical procedures. Precleaned glass sample containers with teflon lids are required.

The Contractor shall describe in the Sampling and Analysis Plan strict chain-of-custody procedures to be used during collection, transport, and analysis of all samples.

3.1.3 Sampling Documentation

Maintain a sample log containing, at a minimum, the following information:

a. Date and Time of Sampling

b. Sample Locations

c. Sample Matrix

d. Sample Identification Number

e. QA/QC Sample Identification

f. Analyses to be Performed

g. Type and Number of Sample Containers

h. Signatures of Individuals Performing Sampling

-- End of Section --

SECTION 01560

TEMPORARY CONTROLS

PART 1 GENERAL

1.1 REFERENCES

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

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926-SUBPART V	Power Transmission and Distribution
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
49 CFR 178	Shipping Container Specification

CORPS OF ENGINEERS (COE)

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	1991 Code for Safety to Life from Fire in Building and Structures
NFPA 241	1989 Safeguarding Construction, Alteration, and Demolition Operations

1.2 DEFINITIONS

1.2.1 Sediment

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

1.2.2 Solid Waste

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

1.2.3 Rubbish

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

1.2.4 Debris

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

1.2.5 Chemical Wastes

This includes salts, acids, alkalies, herbicides, pesticides, and organic chemicals.

1.2.6 Garbage

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

1.2.7 Hazardous Waste

Hazardous substances as defined in 40 CFR 261 or as defined by applicable state and local regulations.

1.2.8 Oily Waste

Petroleum products and bituminous materials.

1.2.9 Class I Ozone Depleting Substance (ODS)

Class I ODS is defined in Section 602(a) of The Clean Air Act and includes the following chemicals:

chlorofluorocarbon-11 (CFC-11)
chlorofluorocarbon-12 (CFC-12)
chlorofluorocarbon-13 (CFC-13)
chlorofluorocarbon-111 (CFC-111)
chlorofluorocarbon-112 (CFC-212)
chlorofluorocarbon-113 (CFC-113)
chlorofluorocarbon-114 (CFC-114)
chlorofluorocarbon-115 (CFC-115)
chlorofluorocarbon-211 (CFC-211)
chlorofluorocarbon-212 (CFC-212)
chlorofluorocarbon-213 (CFC-213)
chlorofluorocarbon-214 (CFC-214)
chlorofluorocarbon-215 (CFC-215)
chlorofluorocarbon-216 (CFC-216)
chlorofluorocarbon-217 (CFC-217)
halon-1211
halon-1301
halon-2402
carbon tetrachloride
methyl chloroform

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 4 of the Basic Contract

1.3.1 SD-08, Statements

a. Class I ODS prohibition G

b. MSDS G

1.3.2 SD-18, Records

a. Solid waste disposal permit

b. Disposal permit for hazardous waste G

1.3.2.1 Disposal Permit for Hazardous Waste

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

1.4 CLASS I ODS PROHIBITION

Class I ODS as defined and identified herein shall not be used in the performance of this contract, nor be provided as part of the equipment. This prohibition shall be considered to prevail over any other provision, specification, drawing, or referenced documents.

1.5 ENVIRONMENTAL PROTECTION REQUIREMENTS

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

1.5.1 Preconstruction Survey

Perform a preconstruction survey of the project site with the Contracting Officer, and take photographs showing existing environmental conditions in and adjacent to the site.

1.6 SAFETY PROGRAM

The Contractor shall implement a safety program conforming to the requirements of Federal, state and local laws, rules, and regulations. The program shall include:

a. Occupational Safety and Health Standards.

b. COE EM-385-1-1.

c. Contract Clause "FAR 52.236-1, Accident Prevention." In this clause, the date of COE EM-385-1-1 should be 1 October 1992.

d. NFPA 241.

e. NFPA 101.

f. 29 CFR 1926-SUBPART V, tagout and lockout procedures.

g. MSDS, supply Material Safety Data Sheet for all hazardous materials brought on-site.

1.6.1 Station Permits

Permits are required for, but are not necessarily limited to, welding, digging, and burning. Allow 7 calendar days for processing of the application.

1.6.2 Unforeseen hazardous Material

All known hazardous materials are indicated on the drawings. If additional material that is not indicated on the drawings is encountered that may be dangerous to human health upon disturbance during construction operations, stop that portion of work and notify the Navy's Technical Representative (NTR) immediately. Intent is to identify materials such as PCB, lead paint, and friable and nonfriable asbestos. Within 14 calendar days the Government will determine if the material is hazardous. If the material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If the material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.234-4, Changer" and "FAR 52.236-2, Differing Site Conditions."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

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

3.1.1 Land Resources

Except in areas to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without the NTR's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the NTR. Where such use of attach ropes, cables, or guys is authorized, the Contractor shall be responsible for any resultant damage.

3.1.1.1 Protection

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

3.1.1.2 Replacement

Remove trees and other landscape features scarred or damaged by equipment operations, and replace with equivalent, undamaged trees and landscape features. Obtain NTR's approval before replacement.

3.1.2 Water Resources

3.1.2.1 Stream Crossings

In areas where frequent crossings are required, install temporary culverts or bridges. Remove temporary culverts or bridges upon completion of work, and repair the area to its original condition.

3.1.2.2 Oily Wastes

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

3.1.3 Fish and Wildlife Resources

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

3.2 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

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

3.3 EROSION AND SEDIMENT CONTROL MEASURES

3.3.1 Burnoff

Burnoff of the ground cover is not permitted.

3.3.2 Borrow Pit Areas

Manage and control borrow pit areas to prevent sediment from entering nearby streams or lakes. Restore areas, including those outside the borrow pit, disturbed by borrow and haul operations. Restoration includes grading, replacement of topsoil, and establishment of a permanent vegetative cover. Uniformly grade side slopes of borrow pit to not more than a slope of 1 part vertical to 2 parts horizontal. Uniformly grade the bottom of the borrow pits to provide a flat bottom and drain by outfall ditches or other suitable means. Stockpile topsoil removed during the borrow pit operation, and use as part of restoring the borrow pit area.

3.3.3 Protection of Erodible Soils

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

3.3.4 Temporary Protection of Erodible Soils

Use the following methods to prevent erosion and control sedimentation:

3.3.4.1 Mechanical Retardation and Control of Runoff

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

3.3.4.2 Vegetation and Mulch

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

a. Seeding: Provide new seeding where ground is disturbed. Include topsoil or nutriment during the seeding operation necessary to reestablish a suitable stand of grass. The seeding operation shall be as specified in Section 0220, "General Excavation, Filling, and Backfilling.

3.4 CONTROL AND DISPOSAL OF SOLID WASTES

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

3.4.1 Disposal of Rubbish and Debris

Dispose of rubbish and debris in accordance with the requirements specified below:

3.4.1.1 Removal From Government Property

Remove and dispose rubbish and debris from Government property.

3.4.2 Garbage Disposal

Place garbage in approved containers, and move to a pickup point or disposal area, where directed.

3.5 CONTROL AND DISPOSAL OF HAZARDOUS WASTE

3.5.1 Hazardous Waste Generation

Handle generated hazardous waste in accordance with 40 CFR 262.

3.5.2 Hazardous Waste Storage

Store hazardous waste in containers in accordance with 49 CFR 178. Hazardous waste shall be identified in accordance with 40 CFR 261 and 40 CFR 262.

3.5.3 Spills of Oil and Hazardous Materials

Take precautions to prevent spills of oil and hazardous material. In the event of a spill, immediately notify the NTR. Spill response shall be in accordance with 40 CFR 300 and applicable state regulations.

3.6 DUST CONTROL

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

3.7 NOISE

Make the maximum use of low-noise emission products, as certified by the EPA. Blasting or use of explosives will not be permitted without written permission from the NTR, and then only during the designated times.

3.8 RESTRICTIONS ON EQUIPMENT

3.8.1 Radio Transmitter Restrictions

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

3.9 FIRE PROTECTION

3.9.1 Compliance

COE EM-385-1-1, NFPA 241, and activity fire regulations. Obtain approval from the activity Fire Chief prior to commencement of hot work operations.

3.9.2 Notification of Fire

Post the activity fire poster in conspicuous locations and at telephones in construction shacks.

3.10 QUARANTINE FOR IMPORTED FIRE ANT (4/82)

Onslow, Jones, and Cartaret Counties and portions of Duplin and Craven Counties have been declared a generally infested area by the United States Department of Agriculture (USDA) for the imported fire ant. Compliance with the quarantine regulations established by this authority as set forth in USDA Quarantine No. 81 dated 9 October 1970, and USDA Publication 301.81-2A of 23 July 1976, is required for operations hereunder. Pertinent requirements of the quarantine for materials originating on the Camp Lejeune reservation, the Marine Corps Air Station (Helicopter), New River and the Marine Corps Air Station, Cherry Point, which are to be transported outside Onslow County or adjacent suppression areas, include the following:

a. Certification is required for the following articles and they shall not be moved from the reservation to any point outside Onslow County and adjacent designated areas unless accompanied by a valid inspection certificate issued by an Officer of the Plant Protection and Quarantine Program of the U.S. Department of Agriculture.

(1) Bulk Soil,

(2) Used mechanized soil-moving equipment. (Used mechanized soil-moving equipment is exempt if cleaned of loose noncompacted soil).

(3) Other products, articles, or means of conveyances, if it is determined by an inspector that they present a hazard of transporting spread of the imported fire ant and the person in possession thereof has been so notified.

b. Authorization for movement of equipment outside the imported fire and regulated area shall be obtained from USDA, APHIS, PPQ, Box 83, Goldsboro, North Carolina, 27530, Attn: Mr. Haywood Cox, telephone (919) 735-1941. Requests for inspection shall be made sufficiently in advance of the date of movement to permit arrangements for the services of authorized inspectors. The equipment shall be prepared and assembled so that it may be readily inspected. Soil on or attached to equipment, supplies, and materials shall be removed by washing with water or such other means as necessary to accomplish complete removal. Resulting spoil shall be wasted as necessary and as directed.

-- End of Section --

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 REFERENCES

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

DEFENSE LOGISTICS AGENCY (DLA)

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

1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit operation and maintenance (O&M) data/manuals which are specifically applicable to this contract and a complete and concise depiction of the provided equipment or product. Data containing extraneous information to be sorted through to find applicable instructions will not be accepted. Present information in sufficient detail to clearly explain user O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section C, Part 7, of the Basic Contract.

1.2.1 Quantity

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

1.2.2 Package Content

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

a. In the event the Contractor fails to deliver O&M Data/Manuals within the time limits set forth above, the Navy's Technical Representative (NTR) may withhold from progress payments 50 percent of the price of the item with which such data/manuals are associated.

1.2.3 Delivery

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

1.2.4 Changes to Submittals

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

1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.3.1 Operating Instructions

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

1.3.1.1 Safety Precautions

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

1.3.1.2 Operator Prestart

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

1.3.1.3 Startup, Shutdown, and Postshutdown Procedures

Include a control sequence for each of these operations.

1.3.1.4 Normal Operations

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

1.3.1.5 Emergency Operations

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

1.3.1.6 Operator Service Requirements

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

1.3.1.7 Environmental Conditions

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

1.3.2 Preventive Maintenance

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

1.3.2.1 Lubrication Data

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

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

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

c. A lubrication schedule showing service interval frequency.

1.3.2.2 Preventive Maintenance Plan and Schedule

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

1.3.3 Corrective Maintenance

Submit O&M data to the NTR for review and acceptance; submit data specified for a given item within (2) weeks after submittals are approved.

1.3.3.1 Troubleshooting Guides and Diagnostic Techniques

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

1.3.3.2 Wiring Diagrams and Control Diagrams

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

1.3.3.3 Maintenance and Repair Procedures

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

1.3.3.4 Removal and Replacement Instructions

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

1.3.3.5 Spare Parts and Supply Lists

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

1.3.3.6 Corrective Maintenance Labor-Hours

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

1.3.4 Appendices

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

1.3.4.1 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.

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

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

manufacturer's standard commercial practice. Use the format in the following example:

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

List FSCM in accordance with DLA H4/H8.

1.3.4.2 Warranty Information

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

1.3.4.3 Personnel Training Requirements

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

1.3.4.4 Testing Equipment and Special Tool Information

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

1.3.4.5 Contractor Information

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

1.4 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

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

1.4.1 Data Package 1

a. Safety precautions

b. Maintenance and repair procedures

c. Warranty information

d. Contractor information

1.4.2 Data Package 2

a. Safety precautions

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan and schedule

f. Maintenance and repair procedures

g. Removal and replacement instructions

h. Spare parts and supply list

i. Parts identification

j. Warranty information

k. Contractor information

1.4.3 Data Package 3

a. Safety precautions

b. Normal operations

c. Emergency operations

d. Environmental conditions

e. Lubrication data

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring diagrams and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Parts identification

m. Warranty information

n. Testing equipment and special tool information

o. Contractor information

1.4.4 Data Package 4

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and postshutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Lubrication data

i. Preventive maintenance plan and schedule

j. Troubleshooting guides and diagnostic techniques

k. Wiring diagrams and control diagrams

l. Maintenance and repair procedures

m. Removal and replacement instructions

n. Spare parts and supply list

o. Corrective maintenance man-hours

p. Parts identification

q. Warranty information

r. Personnel training requirements

s. Testing equipment and special tool information

t. Contractor information

1.4.5 Data Package 5

a. Safety precautions

b. Environmental conditions

c. Preventive maintenance plan and schedule

d. Troubleshooting guides and diagnostic techniques

e. Wiring and control diagrams

f. Maintenance and repair procedures

g. Spare parts and supply list

h. Warranty information

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 02050

DEMOLITION AND REMOVAL

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6	1983 Demolition Operations - Safety Requirements

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 261	Identification and Listing of Hazardous Waste

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA)

SW-846	(1986) Test Methods for Evaluating Solid Waste (Physical/Chemical Methods)

1.2 DEFINITIONS

1.2.1 Uncontaminated Construction Rubble

Material that does not exceed the toxicity characteristic waste standards of 40 CFR 261 based on the Toxicity Characteristic Leaching Procedure (TCLP) and the RCRA characteristics of ignitability, corrosivity, and reactivity as provided in 40 CFR 261.

1.3 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the station daily; do not allow accumulations outside the building. Store materials that cannot be removed daily in areas specified by the Contracting Officer.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 4 of the Basic Contract.

1.4.1 SD-08, Statements

a. Demolition plan

Submit proposed demolition and removal procedures to the Navy's Technical Representative for approval before work is started. The Demolition plan shall include procedures for removal and disposition of materials,

coordination with other work in progress, a detailed description of methods and equipment to be used for each operation and the sequence of operations.

1.5 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," safety requirements shall conform with ANSI A10.6, "Demolition Operations - Safety Requirements."

1.5.1 Notifications

Furnish timely notification of demolition and renovation projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61-SUBPART M. Notify the Regional Office of the Unites States Environmental Protection Agency (USEPA), State's environmental protection agency, and the NTR in writing 10 days prior to the commencement of work in accordance with 40 CFR 61-SUBPART M.

1.6 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

1.7 PROTECTION

1.7.1 Traffic Control Signs

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

1.7.2 Existing Work

Protect existing work which is to remain in place, be reused, or remain the property of the Government. Repair items which are to remain and which are damaged during performance of the work to their original condition, or replace with new. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Contracting Officer approval.

1.7.3 Trees

Conform to Section 01560, "Temporary Controls," for protection of natural resources.

1.7.4 Facilities

Protect electrical and mechanical services and utilities.

1.8 BURNING

Burning will not be permitted.

1.9 RELOCATIONS

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

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Fencing

Remove fencing, posts, and cement as indicated to the nearest post to excavate the underlying contaminated soil.

3.1.2 Monitoring Well Protection

Remove the existing monitoring well 6GW11 protection as indicated to remove the underlying contaminated soil. Remove the four (4) inch thick unreinforced concrete pad and four (4) steel bollards.

3.1.3 Monitoring Well

Remove the existing monitoring well 6GW15 as indicated to remove the underlying contaminated soil. Remove the four (4) inch thick unreinforced concrete pad, four (4) steel bollards, and extract the PVC casings.

3.1.4 Uncontaminated Construction Rubble

Construction rubble inside the indicated limits of the ravine that is determined to be uncontaminated shall be loaded onto trucks or roll-off containers and transported to a North Carolina-approved construction debris disposal facility permitted to accept such materials.

3.2 TESTING REQUIREMENTS FOR DISPOSAL OF CONSTRUCTION RUBBLE

The Contractor shall conduct sampling and analysis in accordance with an approved Sampling and Analysis Plan. A minimum of one composite sample shall be analyzed for RCRA characterization and full TCLP analytes in accordance with test methods contained in EPA SW-846.

3.3 FILLING

Fill holes and other hazardous openings in accordance with Section 02220, "General Excavation, Filling and Backfilling."

3.4 DISPOSITION OF MATERIAL

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

3.5 CLEANUP

3.5.1 Debris and Rubbish

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

-- End of Section --

SECTION 02060

DRUM AND CONTAINER REMOVAL

PART 1 GENERAL

1.1 DEFINITIONS

The following definitions shall apply to all removal requirements.

1.1.1 Spill

A spill shall denote both an intentional and unintentional uncontrolled discharge or release resulting in any quantity of a possibly hazardous constituent running off or about to run off the external surface of equipment or other source, as well as contamination resulting from those releases.

1.1.2 Leak

Leak or leaking shall denote an instance in which any article, container, or equipment has a liquid or semi-liquid on any portion of its external surface.

1.1.3 Container

A container shall be any portable device with a capacity less than or equal to five gallons in which a material can be stored, handled, transported, treated or disposed of.

1.1.4 Drum

A drum shall be any portable device with a capacity greater than five gallons in which a material can be stored, handled, transported, treated or disposed of.

1.1.5 Open

A container or drum shall be considered open if there are any visible holes on the surface of the container or drum, or if the container or drum appear to be leaking.

PART 2 PRODUCTS

2.1 OVERPACK DRUMS

Overpack drums shall meet all federal, state, and local regulations regarding waste containment and transportation. Overpack drums other than 55 or 95 gallon capacity may be used, but must meet the corrosion and reactivity requirements specified in the following sections. The Contractor shall notify the NTR for approval prior to utilizing any overpack drums not specified below.

2.1.1 Steel Overpack Drums

Steel overpack drums shall have 55-gallon capacity and have an open-head with a corrosion resistant epoxy liner, bolt ring, bolt nut, and rubber sponge gasket.

2.1.2 Polyethylene Overpack Drums

Polyethylene overpack drums shall have a 95-gallon capacity and shall be ultra violet light inhibiting with a closed cell polyethylene gasket.

2.2 Rinsate Solutions and Solvents

Rinsate solutions shall be required to triple-rinse and remove any residual solids, liquids, or vapors from the drums and containers.

PART 3 EXECUTION

3.1 REMOVAL OF DRUMS AND CONTAINERS

Initially identify the size, color, condition, type and identifying markings on each of the drums and containers. Remove all drums and containers from the ground surface as indicated. All leaking or open drums and containers holding liquids, sludges, or solids, as well as deteriorated drums that may rupture during handling shall be placed into overpack drums compatible with the drum's contents.

If the potential exists for spilling the liquid contents of the drums and containers during the excavation or moving process, the liquid shall be transferred to an overpack drum using a portable pump capable of transferring the liquid to an appropriate container prior to moving the existing container.

If a rupture occurs during the excavation or moving process, the spilled drum contents and affected soil shall be contained, collected, and overpacked. Remove all visually contaminated soil including a two foot width of soil around and beneath the perimeter of any spill area. The soil shall be placed in the overpack drum containing the spilled drum contents. All excavations shall remain open until the excavated areas are sampled, tested, certified to be clean and approved by the NTR.

Empty and deteriorated drums shall be transferred to the debris staging area.

Transfer all overpack drums, drums and containers holding liquids, solids, or sludges to a lined containment area for compatibility testing and hazard categorization.

3.2 PROCESSING OF DRUMS, CONTAINERS AND THEIR ASSOCIATED CONTENTS

The Contractor shall be responsible for all hazard categorization and waste compatibility testing in accordance with all Federal, State, and local regulations. The Contractor shall be responsible for providing the disposal facilities with all necessary waste analysis and profiles that may be required for waste disposal acceptance.

SECTION 02220

GENERAL EXCAVATION, FILLING, AND BACKFILLING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	1992 Sieve Analysis of Fine and Coarse Aggregates
ASTM D 698	1991 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D 1140	1992 Amount of Material in Soils Finer Than the No. 200 (75-Micrometer) Sieve
ASTM D 1557	1991 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m))
ASTM D 2487	1992 Classification of Soils for Engineering Purposes
ASTM D 4318	1984 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909	Fertilizer

1.2 DEFINITIONS

1.2.1 Cohesive Materials

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

1.2.2 Cohesionless Materials

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

1.3 SUBMITTALS

Submit the following in accordance with Section C of the General Contract.

1.3.1 SD-04, Drawings

1.3.2 SD-08, Statements

a. Dewatering work plan

Submit before starting work.

1.3.3 SD-12, Field Test Reports

a. Fill and backfill test

b. Density tests

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 CONTAMINATED MATERIALS

Transmission and disposal of pesticide contaminated soils shall be in accordance with Section 02223, "Transportation and Disposal of Contaminated Material". Assume for the purposes of on site handling and stockpiling that all soils indicated for removal are contaminated.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

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

2.1.1 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location. Moisture content shall be adjusted as necessary compaction requirements.

2.1.2 Backfill and Fill Material

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

2.1.3 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter,

brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.2 BORROW

Obtain borrow materials conforming to common fill and backfill material from the Government borrow pit as directed by the NTR. The Government borrow pit is located as indicated within a haul distance of 5 miles from the work site. If the Government borrow pit is used, the Contractor shall perform clearing, grubbing, and stripping required for providing access to suitable borrow material. Dispose of materials from clearing and grubbing operations off Government property. Strip top 12 inches of soil material from borrow area and stockpile. After removal of borrow material, regrade borrow pit using stockpiled soil material to contours which shall blend in with adjacent topography. Maximum side slopes shall be two horizontal to one vertical. Excavation and backfilling of borrow pit shall ensure proper drainage.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, and brush within the clearing limits. Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below existing surface.

3.1.2 Unsuitable Material

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

3.2 PROTECTION

3.2.1 Site Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.2.1.1 Surface Drainage

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

3.2.1.2 Subsurface Drainage

Dewatering shall not be required or permitted.

3.2.2 Underground Utilities

The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.

3.2.3 Machinery and Equipment

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

3.3 GENERAL EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Refill with backfill and fill material and compact to 95 percent of ASTM D 698 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with backfill and fill material and compact to 95 percent of ASTM D 698 maximum density.

3.4 EXCAVATION OF CONTAMINATED MATERIALS

3.4.1 Materials and Equipment

3.4.1.1 General

a. Provide all labor, materials, and equipment necessary to accomplish the work specified in these paragraphs.

b. The Contractor shall notify the Contractor Officer at least 48 hours prior to the start of excavation of contaminated soils. The Contractor shall stage his/her operations to minimize the time the contaminated soil is exposed to the weather. Provide protection measures around the area of contaminated soils to divert runoff of water within the excavation boundaries.

3.4.1.2 Unclassified Excavation

Excavation is unclassified. All excavation shall be completed regardless of the type, nature, or condition of the materials encountered.

3.4.2 Limits of Excavation - AOCs 3, 4, 5, and 6

a. Excavations shall be to the depths shown on the construction drawings or until groundwater is encountered or until the soils from the limits of the excavations pass TAL Pesticide analysis for AOC 5 and TAL PCBs for AOCs 3, 4, and 6. A 48 hour turnaround time shall be required to prevent the excavations from remaining open for extended periods of time. All soils removed shall be placed in roll off containers.

b. Once the Contractor has excavated to the specified limits of the excavation, an on-site analysis consisting of a visual inspection shall be performed on the surrounding soil. If the visual inspection reveals evidence of visibly contaminated soil, the Contractor shall consult with the Navy's Technical Representative (NTR) to determine the extent of additional excavation. When the exposed excavation surfaces do not contain visual evidence of contaminated soil, confirmation samples shall be collected and sent to an analytical laboratory for analysis.

c. Following initial soil excavation activities and passive visual inspection of on-site analysis, confirmation soil samples shall be collected and submitted to a laboratory for analysis as specified in Section 01430, "Waste Sampling Requirements".

d. Final Excavation areas shall be governed by field conditions and determined by the Navy's Technical Representative.

e. Construct a small berm around the top perimeter of the excavation areas to prevent surface waters from entering the pits. Remove and contain any ponded water collected in the excavations.

f. Place excavated contaminated soil to be disposed of in roll off boxes. Cover the boxes and secure them within the limits of Storage Lot 203 for processing, testing, and disposal.

g. Contaminated soil and debris to be disposed must not contain free liquids. The Contractor may be required to dewater the soil by applying a drying agent such as kiln dust to the excavated material,

h. Contaminated materials shall be loaded into covered containers or vehicles designed to transport such materials without spillage. Care shall be taken during loading operations to minimize the potential for spillage, tracking, or other means of deposition of contaminated materials outside the work area. Contaminated materials which become spilled on roads, street, or other areas outside the limits of excavation during the loading operation shall be immediately cleaned up to the satisfaction of the Navy's Technical Representative.

i. Backfilling of excavated areas shall begin only after the approval of the Navy's Technical Representative.

j. The Contractor and the Navy's Technical Representative shall work together closely to coordinate excavation, sampling, and analyses to minimize downtime. The Contractor shall schedule work to minimize downtime.

3.4.3 Limits of Excavation - AOC 2

a. The Contractor shall excavate all drums, containers, porcelain, rubble, batteries, and other various debris as directed by the NTR. The Contractor shall use appropriate surface geophysical equipment,

such as magnetometers, to locate surface debris covered by vegetation.

b. Debris and other waste material removed during excavation activities shall be transported and disposed of as described in Section 02223, "Transportation and Disposal of Contaminated Material."

c. Upon removal of all surface debris, the Contractor shall restore the ground surface to approximate the surrounding grade and restore disturbed vegetation.

d. Ground surface restoration shall begin only after the approval of the NTR.

e. The Contractor and the NTR shall work together to coordinate excavation, transportation, and ground surface restoration to minimize downtime. The Contractor shall schedule work to minimize downtime.

3.4.4 Method of Measurement

a. The solid wasted shall be separated according to their final disposal requirements. The quantity of work done under this paragraph shall be measured in tons, which shall be the actual weight of the solid waste removed. Quantity shall be verified by the certified delivery tickets provided by the treatment/disposal facility.

b. No separate measurements shall be made for control of water, protection of obstructions, or other work associated with the excavation and loading of materials at the site. These tasks are considered to be incidental to and part of the work specified.

3.5 FILLING AND BACKFILLING

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

3.5.1 Common Fill Placement

Provide for general site. Place in 12-inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.5.2 Backfill and Fill Material Placement

Provide for contaminated soil removal area. Place in 12-inch lifts.

3.5.3 Method of Measurement

a. The quantity of work done under this paragraphs shall be measured in cubic yards of backfill compacted in place as specified herein. Quantities of backfill /fill shall be computed from the cross

sections taken before and during the work of the excavation prior to and after backfilling. Field measurements, in cubic yards, and quantity computations shall be performed by a state licensed surveyor and submitted to the NTR for approval. Measurement shall not include yardage excavated without authorization, or yardage of materials used for purposed other than those specified.

b. No separate measurement shall be made for grading or finishing the site. These tasks are considered to be incidental to and part of the work specified for "Replacement of Soil and Site Restoration".

3.6 COMPACTION

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

3.6.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5-foot line of the structure to 85 percent of ASTM D 698.

3.6.2 Adjacent Area

Compact areas within 5 feet of structures to 90 percent of ASTM D 698.

3.6.3 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D 698.
Compact fill and backfill materials to 95 percent of ASTM D 698.

3.7 FINISH OPERATIONS

3.7.1 Grading

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

3.7.2 Seed

Scarify existing subgrade. Provide 4 inches of topsoil for newly graded finish earth surfaces and areas disturbed by the Contractor.
If there is insufficient on-site topsoil meeting specified requirements for topsoil, provide topsoil required in excess of that available. Seed shall match existing vegetation. Provide seed at 5 pounds per 1000 square feet. Provide CID A-A-1909, Type I, Class 2, 10-10-10 analysis fertilizer at 25 pounds per 1000 square feet. Provide commercial agricultural limestone of 94-80-14 analysis at 70 pounds per 1000 square feet. Provide mulch and water to establish an acceptable stand of grass.

3.7.3 Protection of Surfaces

Provide an erosion control matting to keep soils in place while allowing turf to be established. Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.8 DISPOSITION OF SURPLUS MATERIAL

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

3.9 FIELD QUALITY CONTROL

3.9.1 Sampling

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

3.9.2 Testing

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

3.9.2.1 Fill and Backfill Material Testing

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

-- End of Section --

SECTION 02223

TRANSPORTATION AND DISPOSAL OF CONTAMINATED MATERIAL

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.

CODE OF FEDERAL REGULATIONS

40 CFR Part 148	Hazardous Waste Injection Restrictions
40 CFR Parts 260 to 280	Standards Applicable to Generators of Hazardous Waste
49 CFR Parts 100 to 199	Transportation

1.2 SUBMITTALS

1.2.1 SD-08, Statements

a. Treatment Facility Permit

1.2.1.1 Treatment Facility Permit

a. Written verification that the proposed disposal site is permitted to accept the contaminated materials specified, prior to the start of excavation. All treatment and disposal facilities shall be identified. Permitting and licensing information shall be provided for each facility along with a contact person, address, and a telephone number. The specific waste types to be treated and disposed must be clearly identified.

1.2.2 SD-18, Records

a. Shipment manifests

b. Delivery and disposal certificates

c. Disposal Site Decontamination certificate

d. Work Site Decontamination certificate

1.2.2.1 Shipment Manifests

Copies of manifests and other documentation required for shipment of waste materials within 24 hours after removal of waste from the site.

1.2.2.2 Delivery and Disposal Certificates

Verification that the wastes were actually delivered and disposed of at the disposal site, within 7 days of disposal.

1.2.2.3 Disposal Site Decontamination Certificate

Verification that all vehicles and containers were decontaminated prior to leaving the disposal site, within 3 days of disposal.

1.2.2.4 Work Site Decontamination Certificate

Verification that all vehicles and containers were decontaminated prior to leaving the site, were properly operating, and were covered, within 24 hours after removal of waste from the site.

1.3 *DEFINITIONS*

The following definitions shall apply, in addition to the definitions for the various waste types described in Part 4 of the Basic Contract.

1.3.1 Government Generated Waste

Government generated waste shall include all contaminated soils at the site *prior to the commencement of contract work.*

1.3.2 Contractor Generated Waste

Contractor generated waste shall include all materials which become contaminated with wastes as defined in the Basic Contract as a result of contractor activity at the site after the commencement of contract work.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Materials and Equipment

Furnish all labor, materials, and equipment necessary to transport and dispose of contaminated soils in accordance with applicable Federal, State, and local requirements.

3.1.2 Waste Disposal

3.1.2.1 Processing Sampling Wastes

Wastes generated during hazard characterization and compatibility testing, which shall include but not be limited to, all surplus samples, glass jars, sampling devices, and chemical materials, shall be packed in overpack drums and labeled for off-site disposal.

3.1.2.2 Processing Rinsate Solutions

Containerize in compatible drums all rinsate solutions for sampling and disposal. The drums containing rinsate solution shall be placed in the final staging area.

3.1.3 Transportation and Disposal Records

Provide and prepare all waste shipment records/manifests for hazardous and nonhazardous wastes, required by the Resource Conservation and Recovery Act (RCRA) and the U.S. Department of Transportation (DOT). The Contractor shall complete all labels, profile sheets, and disposal restriction forms as necessary, including all DOT, USEPA, and state classifications. The Contractor shall provide a 48 hour notification to MCB Environmental Management Division for required signatures on waste manifests. Following completion of all paperwork, the Contractor shall submit this material and supporting documentation to the Navy's Technical Representative.

3.1.4 Transportation

The Contractor shall be solely responsible for complying with all federal, state, and local requirements for transporting hazardous materials through the applicable jurisdictions and shall bear all responsibility and cost for any noncompliance. In addition to those requirements, the Contractor shall do the following:

a. The Contractor shall weigh all containers for disposal prior to leaving MCB Camp Lejeune. The Contractor may use MCB landfill scales if the scales operator is provided with a 24 hour notification. The existing scales in Storage Lot 203 may be used. The Contractor shall provide certified accuracy of the scales at Lot 203 to $\pm$10 percent.

b. Inspect and document all vehicles and containers for proper operation and covering.

c. Inspect all vehicles and containers for proper markings, manifest documents, and other requirements for waste shipment.

d. Perform and document decontamination procedures prior to leaving the worksite and again before leaving the disposal site.

3.1.5 Disposal

All contaminated materials classified as hazardous under RCRA (40 CFR Part 261) that are removed from the site shall be disposed of in a RCRA hazardous waste treatment/disposal facility permitted to accept such materials.

All decontaminated metal material shall be taken to an on-base metal recycling facility.

3.2 Treatment Facilities

The proposed treatment methods for the contaminated soils is incineration. The Contractor shall select a permitted facility for the treatment and disposal of the contaminated soil.

-- End of Section --

SECTION 02510

BITUMINOUS CONCRETE PAVEMENT

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M140	1990 Emulsified Asphalt
AASHTO M208	1990 Cationic Emulsified Asphalt
AASHTO M226	1990 Viscosity Graded Asphalt Cement

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 698	1991 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D 1188	1989 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 1556	1990 Density of Soil in Place by the Sand-Cone Method
ASTM D 2726	1990 Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
ASTM D 2922	1991 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	1988 Moisture Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

FEDERAL SPECIFICATIONS (FS)

FS TT-P-1952	(Rev. B) Paint, Traffic and Airfield Marking, Water Emulsion Base

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION (NCDOT)

NCDOT RS	1990 Roads and Structures

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.2.1 SD-05, Design Data

a. Job-mix formula

1.2.1.1 Job-Mix Formula

Submit the mix design, including mixing temperature, for approval. The mix design shall include a certified laboratory analysis of mix composition with marshall stability value, void content, and flow. After mix design approval, job mixes shall conform to the range of tolerances specified in NCDOT RS. An identical mix design previously approved within the past 12 months by the Atlantic Division, Naval Facilities Engineering Command, may be used without further approval, provided that copies of the previous approval are submitted. Obtain acknowledgement of receipt prior to bituminous concrete placement. Submit additional data regarding materials if the source of the materials changes.

1.2.2 SD-13, Certificates

a. Tack coat

b. Stone base course

c. Paint

1.3 QUALITY ASSURANCE

1.3.1 Modification to References

Except as specified herein or as indicated, work and materials shall be in accordance with the NCDOT RS. The provisions therein for method of measurement and payment do not apply, and references to "Engineer" shall be interpreted to mean the Navy's Technical Representative (NTR).

1.4 ENVIRONMENTAL REQUIREMENTS

Do not produce or place bituminous concrete when the weather is rainy or foggy, when the base course is frozen or has excess moisture, or when the ambient temperature is less than 40 degrees F in the shade away from artificial heat.

1.5 BARRICADES AND SIGNALS

Provide and maintain temporary signs, signals, lighting devices, markings, barricades, and channelizing and hand signaling devices to protect personnel and new construction from damage by equipment and vehicles until the surface is approved by the NTR.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Bituminous Concrete Mix

NCDOT RS, Section 645, Type I-1 for material and mix. Provide crushed stone aggregates for the bituminous mix.

2.1.1.1 Recycled Asphalt Material

Bituminous concrete mix may contain a maximum of 25 percent by weight of the total aggregate material, reclaimed asphalt pavement (RAP). Mix design shall meet the requirements for the type of bituminous concrete specified. Clearly state the viscosity of reclaimed asphalt cement, grade of new asphalt cement, properties of recycling agent if used, and percentage of each in the mix. Combine asphalts and recycling agents to achieve a viscosity of 2000 plus or minus 400 poises at 140 degrees F. Furnish a new job mix formula for each change in percentage of RAP material used.

2.1.2 Stone Base Course

NCDOT RS, Sections 1005 and 1010 for aggregate base course, standard Size No. ABC.

2.1.3 Bituminous Tack Coat

a. Emulsified Asphalts: AASHTO M140, Grades RS-1, MS-1, HFMS-1, SS-1, and SS-1h ; NCDOT RS, Section 1020, Grade RS-1h. Dilute the SS-1 and SS-1h asphalts at the rate of one part water to one part asphalt.

b. Cationic Emulsified Asphalts: AASHTO M208, Grades CRS-1, CSS-1, and CSS-1h ; NCDOT RS, Section 1020, Grade CRS-1h. Dilute the CSS-1 and CSS-1h asphalts at the rate of one part water to one part asphalt.

c. Asphalt Cements: AASHTO M226, Grade AC-20 as modified by NCDOT RS, Section 1020.

2.1.4 Paint

FS TT-P-1952, white, unless indicated otherwise.

2.2 MIX PLANT

NCDOT RS, Sections 610-5.

PART 3 EXECUTION

3.1 INSTALLATION AND APPLICATION

Provide a tack coat and a bituminous concrete overlay and a stone base course, and a bituminous concrete surface course. Subgrade preparation shall be as specified in Section 02220, "General Excavation, Filling,

and Backfilling."

3.1.1 Stone Base Course Placement

Begin spreading base material at the point nearest the source of supply. Permit traffic and hauling over the base. Fill ruts formed by traffic and reroll. After base course placement, continue machining and rolling until surface is smooth, compacted, well bonded, and true to the designed cross section. Compact to 100 percent ASTM D 698 maximum dry density. Maintain the base smooth and true to grade and cross section until bituminous concrete placement.

3.1.2 Bituminous Tack Coat Placement

Provide tack coat on existing pavement to be overlaid at the rate of 0.10 gallon residual asphalt per square yard. Thoroughly clean surfaces to receive the tack coat immediately prior to application of tack coat. Tack coat shall be tacky at the time of bituminous concrete placement.

3.1.3 Bituminous Concrete Application

3.1.3.1 Placing Temperature

Minimum temperature of bituminous concrete during placement into mechanical spreader shall be 225 degrees F. Mixtures which have a lower temperature shall be rejected.

3.1.3.2 Joints

Where new pavement abuts existing bituminous pavement, cut existing surface course along straight lines approximately 6 inches from edge. Cuts shall be vertical and extend full depth of surface course. Prior to bituminous concrete placement, apply asphalt cement to exposed edges of cold joints.

3.1.3.3 Spreading and Finishing Equipment

Spread the bituminous concrete to a uniform density and produce a smooth finish, true to cross section and free from irregularities. Provide adjustable screeds to shape the surface to true cross section.

3.1.3.4 Bituminous Concrete Placement

As continuous as possible. Place in maximum 2-inch lifts. Avoid passing rollers over unprotected edges of bituminous concrete prior to bituminous concrete cooling. If rollers pass over unprotected edges of bituminous concrete prior to cooling, cut bituminous concrete back to expose full depth of bituminous concrete. Immediately prior to resumption of bituminous concrete placement, coat exposed edges of bituminous concrete with asphalt cement. When bituminous concrete placement resumes, rake the hot bituminous concrete against asphalt cement and compact.

3.1.3.5 Featheredges

Accomplish featheredging by raking out the larger aggregate as necessary and sloping the pavement uniformly throughout the featheredge to create a

smooth transition. Unless indicated otherwise, featheredge transition shall be 10 feet.

3.1.3.6 Compaction

NCDOT RS for equipment and compaction procedures, modified to compact bituminous concrete to 96 percent of maximum laboratory density. Finished surface shall be uniform in texture and appearance and free of cracks and creases.

3.1.3.7 Protection

No vehicular traffic shall be allowed on pavement for a minimum of 6 hours after final rolling, or until bituminous concrete has cured, whichever is longer.

3.2 FIELD QUALITY CONTROL

3.2.1 Sampling

Provide new materials where samples are taken. Take the number and size of samples required to perform the following tests.

3.2.1.1 Bituminous Concrete Sampling

a. Job Mix: Take one initial sample and one sample for every 400 tons or fraction thereof.

b. Thickness: Take one sample for every 500 square yards or fraction thereof.

c. Density: One field test for every 1000 square yards or fraction thereof, and one laboratory test for the project. Provide minimum 4-inch diameter cores if nuclear testing is not used.

3.2.1.2 Stone Base Course Sampling

a. Thickness: Take one sample for every 500 square yards or fraction thereof.

b. Density: One field test for every 1000 square yards or fraction thereof, and one laboratory test for the project.

3.2.2 Testing

Provide for each sample.

3.2.2.1 Bituminous Concrete Testing

a. Job Mix: Determine gradation and bitumen content.

b. Thickness: Maximum allowable deficiency shall be 1/4 inch less than the indicated thickness. Average thickness shall be as indicated.

c. Density, In Place: ASTM D 2922 and ASTM D 3017; cored sample ASTM D 1188 or ASTM D 2726.

3.2.2.2 Stone Base Course Testing

a. Thickness: Maximum allowable deficiency shall be 1/2 inch less than the indicated thickness. Average thickness shall be as indicated.

b. Density: ASTM D 1556 or ASTM D 2922 and ASTM D 3017.

-- End of Section --

SECTION 02735

MONITORING WELL

PART 1 - GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS:

D 1785-91	Polyvinylchloride (PVC) Plastic Pipe Schedules 40, 80, and 120

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) PUBLICATION:

570/9-75-001	Manual of Water Well Construction Practices

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 4 of the Basic Contract.

1.2.1 SD-02, Manufacturers Data

a. Bentonite seal

1.2.2 SD-04, Drawings

Shop drawings or catalog cuts showing well components and details of well casings, well screens, and well manhole assemble. Shop drawings or catalog cuts shall be accompanied by a cross section showing the relative size, location, and spacing of the well components such as the hole size, well casing, well screen, gravel filter, and grout.

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact. Replace defective or damaged materials with new materials.

1.4 DESCRIPTION OF WORK

The work includes providing monitoring wells for future sampling and testing, and incidental related work. Provide each system complete and ready for operation. Each system, including equipment, materials, installation, and performance shall be in accordance with the EPA Manual of Water Well Construction Practices, except as modified herein. In the manual referred to herein, the advisory provisions shall be considered mandatory, as though the word "shall" has been substituted for the word "should" wherever it appears. Reference to the "Project Representative" and the "Owner" shall be interpreted to mean the Contracting Officer.

Other applicable requirements are included under Section 01560, "Temporary Controls".

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the respective specifications and other requirements as specified herein.

2.1.1 Monitoring Well Casings

Provide casings that conform to ASTM D 1785, that are threaded, Schedule 40, polyvinylchloride (PVC) 1120 or PVC 1220 with a nominal two inch diameter. Provide Teflon tape for jointing the threaded pipe.

2.1.2 Monitoring Well Screens

Provide monitoring well screens that conform to ASTM D 1785, that are threaded, Schedule 40 PVC with a two inch inside diameter. Provide screens with adequate strength to resist external forces, both during and after installation. The length and the slot opening size of the well screens shall be as indicated on the detail drawings.

2.1.3 Sand Pack

Provide clean sand of the proper size and gradation to allow free flow of water in the well and prevent the infiltration of surrounding soils.

2.1.4 Bentonite Seal

Provide highly plastic colloidal clay consisting of approximately 90 percent montmorillonite.

2.1.5 Well Cap Assembly

The well cap assembly shall consist of a 4" diameter protective steel sleeve (5' total length) with locking cap. The inner 2-inch diameter PVC casing shall be capped with a water tight lockable cap. The assembly shall be provided with a padlock and a minimum of two keys.

PART 3 EXECUTION

3.1 EXISTING WELL PROTECTION

Install four (4) protective steel bollards, 3" diameter, schedule 40 steel pipe, five (5) feet long, two feet of which shall be below grade and cemented in an eight (8) inch diameter hole, as indicated. Fill with concrete or cap to prevent water from standing in the pipes. Paint the pipes yellow or safety orange. Install a four (4) inch diameter protective steel sleeve (five (5) feet total length) with a locking cap centered over the existing well, 6GW-11. This shall be performed by excavating a hole and cementing the casing vertically so that the top of the casing is within one foot from the top of the well. A four (4) foot wide by four (4) foot long by four (4) inch thick concrete pad shall be installed around the

well and bollards. The well shall be positioned in the center of the pad with the bollards located near the corners.

3.2 DRILLED HOLES

Drill holes at the locations shown on the site plans of sufficient size to install the monitoring well, but not less than 6 inches in diameter. The location, size of the well, and the method of drilling must be approved prior to work being started. The drilled hole shall not be less than 15'-6" deep. Keep an accurate log and record of the material drilled and note the depths at which changes in formation occur. Do not install the monitoring well until the drilled hole has been approved by the Contracting Officer.

3.3 WELL INSTALLATION

3.3.1 Well Casing and Well Screen

Install the well casing concentrically in the drilled hole and extend the casing down to a minimum depth as indicated. Seal the bottom of the screen with a threaded plug, consisting of the same material and thickness as the screen body.

3.3.2 Sand Packing

Prior to placing the bentonite seal, fill the entire annular space between the screen and the outside wall of the hole with sand. Extend the sand packing from the bottom of the drilled hole to the bottom of the bentonite seal as indicated on the detail drawing. Place the sand with a tremie pipe in accordance with Articles 54 and 50 of the EPA Manual of Water Well Construction Practices. Control speed of sand placement to prevent bridging and to allow for settlement of the sand. Fill the void between the casing and the drilled hole with bentonite to seal the casing to the wall of the drilled hole as indicated. Place bentonite from the bottom upward to effectively seal the annular void. Equipment and methods required to place the sand shall be approved by the Contracting Officer prior to commencement of work.

3.3.3 Well Protection

Install four (4) protective steel bollards, 3" diameter, schedule 40 steel pipe, five (5) feet long, two feet of which shall be below grade and cemented in an eight (8) inch diameter hole, as indicated. Fill with concrete or cap to prevent water from standing in the pipes. Paint the pipes yellow or safety orange. Install a four (4) inch diameter protective steel sleeve (five (5) feet total length) with a locking cap centered over the well and within one foot from the top of the well. A four (4) foot wide by four (4) foot long by four (4) inch thick concrete pad shall be installed around the well and bollards. The well shall be positioned in the center of the pad with the bollards located near the corners.

3.3.4 Waste Disposal

Handle soil removed from the drilled hole as contaminated soil and dispose of as directed in Section 02223, "Transportation and Disposal of

Contaminated Material".

3.3.5 Well Cap

Provide a well cap in accordance with the design drawings and these specifications.

--End of Section--

SECTION 02831

FENCE, CHAIN LINK

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 94	1990 Ready-Mixed Concrete

FEDERAL SPECIFICATIONS (FS)

FS RR-F-191	(Rev. K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories) (General Specification)
FS RR-F-191/1	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric) (Detail Specification)
FS RR-F-191/3	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces) (Detail Specification)
FS RR-F-191/4	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Accessories) (Detail Specification)

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 4 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Chain-link fencing components

b. Accessories

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

PART 2 PRODUCTS

2.1 CHAIN-LINK FENCING AND ACCESSORIES

FS RR-F-191 and detailed specifications as referenced and other requirements as specified.

2.1.1 Fabric

FS RR-F-191/1; Type I, zinc-coated steel, 12-gage. Mesh size, 2 inches. Provide selvage knuckled at one selvage and twisted and barbed at the other. Height of fabric, as indicated.

2.1.2 Posts, Top Rails, and Braces

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade A. End, corner, and pull posts; Class 1, steel pipe, Grade A. Braces and rails; Class 1, steel pipe, Grade A in minimum sizes listed in FS RR-F-191/3 for each class and grade.

2.1.3 Fencing Accessories

FS RR-F-191/4. Provide wire ties constructed of the same material as the fencing fabric.

2.1.4 Concrete

ASTM C 94, using 3/4-inch maximum-size aggregate, and having minimum compressive strength of 3000 psi at 28 days.

PART 3 EXECUTION

3.1 SITE PREPARATION

3.1.1 Excavation

Excavate to dimensions indicated for concrete-embedded items, except in bedrock. If bedrock is encountered, continue excavation to depth indicated or 18 inches into bedrock, whichever is less, with a diameter in bedrock a minimum of 2 inches larger than outside diameter of post. Clear post holes of loose material. Dispose of waste material outside limits of station.

3.2 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded areas with a repair coating matching original coating. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.2.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10-feet on center. Provide corner or pull posts, with bracing in both directions, for

changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of corner and pull posts.

3.2.2 Post Setting

Set posts plumb. Allow concrete to cure a minimum of 72 hours before performing other work on posts.

3.2.2.1 Earth and Bedrock

Provide concrete bases of dimensions indicated. Compact concrete to eliminate voids, and finish to a dome shape.

3.2.3 Top Rails

Install top rails before installing chain-link fabric. Pass top rail through intermediate post caps. Provide expansion coupling spaced as indicated.

3.2.4 Fabric

Pull fabric taut and secure fabric to top rail, close to both sides of each post and at maximum intervals of 24 inches on center. Secure fabric to posts using stretcher bars, ties or clips spaced 15 inches on center, or by integrally weaving to integral fastening loops of end, corner, pull, and gate posts for full length of each post. Install fabric on opposite side of posts from area being secured. Install fabric so that bottom of fabric is embedded as indicated. Install fence fabric to provide approximately 2-inch deflection at center of fabric span between two posts, when a force of approximately 30 pounds is applied perpendicular to fabric. Fabric should return to its original position when force is removed.

3.3 ACCESSORIES INSTALLATION

3.3.1 Post Caps

Install post caps as recommended by the manufacturer.

3.3.2 Supporting Arms

Install supporting arms as recommended by manufacturer. In addition to manufacturer's standard connections, permanently secure supporting arms to posts. Studs driven by low-velocity power-actuated tools may be used with steel, wrought iron, ductile iron, or malleable iron. Do not use studs driven by power-actuated tools with gray iron or other material that shall fracture.

3.3.3 Barbed Wire

Install barbed wire on supporting arms above fence posts. Extend each end member of gate frames sufficiently above top member to carry five strands of barbed wire in horizontal alignment with barbed wire strands on the fence. Pull each strand taut and securely fasten each strand to each supporting arm or extended member. Secure wires in accordance with fence manufacturer's recommendations.

3.4 CLEANUP

Remove waste fencing materials and other debris from the station.

-- End of Section --

SECTION 02900

GROUNDWATER RECOVERY SYSTEM

PART 1 - GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS

A 312	1989 (Rev. A) Stainless and Welded Austenitic Stainless Steel Pipe
C 478	1989 Precast Concrete Manhole Sections
C 494	1986 Chemical Admixtures for Concrete
C 150	1989 Type I or II Portland Cement
D 2122	1990 Method for Determining Dimensions of Thermoplastic Pipe and Fittings
D 2321	1989 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D3350	1984 Polyethylene Plastic Pipe and Fittings Materials
D 3139	1989 Standard Specification for Joints for Plastic Pressure Pipe Using Flexible Elastometric Seals
F 477	1976 (Rev. 85) Elastometric Seals (Gaskets) for Joining Plastic Pipe

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) PUBLICATIONS

570/9-75-001	Manual of Water Well Construction Practices

STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, FIFTEENTH EDITION

NATIONAL ELECTRICAL CODE

NFPA 70	1993 National Electrical Code

MANUFACTURERS STANDARDIZATION SOCIETY OF VALVE AND FITTINGS INDUSTRY (MSS) PUBLICATION

SP-58-83	Pipe Hangers and Supports - Materials, Design

and Construction

1.2 CERTIFIED GEOLOGIST

A certified professional geologist shall be provided to start up, balance, and provide to the government a report for groundwater recovery operations, as specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Data

a. Well Casing
b. Well Screen
c. Filter Pack Gradation Analysis
d. Groundwater Recovery Equipment, Complete
e. Manhole Sections, Slabs, Steps, Frames and Cover
f. Groundwater Recovery Well Building, complete
g. Casing Pipe
h. Carrier Pipe

1.3.2 SD-12, Field Test Reports

Submit a report, certified by a Professional Geologist, that presents data on the performance of each recovery well installed. Topics to be addressed in the report include, but are not limited to: well installation log, well development report, results of a 72-hour aquifer test, including zones of hydraulic influence and groundwater capture, peak pumping rates, aquifer drawdown data, aquifer hydraulic transmissivity, and storativity.

1.3.3 SD-13, Certificates

a. Certified Professional Engineer's Statements, Designs, Plans and Reports for civil, mechanical and electrical construction and installation of the groundwater recovery system, in accordance with Part 1.2.1.1 of Section 01010, "General Paragraphs."

b. Certified Professional Geologist's Plans and Reports, and specified in Part 1.4.2.

c. Laboratory Tests

1.3.4 SD-19, Operation and Maintenance Manuals:

Furnish the data, for the items listed, to the NTR for review and acceptance; O&M data shall comply with requirements specified in Section 01730, "Operations and Maintenance Data."

a. Groundwater Recovery Equipment, as delineated in paragraph 2.4 of this section (Data package 4).

1.4 EARTHWORK

Provide in accordance with Section 02220 "General Excavation, Filling, and Backfilling" and other sections as applicable.

1.5 ENVIRONMENTAL PROTECTION

Provide in accordance with Section 01560 "Temporary Controls."

1.6 GENERAL REQUIREMENTS

Provide in accordance with Sections 15011 "Mechanical General Requirements" and 16011 "Electrical General Requirements."

1.7 RELATED WORK

Section 02901 "Groundwater Treatment System."

1.8 DESCRIPTION OF WORK

The work includes the installation of a groundwater recovery system as shown on the contract drawings, and as specified herein. The groundwater recovery system shall include: shallow and Castle Hayne (deep) recovery wells, pumps, piping, electric power and control wiring, conduit, and controls, recovery well buildings and appurtenances. the recovery well pumps and controls shall be provided complete by one manufacturer.

Installation of the recovery well system shall be completed in two phases, as described in Part 3. The intent of this phased approach is to install one (1) shallow and one (1) Castle Hayne recovery well as Phase I. Following construction and field performance testing of these two (2) wells, the Contractor shall recommend to the NTR, the placement of the remaining recovery wells in Phase II. Placement of the remaining recovery wells shall be based on the data generated from the field performance test. After approval by the NTR, the Contractor shall install the remaining recovery wells as Phase II.

Provide a total of three (3) shallow recovery wells and three (3) Castle Hayne recovery wells as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

Materials shall conform to the respective specifications and other requirements as specified herein. Where a trade name or manufacturer's name is used or specified, such use or specification is for reference or guidance only; an equivalent in all respects may be provided upon demonstration of equivalency.

2.2 RECOVERY WELLS

2.2.1 Recovery Well Casings

Schedule 40 PVC, threaded for joining to well screen. Casings shall be plumb and centered. Plumbness shall be sufficient to set and operate pump and appurtenances without damage.

2.2.2 Recovery Well Screens

Wire wound, continuous slot, Type 304, Schedule 5, midbody Schedule 40 ends, stainless steel (ASTM A-530) well screens with a 6-inch inside diameter. Provide screens with adequate strength to resist external forces, both during and after installation. Length of well screen shall be as indicated. The well screen opening size shall be 0.010 inch for Type II wells and 0.020 inch for Type III wells. Screens shall be plumb and centered. Plumbness shall be sufficient to set and operate pump and appurtenances without damage.

2.2.3 Filter Pack

Provide clean, round, hard water-worn quartz with less than 5 percent feldspar, no fossils, carbonate or organics. The filter pack shall have a uniformity coefficient of 2.5 or less. The filter pack for Type II wells shall be Morie Sand Number 1 or a commercially available filter pack material with gradation specifications as follows:

Sieve Number	Cumulative Percent Retained
12	2.2
16	61.7
20	97.4
30	99.6
40	99.9
50	100

The filter pack for Type III wells shall be Morie Sand Number 2 or a commercially available filter pack material with gradation specifications as follows:

Sieve Number	Cumulative Percent Retained
8	0.7
12	49.4
16	97.0
20	99.3
30	99.6
40	100

Provide a bentonite seal between the filter pack and base of well head access manhole as indicated.

2.2.4 Cement Grout and Admixtures

Provide neat cement grout as indicated, Type I or II portland cement conforming to ASTM C-150 and water. The mixed grout shall contain no more than seven gallons per gab (1.0 cubic foot or 94 pounds). Admixtures

shall conform to ASTM C-494.

2.3 RECOVERY WELLHEAD BUILDINGS

Provide a liftable, premanufactured building as shown on the drawings at each recovery wellhead. The building installation shall include the building foundation, structure, heating/ventilation system, lighting and electrical systems. The requirements of the wellhead buildings are listed below.

a. The Contractor shall review the building loads and, based on the available soil bearing pressure, design a foundation adequate to support the building. The foundation shall be concrete slab-on-grade construction and shall be designed with adequate steel reinforcing bars. An adequate seal shall be provided between the building walls and the floor slab such that the connection is water-proof.

b. Each building shall have minimum dimensions of 6 feet by 8 feet, with a minimum height of 7 feet. The building shall be constructed of a steel frame, with steel walls and roof. The exterior wall surfaces shall be an exposed aggregate finish, as described in Section 2.3.1. The building shall have at least one personnel-door equipped with a key lock.

c. The building roof shall be removable, or shall have a resealable opening to allow for the removal of the well pump with a crane. Lifting lugs for the entire building, and for the roof only shall be provided.

d. The building heating system shall be designed to maintain an inside temperature of no less than 50 degrees F in the winter. Foam insulation shall be provided in the roof (minimum R31) and walls (minimum R18). Adequate ventilation shall be included to provide six air volume changes per hour for summer ventilation.

e. The building shall be pre-wired for electric. The wiring shall be sealed in rigid conduit. The electrical system shall be adequate to provide lighting that is satisfactory to allow work in the building at any time of the day. Light fixtures shall be water-proof. A minimum of two electrical outlets shall be provided.

f. Openings for wellheads in the floor and openings for piping in the sides of the building may be pre-cut, or may be installed in the field. Openings shall be grouted and adequately sealed to prevent air leakage through the opening.

g. The building shall be designed and installed in accordance with all local, State and Federal building codes. The building shall be erected in strict accordance with the manufacturer's instructions.

h. The building manufacturer shall be a recognized pre-engineered building system manufacturer that is chiefly engaged in the practice of design, fabrication, and/or installation of

pre-engineered buildings, and has been in the pre-engineered building business for at least five years. Acceptable manufacturers include those listed below. Subject to compliance with all requirements described herein, provide products of one of these manufacturers, or NTR approved equal.

C.I.D. Associates, Inc.
P.O. Box 606, Armstrong County
Leechburg, PA 15656-9913
(412) 842-2130

Smith-Midland Corporation
Midland, VA 22728
(703) 439-3266

Fibrebond Corporation
1300 Davenport Drive
Minden, LA 71055
(318) 377-1030

Andrew Corporation
10500 West 153 rd Street
Orlando Park, IL 60462
(708) 329-3300

The Contractor shall submit for approval shop drawings for the building, building systems, and building foundation described herein. The drawings shall be submitted for approval prior to ordering materials. The building warranty shall also be submitted for approval.

2.3.1 Exposed Aggregate Panels

a. The construction of the prefabricated building shall be suitable for a minimum design life of 20 years.

b. The exterior wall surfaces shall be an exposed aggregate finish and the proposed structure shall be subject to the NTR's approval. the Contractor shall provide descriptive pictures and/or drawings for review and approval by the NTR prior to fabrication/construction.

c. Exterior panels shall be fabricated of regular aggregate permanently bonded to a cement board substrate, ASTM C 67, specifically for exterior use, 1/2" minimum thickness, or NTR approved equal and shall comply with the following technical performance.

Property	Technical
Lbs./sq.ft.	3.85 - 4.92
Nominal Thickness	1/2" - 13/16"
Substrate Thickness	8 mm (5/16")
Modulus of Elasticity	2.03 x 10 lbs/in
Density	106 lbs./ft
Water Absorption	14%
Flame Spread Substitute	0

Color Selected by Government

2.4 RECOVERY WELL PIPING MANHOLE

Precast concrete manholes shall include standard manholes complete with frames and covers, manhole's steps and appurtenances of the type indicated.

2.4.1 Riser Sections

Manhole's riser sections shall be constructed of precast reinforced concrete pipe sections. All precast manholes shall consist of the combination of barrel sections resulting in the fewest number of joints. Precast concrete pipe riser sections and slabs shall be reinforced in accordance with ASTM C-478, with a minimum wall thickness of 5 inches and with joints having an "O" ring seal. Manhole section shall be waterproofed on the exterior. Riser sections shall be dimensioned as indicated and shall be adequate to withstand H-20 wheel loads. All top riser sections shall have eccentric openings. The edge of eccentric openings for flat top sections shall be a maximum of 2 inches from the inside wall of the barrel section.

2.4.2 Base Sections

Base sections shall have reinforced flat bottoms protruding 6 inches beyond the outside face of the riser section unless otherwise specified. The base section shall be a minimum of 6 inches in thickness.

2.4.3 Steps

Manhole steps shall be made from copolymer polypropylene plastic. The plastic steps shall be hand driven into preformed holes in cured concrete. The steps shall be a minimum of 12 inches wide and shall be in accordance with OSHA regulations. The quantity shall be as indicated.

2.4.4 Frames and Covers

Frames and covers shall be in accordance with ASTM A-48, Class 30A. Covers shall be provided with a minimum of two 1-1/2" x 3/4" slots unless otherwise specified. Frames and covers shall be adequate to bear H-20 wheel loads and shall be provided with machined bearing surfaces. Material shall be ductile iron and shall conform to ASTM A-536 Grade 65-45-12. Cover shall be of the self sealing type with a continuous gasket secured within a dovetail groove.

2.5 GROUNDWATER RECOVERY EQUIPMENT

The groundwater recovery system shall be provided complete with the following:

2.5.1 Electrical Control Panel

An electrical control panel shall be provided for each extraction system. Each panel shall contain, at a minimum:

Status indicators (on/off) for each station (extraction well)

Emergency power switches for each station

A readout of total flow from the system.

2.5.2 Groundwater Extraction Pump

Each groundwater extraction pump shall be a commercially available submersible pump with an integrated electric motor and impeller stack. Each pump shall be suitably sized for the specified discharge and total dynamic head (TDH) as indicated in the equipment list provided in Section 02901, "Groundwater Treatment System". Materials shall be resistant to corrosion and compatible with site contaminants and conditions. All openings shall be through fittings securely welded to the pump casing and properly water-tight, where desirable. Discharge shall be through the top of the impeller stack with an opening diameter as indicated. There shall be a minimum of two non-return check valves at the connection between the impeller stack and the discharge piping.

2.5.3 Pump Controllers and Well-Head Installations

Pump motors shall be suitable for the discharge and TDH requirements. Each pump motor shall be fitted with a limit switch in each installation. The limit switch shall turn the motor off (low-level switch) within a range of water levels in the particular well from 0.5 feet above the intake to the pump to five feet or less above the intake to the pump. An on/off indicator shall be provided at the PLC panel. A totalizing, mechanical flow meter shall be provided at each well-head. A power switch and circuit breaker (if appropriate) shall be provided at each well-head. A means of measuring the water level in the well shall be provided as part of the pump installation. Each discharge pipe shall have, at the well-head, a ball-type drain valve and a pressure indicator with associated shut-off and drain valves as indicated. The well-head shall be adequately constructed to allow maintenance or replacement of the piping, pump, wiring, and so forth, at each station without shutting down of the entire extraction system or permanent modification of the individual well-head.

2.5.4 Valves

Vales shall be ball-type, fitted with an indicating handle (open, shut or mid-range) and appropriate for the pipe connection. Valves shall be protected from freezing to zero degrees Fahrenheit. Valve shall be suitable for use with site contaminants and conditions. Packing and seals shall be hydrocarbon resistant. Valves shall be resistant to a pH range of 4 to 8, and have a pressure rating of 150 PSIG.

2.5.5 Groundwater Piping

Groundwater piping shall be HDPE, Schedule 40, conforming to ASTM D-3350 and sized as indicated. Piping joints shall be butt fusion welded.

2.5.6 Other

Provide fittings, adapters, air relief valves, and other appurtenances as required to insure a complete and operable system.

PART 3 - EXECUTION

3.1 GENERAL

Groundwater extraction well installation operations shall be supervised, directed, and monitored by a certified professional geologist with experience in hydrogeology and groundwater recovery. Groundwater recovery plans and reports shall be prepared, signed, and sealed, including certification number and date, by the certified professional geologist. Prior to beginning work, the certified professional geologist shall meet with the NTR to discuss the groundwater recovery plan including work procedures and safety precautions.

Installation of the recovery well system shall be completed in two phases. In Phase I, the Contractor shall install one (1) shallow (Type II) and one (1) Castle Hayne (Type III) recovery well as indicated and specified. Following construction and field performance testing of these two recovery wells, as described in Part 1.4.2, the Contractor shall recommend, in a written report to the NTR, the locations for the remaining recovery wells. Placement of the remaining recovery wells shall be based on data generated from the field performance test. After approval from the NTR, the Contractor shall install the remaining recovery wells as Phase II.

For preliminary design purposes, a total of three(3) shallow recovery wells and three (3) Castle Hayne recovery wells are indicated.

3.2 RECOVERY WELLS

3.2.1 General

The two initial recovery wells shall be installed at the locations indicated, and shall be of two types.

Type II - shallow aquifer

Type III - Castle Hayne Aquifer

3.2.2 Type II Soil Boring/Extraction Well Construction and Installation

Soil borings for Type II extraction (recovery) wells shall be advanced using hollow-stem augers with an inside diameter as appropriate. The target depth shall be as indicated.

Type II recovery wells shall be constructed of 6-inch nominal inner diameter, Schedule 40 PVC riser with Schedule 40 stainless steel screen, flush-jointed with a vented cap. The riser shall extend through the floor of the recovery well head building as indicated. The screen section shall be a 10-foot length of 0.010-inch wire-wound slots; the sand pack shall be of Number 1 Morie Sand, or equivalent, extending from the base of the screen to about one foot above the top of the screen (overdevelopment with a surge-block shall be required).

3.2.3 Type III Soil Boring/Extraction Well Construction and Installation

Soil borings for Type III extraction (recovery) wells shall be advanced using hollow-stem augers, with inside diameters as appropriate, to the first confining or segregating layer; a smaller auger may be used initially for sampling a pilot hole, followed by reaming to the larger diameter. After setting the surface casing by pressure-grouting, a period of 16 to 24 hours shall pass before the remainder of the bore shall be drilled by hydraulic rotary methods; the grout seal between the surface casing and the borehole shall be complete from the bottom to the top of the borehole, with some grout inside the casing at the bottom.

Hydraulic rotary drilling of a 8-inch bore shall proceed to the target depth indicated with a 7-7/8 inch tricone bit. The bit shall initially ream out the grout within the surface casing to the bottom of the casing; at the bottom of the surface casing, all drilling fluids within the casing shall be flushed out with fresh water and contained. Drilling below the surface casing to the target depth with clear water is desired; however, drilling with a minimal density bentonite mud shall be acceptable when required by field conditions.

Type III recovery wells shall be constructed of 6-inch nominal inner diameter, Schedule 40 PVC riser with Schedule 40 stainless steel screen, flush-jointed with a vented cap. The riser shall extend through the base of the recovery well head building as indicated. The screen section shall be a 10-foot length of 0.020-inch wire-wound slots; the sand pack shall be of Number 2 Morie Sand, or equivalent, extending from the base of the screen to about one foot above the top of the screen.

3.2.4 Initial Development

The initial development of each well shall be made no sooner than 48 hours after completion of the well. Development shall proceed by over pumping using a submersible or surface pump until the discharge is visibly free of sediment, or until the physical parameters of pH and specific conductance have stabilized within ten percent; development shall not be terminated until at least three borehole volumes have been extracted. Development fluids shall be contained and consolidated for disposal through either the treatment plant or to the on-base sanitary sewer system as directed by the NTR.

3.2.5 Aquifer Test

After the initial shallow aquifer and Castle Hayne aquifer recovery wells have been installed and developed, the Contractor shall conduct an aquifer test to evaluate the actual performance of each well. The Contractor shall perform the aquifer tests as specified in the workplan submitted in accordance with Section 01010, "General Paragraphs", and with approval of the NTR.

The Contractor shall prepare a report which summarizes the data from the aquifer test. Using this information, the NTR shall identify the location for the remaining recovery wells.

3.3 GROUNDWATER RECOVERY

The groundwater recovery system shall be installed, operated, and maintained for three months by the Contractor. The certified professional geologist shall monitor and direct the initial groundwater recovery operations and shall provide a report of progress in the Contractor's Closeout Report in accordance with Section 01010, "General Paragraphs". The progress report shall include the quantity of extracted groundwater, static water levels, drawdown levels and hydrogeologic conditions. After three months operation of the systems by the Contractor the Government shall assume operation of the system. The Contractor is to provide training for the Government personnel to properly operate and maintain the system. This training shall be given by the certified professional geologist for five 8-hour working days.

3.3.1 Discharge of Groundwater

The groundwater shall be discharged to the groundwater treatment system (Section 02901, "Groundwater Treatment System").

3.3.2 Waste Disposal

All soil removed from drill holes shall be tested for characteristics of hazardous waste as specified in Section 01560, "Environmental Protection", disposal shall be in accordance with test results. Soil not reused in trenches shall be considered debris and shall be disposed of as specified in Sections 01560, "Environmental Protection," and 02220, "General Excavation, Filling, and Backfilling."

3.4 SPARE PARTS

Contractor shall provide a list of recommended spare critical parts for the system together with a cost estimate and source of the recommended spare parts. This list shall be provided to the NTR within (2) weeks after submittals are approved.

3.5 FINAL CLEANUP

Remove waste material and other debris from the site.

3.6 NAMEPLATES

Provide laminated plastic nameplates for equipment, gauges, thermometers, and stop valves. Laminated plastic shall be 0.125 inch thick Melamine plastic, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be one inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information:

a. Manufacturer, type, and model number

b. Contract number and accepted date
c. Capacity or size
d. System in which installed
e. System which it controls

3.7 INSTRUMENTATION AND CONTROLS

Install all system components and appurtenances in accordance with the manufacturer's recommendations and as shown. Provide all necessary interconnections, services, and adjustments required for a complete operable system. All electrical work shall be in accordance with NFPA 70 and as specified.

3.8 TESTS

Upon completion and before final acceptance of the work, each system shall be tested as in service to determine compliance with the contract requirements and warranty. Each new piping system and any pressure vessels shall be hydrostatically tested with clean water at not less than 125 psig and shall show no leakage or reduction in gauge pressure after 4 hours. All equipment shall be tested in operation for a continuous period of not less than 3 months. During the tests, all equipment shall be tested under every condition of operation. All controls shall be tested to demonstrate performance of their required function. All piping shall be thoroughly flushed and cleaned before being placed in operation. The Contractor shall furnish instruments, connecting devices and personnel for the test. Each system shall be completely tested for compliance with specification and all conditions thereof, and all adjusting and balancing shall be completed to the satisfaction of the NTR. Adjustment of controls and balancing of systems shall extend for 3 months after the completed systems are put in operation.

-- End of Section --

SECTION 02901

GROUNDWATER TREATMENT SYSTEM

PART 1 - GENERAL

1.1 REFERENCES

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

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 136	40 CFR 136 Guidelines Establishing Test Procedures for the Analysis of Pollutants

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electric Code

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Programmable Logic Controller
b. Instrument Specifications and Data Sheets

1.2.2 SD-04, Drawings

a. Piping Design/Layout Drawings (Plans and Elevations)
b. Instrument Loop Drawings
c. Control System Ladder Logic Diagram
d. Cable/Conduit Layout Drawings
e. Control Panel Layout Drawings
f. Cable/Conduit Schedule (if required)
g. MCC/Power Distribution Schematics

1.2.3 SD-19, Operations and Maintenance Data

a. Groundwater Treatment System (Data Package 4). (Provide O&M package for water treatment system as a complete and operable unit. Provide individual component data packages as specified in the applicable section.)

1.3 EQUIPMENT

Provide in accordance with the following Sections of these specifications:

11300	Groundwater Feed Tank and Appurtenances
11302	Initial/Final pH Adjust Tanks and Chemical Feed Systems
11303	Polymer Feed System

11304 Inclined Plate Clarifier and Appurtenances
11305 Sand Filters
11307 Air Stripper and Holding Tank
11308 Cartridge Filters
11309 Carbon Adsorbers
11310 Spent Backwash Holding Tank and Appurtenances
11311 Treated Effluent Tank and Appurtenances
11313 Sludge Thickening Tank and Appurtenances
11314 Dewatering Press
11315 Centrifugal Pumps
11316 Air Operated Pumps
15487 Compressed Air System

Other sections as applicable

1.4 TREATMENT BUILDING

Design/Provide in accordance with applicable State and local codes and with the following Sections of these specifications:

03302 Cast in Place Concrete (Minor Construction)

13121 Pre-engineered Metal Buildings (Rigid Frame)

Other sections as applicable

1.5 GENERAL REQUIREMENTS

Provide in accordance with Sections 15011 "Mechanical General Requirements" and 16011, "Electrical General Requirements."

1.6 ENVIRONMENTAL PROTECTION

Provide in accordance with Section 01560, "Temporary Controls."

1.7 DESCRIPTION OF WORK

The work includes the design and installation of a groundwater treatment system as indicated on the drawings, and specified herein. The system shall include groundwater feed storage and equalization, initial pH adjustment, sand filtration, air stripping, granular activated carbon (GAC) adsorption, treated effluent storage and discharge, and all associated pumps, piping and controls.

PART 2 - PRODUCTS

2.1 PIPING AND VALVES

Provide in accordance with the following sections of these specifications:

15400 Plumbing
15401 Contaminated Groundwater
15402 Caustic Service
15403 Acid Service
15404 Sludge Service

15405 Air Service

2.2 GROUNDWATER TREATMENT CONTROL SYSTEM

A groundwater treatment control system shall be designed and provided by the Contractor. Analog and digital inputs and outputs (I/O) are as indicated on the drawings.

PART 3 - EXECUTION

3.1 GENERAL

Design, provide and install the following in accordance with the applicable codes and requirements as required for a complete and operable system:

Reinforced concrete floor, exterior tank foundations, and pre-engineered metal building with masonry curtain walls.

Groundwater treatment system piping.

Groundwater treatment control system. All electrical work shall be in accordance with NFPA 70 and as specified in Division 16.

Install the following in accordance with the applicable sections of these specifications:

Initial pH Adjustment System (caustic)

Polymer Mixing and Feed System

Inclined Plate Clarifier

Sludge Thickening Tank

Dewatering Press

Final pH Adjustment System (Acid)

Three Multimedia Sand Filters

Packed Tower Air Stripper

Four Granular Activated Carbon (GAC) Adsorbers

Treated Groundwater Storage Tank

Groundwater shall be treated to the effluent requirements specified and discharged to the surface as indicated.

3.2 EFFLUENT REQUIREMENTS

Volatile organic contaminants have been detected at the following maximum concentrations, in parts per billion (ppb), and shall be removed to below the following limits, in parts per billion:

	Influent	Effluent
Vinyl Chloride	800	0.015
Trichloroethene	58,000	2.8
1,2-Dichloroethene	30,000	70
1,2-Dichloroethane	30	0.38
Tetrachloroethene	920	0.7
Ethylbenzene	52	29

Inorganics shall be removed as necessary to provide proper treatment system performance.

3.3 PIPING, VALVES AND INSTRUMENTS

The Contractor shall design and install all piping in accordance with the applicable sections of these specifications as required for a complete and operable system. Attachment A of this section provides associated line list and instrument list.

3.4 INSTRUMENTATION AND CONTROL SYSTEM

The Contractor shall design the instrumentation and control system for the groundwater treatment system to provide for a system that continuously processes contaminated groundwater with a minimal amount of operator input. The basis of the system shall be a set of programmable logic controller (PLC) modules with a central, dedicated operator interface module. This PLC system shall be located in the treatment system building office, as indicated.

3.4.1 System Inputs and Outputs

Based on the Piping and Instrument Diagrams (P&IDs) there are 112 Input/Outputs (I/Os) in the PLC system. To allow for system expansion, provide a system with at least 224 I/Os. I/Os to be provided for the control system are as follows:

Digital Inputs (DI)	44
Digital Outputs (DO)	42
Analog Inputs (AI)	18
Analog Outputs (AO)	8

The PLC system logic and controls shall be designed to adjust to step changes that may be introduced to the system. The logic for the control of the treatment system is as indicated.

3.4.2 Contractor Provided Information

The Contractor shall provide the following items to complete the design and construct the control system:

Instrument Loop Drawings
Cable/Conduit Layout Drawings
Panel Layout Drawings
Operator Interface Display Graphics Drawings
Instrument Installation Detail Drawings

Instrument Specifications
PLC Specifications
Instrument Data Sheets
Programming the Control Logic for the PLC

The PLC system shall receive inputs from and send outputs to the extraction well system and the groundwater treatment system. The inputs shall include items such as, but not limited to, levels, alarms, flowrates, pressures, on/off indicators, and start/stop signals. Outputs shall include items such as, but not limited to, control set points, start/stop signals, and speed controller signals. The treatment system PLC system shall also interface with equipment vendor PLC systems via a data highway interface.

Piping, Power, Controls, Accessories, and Appurtenances shall be installed in accordance with the manufacturer's recommendation and as shown. Provide all necessary interconnections, services, and adjustments as required for a complete and operable system. All electrical work shall be in accordance with NFPA 70 and as specified in Division 16.

3.5 NAMEPLATES

Provide laminated plastic nameplates for equipment, gauges, thermometers, and stop valves. Laminated plastic shall be 0.125 inch thick Melamine plastic, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be one inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information:

a. Identification number indicated on drawings
b. Manufacturer, type, and model number
c. Capacity or size
d. System in which installed

3.6 SEQUENCE OF OPERATION

3.6.1 Influent Flow

Groundwater shall be pumped to the Groundwater Feed Storage Tank for equalization. Groundwater will then be pumped to the Initial pH Adjust Tank at a flowrate controlled to provide continuous processing of the contaminated groundwater.

3.6.2 Initial pH Adjustment

The pH of the groundwater shall be raised in the Initial pH Adjust Tank to between 9.0 and 9.5 in order to precipitate out dissolved iron. The groundwater shall then be pumped to the Solids Removal System at a flowrate controlled to provide continuous processing.

3.6.3 Solids Removal System

Groundwater feed from the Initial pH Adjust Tank shall be flash mixed with a polymer solution, then slow mixed in a separate compartment of the system to form flocculate. Groundwater and flocculate shall flow by gravity to an inclined plate clarifier. Clear water from the clarifier shall flow by gravity to the Final pH Adjust Tank.

Sludge collected at the clarifier bottom shall be continuously recycled to the flocculation chamber to optimize solids loading. Sludge shall be blown down intermittently to a Sludge Thickening Tank and thickened by gravity separation. Solids from the Sludge Thickening Tank shall be pumped intermittently to a Dewatering Filter Press for dewatering.

3.6.4 Final pH Adjustment

Clarifier overflow shall flow by gravity to the Final pH Adjust Tank and lowered to a neutral pH by acid addition. The process water shall then be pumped to the Solids Filtration System at a flowrate controlled to provide continuous processing.

3.6.5 Solids Filtration System

Process water from the Final pH Adjust Tank shall pass through a Sand Filter. Sand Filters shall be backwashed automatically based on differential pressure. Backwash water shall flow to a Backwash Water Holding Tank.

3.6.6 Air Stripping

Process water from the Sand Filters shall flow to a Packed Tower Air Stripper. The process water shall enter the top of the tower and flow by gravity, counter current to the stripping air, to an Air Stripper Effluent Holding Tank.

3.6.7 Granular Activated Carbon (GAC) Adsorption

Process water shall be pumped from the Air Stripper Effluent Holding Tank through Granular Activated Carbon Adsorbers to a Treated Effluent Storage Tank. GAC Adsorbers shall be backwashed automatically based on differential pressure. Backwash water shall flow to the Spent Backwash Holding Tank.

3.6.8 Treated Effluent Storage and Discharge

Treated effluent shall be stored in sufficient capacity to provide backwash water demands and dilution water demands for the acid, caustic and polymer mix tanks. Treated effluent shall be discharged by gravity to a drainage ditch as indicated.

3.7 STARTUP AND INITIAL TESTING

The Contractor shall provide all startup and testing services in accordance with the applicable Sections of these specifications and make all required adjustments.

Water generated during system startup and testing shall be discharged per the direction of the NTR. Unless otherwise noted, clean water shall be used for testing.

Provide valves and fittings as required to obtain water samples for testing. Samples shall be obtained via fittings from the effluent piping of the equipment being tested. Samples shall not be obtained from temporary drain hoses or pipes.

Maintain an accurate log of all test procedures and results. Submit a report of procedures and results to the NTR for approval.

Upon completion of startup and testing, treated groundwater shall be discharged to surface as indicated only after the approval of the NTR.

3.8 OPERATIONS

The groundwater treatment system shall be operated and maintained by the Contractor for a period of three months. The three month operational period will start only after all components of the system have been through the startup and initial testing, the aquifer testing specified in Section 02900, "Product Recovery System" have been completed, all recovery wells have been installed, and the NTR has accepted the system in its entirety. A state certified professional geologist or engineer shall monitor the groundwater treatment system's operation, and provide an initial and a final report containing hours of operation, volume of water treated, and weekly water quality laboratory analysis. The report shall include specific performance data for the major components of the system, including, but not limited to, the solids removal system, air stripping system, granular activated carbon adsorption system, and the dewatering press system. After three months operation by the Contractor, the Government shall assume operation of the equipment. The Contractor shall provide training (five 8 hour days) for Government personnel in how to properly operate and maintain the system. This training shall be in addition to the training required by Section 02900, "Product Recovery System." The training shall include one 8 hour day of training by the air stripper manufacturer's field representative.

3.8.1 Water Quality Analyses

Water quality analysis of the groundwater treatment system influent and effluent shall be for volatile organic compounds and metals as required to evaluate treatment system performance. The Contractor shall submit a Sampling and Analysis Plan outlining all sampling and analysis methods, procedures and frequencies.

3.9 FINAL TESTING

Upon completion and before final acceptance of the work, each system shall be tested as in service to determine compliance with the contract requirements and warranty. Each new piping system and all pressure vessels shall be hydrostatically tested at not less than 125 psig and shall show no leakage or reduction in gauge pressure after 4 hours. All equipment shall

be tested in operation for a continuous period of not less than 3 months. During the tests, all equipment shall be tested under every condition of operation. All controls shall be tested to demonstrate performance of their required function. All piping shall be thoroughly flushed and cleaned before being placed in operation. The Contractor shall furnish instruments, connecting devices and personnel for the test. All defects in the work provided by the Contractor shall be corrected by him. Each system shall be completely tested for compliance with specification and all conditions thereof, and all adjusting and balancing shall be completed to the satisfaction of the NTR. Adjustment of controls and balancing of systems shall extend for one year after the completed systems are put in operation. The Contractor shall furnish all materials and labor to make all repairs required one year after the systems are accepted by the NTR.

-- End of Section --

ATTACHMENT A
EQUIPMENT, INSTRUMENT, AND LINE LISTS

P&ID Location No.	Drawing No.
22220135	P-4
22220235	P-5
22220335	P-6
22220435	P-7

BAKER ENVIRONMENTAL, INC

Equipment List

MCB Camp Lejeune - OU No. 2 Lejeune, NC

Groundwater Treatment System

CTO - 222

04/22/94

Equipment Tag	Equipment Name	Vessel Size	Design Flow (GPM)	Design Pressure (PSIG)	Operatin Pressure (PSIG)	Design Temp (F)	Material of Construction	Horsepower (HP)	Insulation Spec	Insulatio Spec	Specification No.	P & ID Location
P-100	A1MW24B EXTRACTION PUMP	NA	10	50 TDH		150	CARBON STEEL	0.25	NONE		11315	22220135
P-101	A1MW9B EXTRACTION PUMP	NA	200	150 TDH		150	CARBON STEEL	15.0	NONE		11315	22220135
P-102	A1MW25B EXTRACTION PUMP	NA	10	50 TDH		150	CARBON STEEL	0.33	NONE		11315	22220135
P-103	BEW6A EXTRACTION PUMP	NA	200	155 TDH		150	CARBON STEEL	15.0	NONE		11315	22220135
P-104	BEW4B EXTRACTION PUMP	NA	10	47 TDH		150	CARBON STEEL	0.25	NONE		11315	22220135
P-110A	GROUNDWATER FEED PUMP	NA	540	40 TDH		150	CARBON STEEL	15.0	NONE		11315	22220135
P-110B	GROUNDWATER FEED PUMP	NA	540	40 TDH		150	CARBON STEEL	15.0	NONE		11315	22220135
P-180	BUILDING SUMP PUMP	NA	15	80 TDH		150	CARBON STEEL	0.75	NONE		11315	22220135
P-181	BUILDING SUMP PUMP	NA	15	80 TDH		150	CARBON STEEL	0.75	NONE		11315	22220135
T-110	GROUNDWATER STORAGE TANK	13 FT. DIAM X 25 FT. HIGH	24,000 GA	0 TO -4"WC		150	CARBON STEEL	NA	NONE		11300	22220135
T-180	BUILDING SUMP	4 FT. DIA x 4 FT. DEEP	375 GAL	0		150	CONCRETE	NA	NONE			22220135
T-181	BUILDING SUMP	4 FT. DIA x 4 FT. DEEP	375 GAL	0		150	CONCRETE	NA	NONE			22220135
A-120	NAOH MIX TANK AGITATOR	NA	NA			150	CARBON STEEL	1.0	NONE		11302	22220235
A-125	POLYMER MIX TANK AGITATOR	NA	NA			150	CARBON STEEL	1.5	NONE		11303	22220235
A-130	INITIAL PH ADJUST TNK AGITATOR	NA	NA			150	CARBON STEEL	2.5	NONE		11302	22220235
P-120A	20% NAOH FEED PUMP	NA	3.5 GPH	15		150	CARBON STEEL	0.25	NONE		11302	22220235
P-120B	20% NAOH FEED PUMP	NA	3.5 GPH	15		150	CARBON STEEL	0.25	NONE		11302	22220235
P-121	50% NAOH FEED PUMP	NA	5	10		150	CARBON STEEL	0.50	NONE		11302	22220235
P-130A	SOLIDS REMOVAL FEED PUMP	NA	540	40 TDH		150	CARBON STEEL	15.0	NONE		11315	22220235
P-130B	SOLIDS REMOVAL FEED PUMP	NA	540	40 TDH		150	CARBON STEEL	15.0	NONE		11315	22220235
P-131	POLYMER DRUM PUMP	NA	0.5	10		150	CARBON STEEL	0.75	NONE		11303	22220235
P-132A	POLYMER FEED PUMP	NA	3	15		150	CARBON STEEL	0.75	NONE		11303	22220235

BAKER ENVIRONMENTAL, INC

Equipment List

MCB Camp Lejeune - OU No. 2 Lejeune, NC

Groundwater Treatment System

CTO - 222

04/22/94

Equipment Tag	Equipment Name	Vessel Size	Design Flow (GPM)	Design Pressure (PSIG)	Operatin Pressure (PSIG)	Design Temp (F)	Material of Construction	Horsepower (HP)	Insulation Spec	Insulatio Spec	Specification No.	P & ID Location
P-132B	POLYMER FEED PUMP	NA	3	15		150	CARBON STEEL	0.75	NONE		11303	22220235
P-140A	SLUDGE RECYCLE PUMP	NA	40	20		150	CARBON STEEL	NA	NONE		11313	22220235
P-140B	SLUDGE RECYCLE PUMP	NA	40	20		150	CARBON STEEL	NA	NONE		11304	22220235
P-141	FILTER PRESS FEED PUMP	NA	25	100		150	CARBON STEEL	NA	NONE		11314	22220235
P-143	SLUDGE BLOWDOWN PUMP	NA	2	20		150	CARBON STEEL	NA	NONE		11304	22220235
P-145	SUPERNATANT RETURN PUMP	NA	10	20		150	CARBON STEEL	3.5	NONE		11313	22220235
T-120	NAOH MIX TANK	3 FT. DIAM X 6 FT. HIGH	300 GAL	0		150	CARBON STEEL	NA	NONE		11302	22220235
T-125	POLYMER MIX TANK	6 FT. DIAM X 12 FT. HIGH	2,700 GAL	0		150	CARBON STEEL	NA	NONE		11303	22220235
T-130	INITIAL PH ADJUST TANK	9 FT. DIAM X 16 FT. HIGH	6,500 GAL	0 TO -4"WC		150	CARBON STEEL	NA	NONE		11302	22220235
T-140	SLUDGE THICKENING TANK	6 FT. DIAM X 11 FT. HIGH	1,900 GAL	0 TO -4"WC		150	CARBON STEEL	NA	NONE		11313	22220235
T-145	SUPERNATANT HOLDING TANK	6 FT. DIAM X 4 FT. HIGH	900 GAL	0 TO -4"WC		150	CARBON STEEL	NA	NONE		11313	22220235
X-130A	FLASH MIX TANK	2 FT. X 2 FT. X 6 FT.	200 GAL	0 TO -4"WC		150	CARBON STEEL				11304	22220235
X-130B	FLOCCULATION TANK	5 FT. X 5 FT. X 6 FT.	1,200 GAL	0 TO -4"WC		150	CARBON STEEL				11304	22220235
X-130C	INCLINED PLATE CLARIFIER	14 FT. X 9 FT. X 18 FT.	21,500 GA	0 TO -4"WC		150	CARBON STEEL	NA	NONE		11304	22220235
X-140	PLATE AND FRAME FILTER PRESS	NA	30	150	100	150	CARBON STEEL	NA	NONE		11314	22220235
A-200	FINAL PH ADJUST AGITATOR	NA	NA			150	CARBON STEEL	2.5	NONE		11302	22220335
A-211	ACID MIX AGITATOR	NA	NA			150	304 STAINLESS STEE	1.0	NONE		11302	22220335
P-200A	AIR STRIPPER FEED PUMP	NA	540	80 TDH		150	CARBON STEEL	20.0	NONE		11315	22220335
P-200B	AIR STRIPPER FEED PUMP	NA	540	80 TDH		150	CARBON STEEL	20.0	NONE		11315	22220335
P-211	37% HCL FEED PUMP	NA	5	10		150	PVC BODY/TEFLON D	0.50	NONE		11302	22220335
P-211A	10% HCL FEED PUMP	NA	25 GPD	20		150	PVC BODY/TEFLON D	0.25	NONE		11302	22220335
P-211B	10% HCL FEED PUMP	NA	25 GPD	20		150	PVC BODY/TEFLON D	0.25	NONE		11302	22220335

BAKER ENVIRONMENTAL, INC

Equipment List

MCB Camp Lejeune - OU No. 2 Lejeune, NC

CTO - 222

Groundwater Treatment System

04/22/94

Equipment Tag	Equipment Name	Vessel Size	Design Flow (GPM)	Design Pressure (PSIG)	Operatin Pressure (PSIG)	Design Temp (F)	Material of Construction	Horsepower (HP)	Insulation Spec	Insulatio Spec	Specification No.	P & ID Location
T-200	FINAL PH ADJUST TANK	9 FT. DIAM X 16 FT. HIGH	6,000 GAL	0 TO -4"WC		150	CARBON STEEL	NA	NONE		11302	22220335
T-211	HCL MIX TANK	3 FT. DIAM X 5 FT. HIGH	200 GAL	0		150	FRP	NA	NONE		11302	22220335
X-200A	SAND FILTER	6 FT. DIAM X 12 FT HIGH	150	150		150	CARBON STEEL	NA	NONE		11305	22220335
X-200B	SAND FILTER	6 FT. DIAM X 12 FT HIGH	150	150		150	CARBON STEEL	NA	NONE		11305	22220335
X-200C	SAND FILTER	6 FT. DIAM X 12 FT HIGH	150	150		150	CARBON STEEL	NA	NONE		11305	22220335
C-200	AIR STRIPPING COLUMN	5 FT. DIAM X 35 FT. HIGH	300	8" WC	3" WC	150	C.S. W/ TELURETTE	NA	NONE		11307	22220435
F-220A	CARTRIDGE FILTER	3 FT. DIAM X 5 FT. HIGH	300	150		150	CARBON STEEL/DI	NA	NONE		11308	22220435
F-220B	CARTRIDGE FILTER	3 FT. DIAM X 5 FT. HIGH	300	150		150	CARBON STEEL/DI	NA	NONE		11308	22220435
F-220C	CARTRIDGE FILTER	3 FT. DIAM X 5 FT. HIGH	300	150		150	CARBON STEEL/DI	NA	NONE		11308	22220435
K-200	AIR STRIPPING COLUMN FAN	NA	5000 ACF	8" WC	3" WC	150	FRP	5.0	NONE		11307	22220435
P-205	SPENT BACKWASH WATER PUMP	NA	20	40 TDH		150	CARBON STEEL	7.5	NONE		11315	22220435
P-220A	GAC ADSORBER FEED PUMP	NA	540	100 TDH		150	CARBON STEEL	20.0	NONE		11315	22220435
P-220B	GAC ADSORBER FEED PUMP	NA	540	100 TDH		150	CARBON STEEL	20.0	NONE		11315	22220435
P-240	CHEMICAL MIX FEED PUMP	NA	45	80 TDH		150	CARBON STEEL	10.0	NONE		11315	22220435
P-241	BACKWASH WATER PUMP	NA	350	80 TDH		150	CARBON STEEL	15.0	NONE		11315	22220435
T-205	BACKWASH WATER HOLDING TANK	13 FT. DIAM X 23 FT. HIGH	22,000 GA	0		150	CARBON STEEL	NA	NONE		11310	22220435
T-220	STRIPPER EFFLUENT HOLDING TAN	12 FT. DIAM X 8 FT. HIGH	6,500 GAL	0		150	CARBON STEEL	NA	NONE		11302	22220435
T-240	TREATED EFFLUENT HOLDING TAN	15 FT. DIAM X 28 FT. HIGH	35,000 GA	0		150	CARBON STEEL	NA	NONE		11311	22220435
X-220A	GAC ADSORBER	7 FT. DIAM X 10 FT. HIGH	500	150		150	CARBON STEEL	NA	NONE		11309	22220435
X-220B	GAC ADSORBER	7 FT. DIAM X 10 FT. HIGH	500	150		150	CARBON STEEL	NA	NONE		11309	22220435
X-220C	GAC ADSORBER	7 FT. DIAM X 10 FT. HIGH	500	150		150	CARBON STEEL	NA	NONE		11309	22220435
X-220D	GAC ADSORBER	7 FT. DIAM X 10 FT. HIGH	500	150		150	CARBON STEEL	NA	NONE		11309	22220435

Instrument List

BAKER ENVIRONMENTAL, INC

MCB Camp Lejeune - OU No. 2 Lejeune, VA

CTO - 222

Groundwater Treatment System

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
FCV-110	FLOW CONTROL VALVE	140	22220135							
FE-100	FLOW METER	110	22220135							
FE-101	FLOW METER	108	22220135							
FE-102	FLOW METER	106	22220135							
FE-103	FLOW METER	115	22220135							
FE-104	FLOW METER	117	22220135							
FE-105B	FLOW METER	114	22220135							
FE-110	FLOW METER	140	22220135							
FI-105A	FLOW METER (INDICATING)	114	22220135							
FICA-110	FLOW INDICATING CONTROLLER ALA	T-110	22220135							
FIQ-100	TOTALIZING/INDICATING FLOW METE	110	22220135							
FIQ-101	TOTALIZING/INDICATING FLOW METE	108	22220135							
FIQ-102	TOTALIZING/INDICATING FLOW METE	106	22220135							
FIQ-103	TOTALIZING/INDICATING FLOW METE	115	22220135							
FIQ-104	TOTALIZING/INDICATING FLOW METE	117	22220135							
FIT-105A	FLOW TRANMITTER (INDICATING)	114	22220135							
FIT-110	FLOW TRANMITTER (INDICATING)	140	22220135							
FQ-105A	FLOW TOTALIZER (DIPLAYED IN PLC)	114	22220135							
HIS-100	REMOTE START/STOP SWITCH (AT PL	P-100	22220135							
HIS-103	REMOTE START/STOP SWITCH (AT PL	P-101	22220135							
HIS-110A	REMOTE START/STOP SWITCH (AT PL	P-110A	22220135							
HIS-110B	REMOTE START/STOP SWITCH (AT PL	P-110B	22220135							
HS-100	FIELD MOUNTED HAND SWITCH - HOA	P-100	22220135							
HS-101	FIELD MOUNTED HAND SWITCH - HOA	P-101	22220135							
HS-102	FIELD MOUNTED HAND SWITCH - HOA	P-102	22220135							
HS-103	FIELD MOUNTED HAND SWITCH - HOA	P-103	22220135							
HS-104	FIELD MOUNTED HAND SWITCH - HOA	P-104	22220135							

Instrument List

BAKER ENVIRONMENTAL, INC

MCB Camp Lejeune - OU No. 2 Lejeune, VA

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Groundwater Treatment System

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
HS-110A	FIELD MOUNTED HAND SWITCH - HOA	P-110A	22220135							
HS-110B	FIELD MOUNTED HAND SWITCH - HOA	P-110B	22220135							
HS-180	FIELD MOUNTED HAND SWITCH - HOA	P-180	22220135							
HS-181	FIELD MOUNTED HAND SWITCH - HOA	P-180	22220135							
I-100	PLC INTERLOCK - STOP PUMP P-100	P-100	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-101	PLC INTERLOCK - STOP PUMP P-101	P-101	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-102	PLC INTERLOCK - STOP PUMP P-102	P-102	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-103	PLC INTERLOCK - STOP PUMP P-105A	P-103	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-104	PLC INTERLOCK - STOP PUMP P-105B	P-104	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-110	PLC INTERLOCK - STOP PUMP P-110A	P-110A	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-110	PLC INTERLOCK - STOP PUMP P-110A	P-110A	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-110	PLC INTERLOCK INPUT - FROM LICA-1	T-110	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-131	PLC INTERLOCK - STOP PUMP P-110A	P-110A	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-131	PLC INTERLOCK - STOP PUMP P-110A	P-110A	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-150	PLC INTERLOCK - STOP P-100, P-102, P	P-100	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-150	PLC INTERLOCK INPUT - FROM LSHH-1	T-110	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-151	PLC INTERLOCK-STOP P-101 AND P-10	P-101	22220135	(-)	(-)	(-)	(-)		(-)	(-)
I-151	PLC INTERLOCK INPUT - FROM LAH-11	T-110	22220135	(-)	(-)	(-)	(-)		(-)	(-)
LAH-100	LOW LEVEL ALARM (DISPLAYED IN PL	P-100	22220135							
LAH-101	LOW LEVEL ALARM (DISPLAYED IN PL	P-101	22220135							
LAH-102	LOW LEVEL ALARM (DISPLAYED IN PL	P-102	22220135							
LAH-103	LOW LEVEL ALARM (DISPLAYED IN PL	P-103	22220135							
LAH-104	LOW LEVEL ALARM (DISPLAYED IN PL	P-104	22220135							
LAH-180	HIGH LEVEL ALARM (DISPLAYED IN PL	P-180	22220135							
LAH-181	HIGH LEVEL ALARM (DISPLAYED IN PL	P-181	22220135							
LAL-100	LOW LEVEL ALARM (DISPLAYED IN PL	P-100	22220135							
LAL-101	LOW LEVEL ALARM (DISPLAYED IN PL	P-101	22220135							
LAL-102	LOW LEVEL ALARM (DISPLAYED IN PL	P-102	22220135							

Instrument List

BAKER ENVIRONMENTAL, INC

MCB Camp Lejeune - OU No. 2 Lejeune, VA

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
LAL-103	LOW LEVEL ALARM (DISPLAYED IN PL	P-103	22220135							
LAL-104	LOW LEVEL ALARM (DISPLAYED IN PL	P-104	22220135							
LE-100	LEVEL MONITOR (IN FIELD)	P-100	22220135							
LE-101	LEVEL MONITOR (IN FIELD)	P-101	22220135							
LE-102	LEVEL MONITOR (IN FIELD)	P-102	22220135							
LE-103	LEVEL MONITOR (IN FIELD)	P-103	22220135							
LE-104	LEVEL MONITOR (IN FIELD)	P-104	22220135							
LICA-110	LEVEL INDICATING CONTROLLER ALA	T-110	22220135							
LIT-110	LEVEL TRANSMITTER (INDICATING)	T-110	22220135							
LSH-100	HIGH LEVEL SWITCH	P-100	22220135							
LSH-101	HIGH LEVEL SWITCH	P-101	22220135							
LSH-102	HIGH LEVEL SWITCH	P-102	22220135							
LSH-103	HIGH LEVEL SWITCH	P-103	22220135							
LSH-104	HIGH LEVEL SWITCH	P-104	22220135							
LSH-110	HIGH LEVEL SWITCH	T-110	22220135							
LSHH-110	HIGH HIGH LEVEL SWITCH	T-110	22220135							
LSHL-180	HIGH & LOW LEVEL SWITCH (FLOATIN	T-180	22220135							
LSHL-181	HIGH & LOW LEVEL SWITCH (FLOATIN	T-181	22220135							
LSL-100	LOW LEVEL SWITCH	P-100	22220135							
LSL-101	LOW LEVEL SWITCH	P-101	22220135							
LSL-102	LOW LEVEL SWITCH	P-102	22220135							
LSL-103	LOW LEVEL SWITCH	P-103	22220135							
LSL-104	LOW LEVEL SWITCH	P-104	22220135							
PI-100	PRESSURE GAUGE	110	22220135							
PI-101	PRESSURE GAUGE	108	22220135							
PI-102	PRESSURE GAUGE	106	22220135							
PI-103	PRESSURE GAUGE	115	22220135							
PI-104	PRESSURE GAUGE	117	22220135							

Instrument List

BAKER ENVIRONMENTAL, INC

MCB Camp Lejeune - OU No. 2 Lejeune, VA

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Groundwater Treatment System

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
PI-110	PRESSURE GAUGE	140	22220135							
PI-110A	PRESSURE GAUGE	137	22220135							
PI-110B	PRESSURE GAUGE	139	22220135							
PIA-105A	PRESSURE ALARM (INDICATING)	114	22220135							
PIT-105A	PRESSURE TRANSMITTER (INDICATIN	114	22220135							
RO-110	RESTRICTING ORIFICE	135	22220135							
TI-110	TEMPERTURE INDICATOR	T-110	22220135							
XI-100	POSITION INDICATOR (ON/OFF)	P-100	22220135							
XI-101	POSITION INDICATOR (ON/OFF)	P-101	22220135							
XI-102	POSITION INDICATOR (ON/OFF)	P-102	22220135							
XI-103	POSITION INDICATOR (ON/OFF)	P-105A	22220135							
XI-104	POSITION INDICATOR (ON/OFF)	P-105B	22220135							
XI-110A	POSITION INDICATOR (ON/OFF)	P-110A	22220135							
XI-110B	POSITION INDICATOR (ON/OFF)	P-110B	22220135							
AE-130A	PH PROBE	212	22220235							
AE-130B	PH PROBE	213	22220235							
AICA-130	PH INDICATOR CONTROLLER ALARM	T-130	22220235							
AIT-130A	PH INDICATING TRANSMITTER	212	22220235							
AIT-130B	PH INDICATING TRANSMITTER	213	22220235							
FCV-130	FLOW CONTROL VALVE	209	22220235							
FE-125	FLOW METER	491	22220235							
FE-130	FLOW METER	209	22220235							
FI-125	FLOW METER (INDICATING)		22220235							
FICA-130	FLOW INDICATING CONTROLLER ALA	T-130	22220235							
FIT-130	FLOW TRANMITTER (INDICATING)	209	22220235							
FV-120	FLOW VALVE	490	22220235							
FV-125	FLOW VALVE	T-125	22220235							
HIS-120	REMOTE START/STOP SWITCH (AT PL	A-120	22220235							

Instrument List

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MCB Camp Lejeune - OU No. 2 Lejeune, VA

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
HIS-120A	REMOTE START/STOP SWITCH (AT PL	P-120A	22220235							
HIS-120B	REMOTE START/STOP SWITCH (AT PL	P-120B	22220235							
HIS-130	REMOTE START/STOP SWITCH (AT PL	A-130	22220235							
HIS-130A	REMOTE START/STOP SWITCH (AT PL	P-130A	22220235							
HIS-130B	REMOTE START/STOP SWITCH (AT PL	P-130B	22220235							
HIS-130C	REMOTE SELECTOR SWITCH (AT PLC)	T-130	22220235							
HS-120	FIELD MOUNTED HAND SWITCH - HOA	A-120	22220235							
HS-120A	FIELD MOUNTED HAND SWITCH - HOA	P-120A	22220235							
HS-120B	FIELD MOUNTED HAND SWITCH - HOA	P-120B	22220235							
HS-121	FIELD MOUNTED HAND SWITCH - HOA	P-121	22220235							
HS-130	FIELD MOUNTED HAND SWITCH - HOA	A-130	22220235							
HS-130A	FIELD MOUNTED HAND SWITCH - HOA	P-130A	22220235							
HS-130B	FIELD MOUNTED HAND SWITCH - HOA	P-130B	22220235							
I-120	PLC INTERLOCK - STOP P-120B	P-120B	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-120	PLC INTERLOCK - STOP P-120A	P-120A	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-120	PLC INTERLOCK - STOP A-120	A-120	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-120	PLC INTERLOCK - STOP P-110A	P-110A	22220235							
I-121	PLC INTERLOCK - OPEN FV-120	490	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-121	PLC INTERLOCK - START P-121	P-121	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-121	PLC INTERLOCK INPUT - FROM LAL-12	T-120	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-122	PLC INTERLOCK - STOP P-121	P-121	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-122	PLC INTERLOCK - CLOSE FV-120	490	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-122	PLC INTERLOCK INPUT - FROM LAH-12	T-120	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-125	PLC INTERLOCK INPUT - FROM LAL-12	T-125	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-130	PLC INTERLOCK - STOP A-130	A-130	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-130	PLC INTERLOCK - STOP P-130A	P-130A	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-130	PLC INTERLOCK INPUT - FROM LALL-1	T-130	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-130	PLC INTERLOCK - STOP P-130B	P-130B	22220235	(-)	(-)	(-)	(-)		(-)	(-)

Instrument List

BAKER ENVIRONMENTAL, INC

MCB Camp Lejeune - OU No. 2 Lejeune, VA

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Groundwater Treatment System

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
I-130	PLC INTERLOCK INPUT - FROM LALL-1	T-120	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-131	PLC INTERLOCK INPUT - FROM LAHH-1	T-130	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-131	PLC INTERLOCK - STOP P-110A	T-120	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-200	PLC INTERLOCK - STOP P-130B	P-130B	22220235	(-)	(-)	(-)	(-)		(-)	(-)
I-200	PLC INTERLOCK - STOP P-130A	P-130A	22220235	(-)	(-)	(-)	(-)		(-)	(-)
LAH-120	HIGH LEVEL ALARM (DISPLAYED IN PL	T-120	22220235							
LAHH-130	HIGH LEVEL ALARM (DISPLAYED IN PL	T-120	22220235							
LAL-120	LOW LEVEL ALARM (DISPLAYED IN PL	T-120	22220235							
LAL-125	LOW LEVEL ALARM (DISPLAYED IN PL	T-125	22220235							
LALL-120	LOW LOW LEVEL ALARM (DISPLAYED I	T-120	22220235							
LALL-130	LOW LOW LEVEL ALARM (DISPLAYED I	T-120	22220235							
LICA-130	LEVEL INDICATING CONTROLLER ALA	T-130	22220235							
LIT-130	LEVEL TRANSMITTER (INDICATING)	T-130	22220235							
LSH-120	HIGH LEVEL SWITCH	T-120	22220235							
LSHH-130	HIGH LEVEL SWITCH	T-120	22220235							
LSL-120	LOW LEVEL SWITCH	T-120	22220235							
LSLL-120	LOW LOW LEVEL SWITCH	T-120	22220235							
LSLL-130	LOW LOW LEVEL SWITCH	T-120	22220235							
PI-120A	PRESSURE GAUGE	204	22220235							
PI-120B	PRESSURE GAUGE	206	22220235							
PI-130A	PRESSURE GAUGE	209	22220235							
PI-130B	PRESSURE GAUGE	211	22220235							
RO-120	RESTRICTING ORIFICE	490	22220235							
RO-130	RESTRICTING ORIFICE	212	22220235							
SC-120A	SPEED CONTROLLER	P-120A	22220235							
SC-120B	SPEED CONTROLLER	P-120B	22220235							
XI-120A	POSITION INDICATOR (ON/OFF)	P-120A	22220235							
XI-120B	POSITION INDICATOR (ON/OFF)	P-120B	22220235							

Instrument List

BAKER ENVIRONMENTAL, INC

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
XI-130A	POSITION INDICATOR (ON/OFF)	P-130A	22220235							
XI-130B	POSITION INDICATOR (ON/OFF)	P-130B	22220235							
XI-132A	POSITION INDICATOR (ON/OFF-VIA DA	P-132A	22220235							
XI-132B	POSITION INDICATOR (ON/OFF-VIA DA	P-132B	22220235							
XI-140A	POSITION INDICATOR (ON/OFF-VIA DA	P-140A	22220235							
XI-140B	POSITION INDICATOR (ON/OFF-VIA DA	P-140B	22220235							
AE-200A	PH PROBE	314	22220335							
AE-200B	PH PROBE	315	22220335							
AICA-200	PH INDICATOR CONTROLLER ALARM	T-200	22220335							
AIT-200A	PH INDICATING TRANSMITTER	314	22220335							
AIT-200B	PH INDICATING TRANSMITTER	315	22220335							
FCV-200	FLOW CONTROL VALVE	310	22220335							
FE-200	FLOW METER	310	22220335							
FICA-200	FLOW INDICATING CONTROLLER ALA	T-200	22220335							
FIT-200	FLOW TRANMITTER (INDICATING)	310	22220335							
FV-211	RESTRICTING ORIFICE	415	22220335							
HIS-200	REMOTE START/STOP SWITCH (AT PL	A-200	22220335							
HIS-200A	REMOTE START/STOP SWITCH (AT PL	P-200A	22220335							
HIS-200B	REMOTE START/STOP SWITCH (AT PL	P-200B	22220335							
HIS-200C	REMOTE SELECTOR SWITCH (AT PLC)	T-200	22220335							
HIS-211	REMOTE START/STOP SWITCH (AT PL	A-211	22220335							
HIS-211A	REMOTE START/STOP SWITCH (AT PL	P-212A	22220335							
HIS-211B	REMOTE START/STOP SWITCH (AT PL	P-212B	22220335							
HS-200	FIELD MOUNTED HAND SWITCH - HOA	A-200	22220335							
HS-200A	FIELD MOUNTED HAND SWITCH - HOA	P-200A	22220335							
HS-200B	FIELD MOUNTED HAND SWITCH - HOA	P-200B	22220335							
HS-211	FIELD MOUNTED HAND SWITCH - HOA	A-211	22220335							
HS-211A	FIELD MOUNTED HAND SWITCH - HOA	P-211A	22220335							

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MCB Camp Lejeune - OU No. 2 Lejeune, VA

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
HS-211B	FIELD MOUNTED HAND SWITCH - HOA	P-211B	22220335							
HS-211C	FIELD MOUNTED HAND SWITCH - HOA	P-211	22220335							
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-	VENDOR PLC INTERLOCK	X-200A/B/C	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-200	PLC INTERLOCK INPUT - FROM LAHH-2	T-200	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-201	PLC INTERLOCK - STOP A-200	A-200	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-201	PLC INTERLOCK - STOP P-200A	P-200A	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-201	PLC INTERLOCK - STOP P-200B	P-200B	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-201	PLC INTERLOCK INPUT - FROM LALL-2	T-200	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-203	PLC INTERLOCK - STOP P-130A	P-130A	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-203	PLC INTERLOCK - STOP P-130B	P-130B	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-203	PLC INTERLOCK - STOP P-130A	P-130A	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-211	PLC INTERLOCK - STOP A-211	A-211	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-211	PLC INTERLOCK - STOP P-212A	P-212A	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-211	PLC INTERLOCK - STOP P-212B	P-212B	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-211	PLC INTERLOCK INPUT - FROM LALL-2	T-211	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-212	PLC INTERLOCK - START P-211	P-211	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-212	PLC INTERLOCK - OPEN FV-211	415	22220335	(-)	(-)	(-)	(-)		(-)	(-)

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
I-212	PLC INTERLOCK INPUT - FROM LAL-21	T-211	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-213	PLC INTERLOCK - STOP P-211	P-211	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-213	PLC INTERLOCK - CLOSE FV-211	415	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-213	PLC INTERLOCK INPUT - FROM LAH-21	T-211	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-221	PLC INTERLOCK - STOP P-200B	P-200B	22220335	(-)	(-)	(-)	(-)		(-)	(-)
I-221	PLC INTERLOCK - STOP P-200A	P-200A	22220335	(-)	(-)	(-)	(-)		(-)	(-)
LAH-211	HIGH LEVEL ALARM (DISPLAYED IN PL	T-211	22220335							
LAHH-200	HIGH LEVEL ALARM (DISPLAYED IN PL	T-200	22220335							
LAL-211	LOW LEVEL ALARM (DISPLAYED IN PL	T-211	22220335							
LALL-200	LOW LOW LEVEL ALARM (DISPLAYED I	T-200	22220335							
LALL-211	LOW LOW LEVEL ALARM (DISPLAYED I	T-211	22220335							
LICA-200	LEVEL INDICATING CONTROLLER ALA	T-200	22220335							
LIT-200	LEVEL TRANSMITTER (INDICATING)	T-200	22220335							
LSH-211	HIGH LEVEL SWITCH	T-211	22220335							
LSHH-200	HIGH LEVEL SWITCH	T-200	22220335							
LSL-211	LOW LEVEL SWITCH	T-211	22220335							
LSLL-200	LOW LOW LEVEL SWITCH	T-200	22220335							
LSLL-211	LOW LOW LEVEL SWITCH	T-211	22220335							
PI-200A	PRESSURE GAUGE	310	22220335							
PI-200B	PRESSURE GAUGE	313	22220335							
PI-200C	PRESSURE GAUGE	310	22220335							
PI-211A	PRESSURE GAUGE	305	22220335							
PI-211B	PRESSURE GAUGE	307	22220335							
RO-200	RESTRICTING ORIFICE	314	22220335							
RO-211	RESTRICTING ORIFICE	415	22220335							
SC-211A	SPEED CONTROLLER	P-212A	22220335							
SC-211B	SPEED CONTROLLER	P-212B	22220335							
XI-200A	POSITION INDICATOR (ON/OFF-VIA DA	X-200A	22220335							

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XI-200B	POSITION INDICATOR (ON/OFF-VIA DA	X-200B	22220335							
XI-200C	POSITION INDICATOR (ON/OFF-VIA DA	X-200C	22220335							
XI-200C	POSITION INDICATOR (ON/OFF)	P-200A	22220335							
XI-200D	POSITION INDICATOR (ON/OFF)	P-200B	22220335							
XI-211A	POSITION INDICATOR (ON/OFF)	P-212A	22220335							
XI-211B	POSITION INDICATOR (ON/OFF)	P-212B	22220335							
FCV-220	FLOW CONTROL VALVE	406	22220435							
FE-220	FLOW METER	406	22220435							
FE-240	FLOW METER	413	22220435							
FICA-220	FLOW INDICATING CONTROLLER ALA	T-220	22220435							
FIQ-240	TOTALIZING/INDICATING FLOW METE	413	22220435							
FIT-220	FLOW TRANMITTER (INDICATING)	406	22220435							
FIT-240	FLOW TRANMITTER (INDICATING)	413	22220435							
HIS-200D	FIELD MOUNTED HAND SWITCH - HOA	K-200	22220435							
HIS-205	REMOTE START/STOP SWITCH (AT PL	P-205	22220435							
HIS-220A	REMOTE START/STOP SWITCH (AT PL	P-220A	22220435							
HIS-220B	REMOTE START/STOP SWITCH (AT PL	P-220B	22220435							
HIS-240	REMOTE START/STOP SWITCH (AT PL	P-240	22220435							
HIS-241	REMOTE START/STOP SWITCH (AT PL	P-241	22220435							
HS-200	FIELD MOUNTED HAND SWITCH - HOA	K-200	22220435							
HS-205	FIELD MOUNTED HAND SWITCH - HOA	P-205	22220435							
HS-220A	FIELD MOUNTED HAND SWITCH - HOA	P-220A	22220435							
HS-220B	FIELD MOUNTED HAND SWITCH - HOA	P-220B	22220435							
HS-240	FIELD MOUNTED HAND SWITCH - HOA	P-240	22220435							
HS-241	FIELD MOUNTED HAND SWITCH - HOA	P-241	22220435							
I-121	PLC INTERLOCK - START P-240	P-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-122	PLC INTERLOCK - START P-240	P-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-125	PLC INTERLOCK - START P-240	P-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
I-201	PLC INTERLOCK - STOP K-200	K-200	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-203	PLC INTERLOCK - STOP P-110B	P-110B	22220435							
I-205	PLC INTERLOCK - START P-205	P-205	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-205	PLC INTERLOCK INPUT - FROM LSH-20	T-205	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-206	PLC INTERLOCK - STOP P-205	P-205	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-206	PLC INTERLOCK INPUT - FROM LSL-20	T-205	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-212	PLC INTERLOCK - START P-240	P-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-213	PLC INTERLOCK - START P-240	P-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-220	PLC INTERLOCK INPUT - FROM LICA-2	T-220	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-220	PLC INTERLOCK - STOP P-220B	P-220B	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-220	PLC INTERLOCK - STOP P-220A	P-220A	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-221	PLC INTERLOCK INPUT - FROM LICA-2	T-220	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-221	PLC INTERLOCK - STOP A-200	A-200	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-240	PLC INTERLOCK - DISABLES P-240	P-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-240	PLC INTERLOCK INPUT - FROM LICA-2	T-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-240	PLC INTERLOCK - DISABLES P-241	P-241	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-241	PLC INTERLOCK INPUT - FROM LICA-2	T-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-241	PLC INTERLOCK INPUT - FROM LICA-2	T-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-241	PLC INTERLOCK INPUT - FROM LICA-2	T-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-241	PLC INTERLOCK - STOP P-110B	P-110B	22220435							
I-241	PLC INTERLOCK INPUT - FROM LICA-2	T-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-242	PLC INTERLOCK INPUT - FROM LICA-2	T-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-242	PLC INTERLOCK - STOP P-220B	P-220B	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-242	PLC INTERLOCK - STOP P-220A	P-220A	22220435	(-)	(-)	(-)	(-)		(-)	(-)
I-243	PLC INTERLOCK INPUT - FROM LICA-2	T-240	22220435	(-)	(-)	(-)	(-)		(-)	(-)
LG-205	LEVEL GAUGE	T-205	22220435							
LIA-240	LEVEL INDICATING CONTROLLER ALA	T-240	22220435							
LICA-220	LEVEL INDICATING CONTROLLER ALA	T-220	22220435							

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
LIT-220	LEVEL TRANSMITTER (INDICATING)	T-220	22220435							
LIT-240	LEVEL TRANSMITTER (INDICATING)	T-240	22220435							
LSH-205	HIGH LEVEL SWITCH	T-205	22220435							
LSL-205	LOW LEVEL SWITCH	T-205	22220435							
PI-	PRESSURE GAUGE	406	22220435							
PI-150	PRESSURE GAUGE	401	22220435							
PI-200	PRESSURE GAUGE (BY COLUMN VEN	C-200	22220435							
PI-200	PRESSURE GAUGE (BY COLUMN VEN	C-200	22220435							
PI-200A	PRESSURE GAUGE	412	22220435							
PI-205	PRESSURE GAUGE	401	22220435							
PI-220	PRESSURE GAUGE	406	22220435							
PI-220A	PRESSURE GAUGE	406	22220435							
PI-220B	PRESSURE GAUGE	408	22220435							
PI-220C	PRESSURE GAUGE	406	22220435							
PI-240	PRESSURE GAUGE	415	22220435							
PI-241	PRESSURE GAUGE	417	22220435							
PSV-	PRESSURE SAFETY RELIEF VALVE (BY	X-200A	22220435							
PSV-	PRESSURE SAFETY RELIEF VALVE (BY	X-200B	22220435							
PSV-	PRESSURE SAFETY RELIEF VALVE (BY	X-200C	22220435							
PSV-	PRESSURE SAFETY RELIEF VALVE (BY	X-220B	22220435							
PSV-	PRESSURE SAFETY RELIEF VALVE (BY	X-220A	22220435							
PSV-200	PRESSURE SAFETY RELIEF VALVE (BY	C-200	22220435							
RO-220	RESTRICTING ORIFICE	410	22220435							
XI-200	POSITION INDICATOR (ON/OFF-VIA DA	K-200	22220435							
XI-220A	POSITION INDICATOR	P-220A	22220435							
XI-220B	POSITION INDICATOR (ON/OFF)	P-220B	22220435							
XI-221A	POSITION INDICATOR (ON/OFF-VIA DA	X-220A	22220435							
XI-221B	POSITION INDICATOR (ON/OFF-VIA DA	X-220B	22220435							

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Instrument No.	Instrument Description	Line/ Equip Location	P & ID Location	Piping Dwg.	Plan Dwg.	Instrument Dwg.	Loop Dwg.	Specification No.	Specification Sheet No.	Connection Size
XI-221C	POSITION INDICATOR (ON/OFF-VIA DA	X-220C	22220435							
XI-221D	POSITION INDICATOR (ON/OFF-VIA DA	X-220D	22220435							
XI-240	POSITION INDICATOR (ON/OFF)	P-240	22220435							
XI-241	POSITION INDICATOR (ON/OFF)	P-241	22220435							

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Line Number	Line Size	Fluid Symbol	Line Spec	Line Origin	Line Termination	Design Flow (GPM)	Design Temperature (F)	Design Pressure (PSIG)	Insulation Spec	Insulation Thickness	Paint Spec	Tracing/ Type	P & ID Dwg
107	11/2"	GW	-02900	P-102	11302900-6"-GW								22220135
108	6"	GW	-02900	P-101	11602900-8"-GW								22220135
110	11/2"	GW	-02900	P-100	11402900-8"-GW								22220135
113	8"	PW	-15401	11402900-8"-PW	T-110								22220135
114	8"	GW	-02900	11602900-8"-GW	11315401-8"-PW								22220135
115	6"	GW	-02900	P-103	11802900-6"-GW								22220135
116	8"	GW	-02900	11802900-6"-GW	11402900-8"-GW								22220135
117	11/2"	GW	-02900	P-104	11802900-4"-GW								22220135
118	6"	GW	-02900	11502900-6"-GW	11602900-6"-GW								22220135
133	8"	V	-15600	T-110	ATMOSPHERE								22220135
134	11/2"	SL	-15401	P-180	T-110								22220135
135	3"	PW	-15401	13715401-8"-PW	14315401-3"-PW								22220135
136	8"	PW	-15401	14415401-8"-PW	P-110A								22220135
137	8"	PW	-15401	P-110A	T-130								22220135
138	8"	PW	-15401	13615401-8"-PW	P-110B								22220135
139	8"	PW	-15401	P-110B	13715401-8"-PW								22220135
141	8"	PW	-15401	13715401-8"-PW	13715401-8"-PW								22220135
142	4"	SL	-15401	T-110	4" HOSE CONNECTION								22220135
143	3"	PW	-15401	13515401-6"-PW	T-110								22220135
144	8"	PW	-15401	13715401-6"-PW	T-110								22220135
201	1/2"	NAH	-15401	1/2" NAOH HOSE CONNEC	P-121								22220235
202	1/2"	NAH	-15401	P-121	T-120								22220235
203	3/4"	NAH	-15402	T-120	P-120A								22220235
204	1/2"	NAH	-15402	P-120A	T-130								22220235
205	3/4"	NAH	-15402	20315402-3/4"-NAH	P-120B								22220235

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Line Number	Line Size	Fluid Symbol	Line Spec	Line Origin	Line Termination	Design Flow (GPM)	Design Temperature (F)	Design Pressure (PSIG)	Insulation Spec	Insulation Thickness	Paint Spec	Tracing/ Type	P & ID Dwg
206	1/2"	NAH	-15402	P-120B	20415402-3/4"-NAH								22220235
207	4"	V	-15600	T-120	ATMOSPHERE (4")								22220235
208	6"	PW	-15401	T-130	P-130A								22220235
209	6"	PW	-15401	P-130A	X-130A								22220235
210	6"	PW	-15401	20815401-6"-PW	P-130								22220235
211	6"	PW	-15401	P-130B	20915401-6"-PW								22220235
212	2"	PW	-15401	20915401-6"-PW	T-130								22220235
213	2"	PW	-15401	21215401-2"-PW	21215410-2"-PW								22220235
214	6"	PW	-15401	20915410-6"-PW	20915410-6"-PW								22220235
215	6"	V	-15401	T-130	ATMOSPHERE (6")								22220235
216	8"	PW	-15401	X-130C	T-200								22220235
218	8"	V	-15600	X-130	ATMOSPHERE (8")								22220235
219	6"	SL	-15404	T-140	P-141								22220235
220	6"	PW	-15401	X-140	T-205								22220235
301	3/4"	AC	-15403	3/4" HCL HOSE CONNECT	P-211								22220335
302	3/4"	AC	-15403	P-211	T-211								22220335
303	4"	V	-15600	T-211	ATMOSPHERE (4")								22220335
304	3/4"	AC	-15403	T-211	P-212A								22220335
305	1/2"	AC	-15403	P-212A	T-200								22220335
306	3/4"	AC	-15403	30415403-3/4"-AC	P-212B								22220335
307	1/2"	AC	-15403	P-212B	30515403-3/4"-AC								22220335
308	6"	V	-15600	T-200	ATMOSPHERE (6")								22220335
309	6"	PW	-15401	T-200	P-200A								22220335
310	6"	PW	-15401	P-200A	FILTER FEED MANIFOLD								22220335
311	6"	PW	-15401	31015401-6"-PW	31015401-6"-PW								22220335

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Line Number	Line Size	Fluid Symbol	Line Spec	Line Origin	Line Termination	Design Flow (GPM)	Design Temperature (F)	Design Pressure (PSIG)	Insulation Spec	Insulation Thickness	Paint Spec	Tracing/ Type	P & ID Dwg
312	6"	PW	-15401	30915401-6"-PW	P-200B								22220335
313	6"	PW	-15401	P-200B	31015401-6"-PW								22220335
314	2"	PW	-15401	31015401-6"-PW	T-200								22220335
315	2"	PW	-15401	31415401-6"-PW	31415401-6"-PW								22220335
321	6"	PW	-15401										22220335
322	6"	PW	-15401										22220335
401	2"	BW	-15401	P-205	T-130 (P-5)								22220435
402	3"	BW	-15401	T-205	P-205				XXXXX	1"			22220435
403	4"	SL	-15600	T-205	HOSE CONNECTION				XXXXX	1"			22220435
404	8"	BW	-15401	TP 310	432-15401-8"-BW								22220435
405	8"	V	-15401	T-205	ATMOSPHERE (OUTSIDE BLG)								22220435
406	6"	PW	-15401	P-220A	TP 340	320							22220435
407	6"	PW	-15401	TP 250	P-220A								22220435
408	6"	PW	-15401	P-220B	406-15401-6"-PW								22220435
409	6"	PW	-15401	407-15601-6"-PW	P-220B								22220435
410	2"	PW	-15401	406-15401-6"-PW	TP 230 (T-220)								22220435
411	6"	PW	-15401	431-15401-6"-PW	412-15401-6"-GW								22220435
412	2"	TGW	-15401	TP 320	T-240	300			XXXXX	1"			22220435
413	8"	TGW	-15401	T-240	BOUSCH CREEK	300			XXXXX	1"			22220435
414	6"	TGW	-15401	T-240	P-240	45			XXXXX	1"			22220435
415	4"	TGW	-15401	P-240	T-211 (DWG P-6)								22220435
416	8"	TGW	-15401	T-240	P-241	350			XXXXX	1"			22220435
417	8"	TGW	-15401	P-241	TP 210 (DWG P-6)	350							22220435
418	6"	TGW	-15401	417-15401-8"-TGW	TP 330	250							22220435
419	4"	TGW	-15401	415-15401-4"-TGW	TP 180 (DWG P-5)	45							22220435

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04/22/94

Line Number	Line Size	Fluid Symbol	Line Spec	Line Origin	Line Termination	Design Flow (GPM)	Design Temperature (F)	Design Pressure (PSIG)	Insulation Spec	Insulation Thickness	Paint Spec	Tracing/ Type	P & ID Dwg
420	4"	TGW	-15401	415-15401-4"-TGW	T-120 (DWG P-5)	45							22220435
421	4"	TGW	-15401	T-240	HOSE CONNECTION	200							22220435
422	6"	V	-15600	T-240	ATMOSPHERE								22220435
424	2"	A	-15600	C-200	ATMOSPHERE	3000 ACFM							22220435
430	2"	A	-15406	TP 310	432-15401-8"-BW								22220435
430	6"	PW	-15406	P-220A	TP 340	320							22220435
431	6"	PW	-15401	P-220A	TP 340	320							22220435
432	8"	BW	-15401		HOSE CONNECTION				XXXXX	1"			22220435
433	2"	PW	-15401	431-15401-6"-PW	412-15401-6"-GW								22220435
435	6"	PW	-15401	P-220A	TP 340	320							22220435
436	6"	PW	-15401	P-220A	TP 340	320							22220435
437	6"	PW	-15401	P-220A	TP 340	320							22220435

SECTION 02902

VACUUM EXTRACTION SYSTEM

PART 1 - GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR CIVIL ENGINEERS

ASCE 7	1988 Minimum Design Loads for Buildings and other Structures.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS

C 150	1989 Type I or II Portland Cement
D 1785	1989 Poly (Vinyl Chloride) (PVC) Plastic Pipe
D 2466	1988 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings
D 2564	1988 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 136	40 CFR 136 Guidelines Establishing Test Procedures for the Analysis of Pollutants

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electric Code

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data:

a. Piping and Fittings
b. PVC Solvent Cement
c. Valves
d. Treatment System Control Panel

1.2.2 SD-12, Field Test Reports:

a. Vacuum Extraction System Test

b. Carbon Contactors

1.2.3 SD-19, Operations and Maintenance Data:

a. Vacuum Extraction System (Provide O&M package for system as a complete and operable unit.

1.3 DESCRIPTION OF SYSTEM

Provide vacuum extraction systems in accordance with this Section of these specifications to meet the performance requirements specified.

The primary objective of the work is to achieve source (i.e., soil) remediation. The work includes the design and installation of a soil vacuum extraction system (SVE) to remediate the soil to the cleanup goals specified. Existing contaminant conditions are as identified to the Contractor by separate document.

An onsite pilot test was performed to provide preliminary site-specific data for the design of the SVE system. The results of this test are included in the Basis of Design Report, provided to the Contractor as a separate document.

1.4 EQUIPMENT BUILDING

Provide in accordance with this section and the following Sections of these specifications:

03302 Cast in Place Concrete (Minor Construction)

Other sections as applicable

1.5 GENERAL REQUIREMENTS

Provide in accordance with Sections 15011 "Mechanical General Requirements" and 16011, "Electrical General Requirements."

1.6 ENVIRONMENTAL PROTECTION

Provide in accordance with Section 01560 "Temporary Controls."

PART 2 - PRODUCTS

2.1 PIPING AND VALVES

All piping valves and fittings shall be rated to resist external and operating forces. All materials shall be resistant to corrosion by the contaminants and conditions at the site.

PVC Piping and fittings shall conform to ASTM 1785 and ASTM 2466.

2.2 VACUUM EXTRACTION WELLS

2.2.1 Well Casings and Screens

Provide casing and screens with adequate strength to resist external and operating forces. Length of well screen and screen opening size shall be designed by the Contractor.

PVC casing and screens shall conform to ASTM 1785.

2.2.2 Filter Pack

Provide clean, round, hard water-worn quartz with less than 5 percent feldspar, no fossils, carbonate or organics. The filter pack shall have gradation specifications designed by the Contractor to facilitate the flow of gas and liquid from the surrounding soil.

2.2.3 Cement Grout

Provide neat cement grout, Type I or II portland cement conforming to ASTM C150.

2.3 EQUIPMENT BUILDING

2.3.1 General Building Requirements

A liftable, preassembled, building shall be provided and sized as required to enclose and maintain soil vapor extraction and treatment equipment, as well as the groundwater extraction well equipment. Refer to Section 02900, "Groundwater Recovery System."

2.3.1.1 Foundation Requirements

Design spread foundations for an allowable soil bearing pressure of 2000 pounds per square foot. Use a concrete compressive strength as specified in Section 03302, "Cast-in-Place Concrete, (Minor Construction)." Actual foundation loads shall be provided by the Contractor, for verification by the Government.

PART 3 EXECUTION

3.1 GENERAL

Confirm that the technology is appropriate for the soil and shallow aquifer remediation at the sites.

Provide the data necessary to design and install a full-scale remediation system at the site.

Design and install a full-scale vacuum extraction system to remediate the soil within the full area of the site as indicated to the cleanup goals specified. Separated liquid shall be pumped to the groundwater treatment building. Gases removed shall be vented to the atmosphere if contaminant levels are within acceptable environmental limits, or passed through a granular activated carbon filter if necessary to meet air discharge

requirements.

3.2 SAMPLING AND ANALYSIS PLAN

Submit in accordance with Section 01010, "General Paragraphs."

3.3 AREA OF COVERAGE

The full scale vacuum extraction system shall remediate the soil and shallow aquifer within AOC 1 as indicated on the drawings.

3.4 EFFLUENT REQUIREMENTS

Separated liquid shall be discharged to the on-site groundwater treatment system without further treatment.

Volatile contaminants vented to the atmosphere shall not exceed the emission rates for volatile organic compounds and toxics as specified in the State of North Carolina.

3.5 CLEANUP GOALS

The soil cleanup goals, in parts per billion, for the contaminants of concern in AOC 1 are as follows:

Trichloroethene	32.2
Tetrachloroethene	10.5
Benzene	5.4

3.6 INSTALLATION

Install equipment, piping, power, controls, accessories and appurtenances in accordance with the manufacturer's recommendation. Provide all necessary interconnections, services, and adjustments as required for a complete and operable system. All electrical work shall be in accordance with NFPA 70 and as specified in Section 16011.

3.6.1 Piping

All extraction piping shall be installed 18" underground from vent wells to the equipment building. Separated water piping shall be installed 18" underground from the equipment building to the groundwater extraction header as indicated and installed with a backflow preventer.

3.6.2 Sampling Ports

The system shall be provided with sampling ports for acquisition of influent and effluent vapors and liquids for analysis.

3.6.3 Soil Disposal

Material excavated for the installation of piping and the equipment building shall be sampled and disposed of in accordance with state and Federal regulations and in accordance with Section 01560.

3.6.4 Nameplates

Provide laminated plastic nameplates for equipment, gauges, thermometers, and stop valves. Laminated plastic shall 0.125 inch thick Melamine plastic, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be one inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Equipment nameplates shall show the following information:

a. Manufacturer, type, and model number
b. Contract number and accepted date
c. Capacity or size

3.6.5 Soil Vapor Extraction System

The extraction system shall be designed for continuous operation and equipped with instrumentation for process evaluation including pressure, vacuum and temperature indicators, a recovered groundwater totalizer, and flow meter for vapor flow determination.

3.6.6 Vapor/Liquid Separator

Vapor/Liquid separator vessel shall be epoxy coated for corrosion protection.

3.7 SEQUENCE OF OPERATION

3.7.1 Extraction

Soil vapor shall be extracted from vent wells in the areas indicated to a depth designed by the Contractor based on initial testing. The number and arrangement of the vent wells shall be determined by the Contractor and approved by the NTR.

3.7.2 Separation

Extracted soil vapor shall be delivered to an inlet separator to separate vapor from liquid. The separated liquid shall be pumped to the groundwater treatment building as indicated. Separated vapor shall be discharged to atmosphere or, if necessary to meet state emission requirements, delivered to the vapor treatment equipment.

3.7.3 Vapor Treatment

Separated vapor shall be treated by granular activated carbon, if necessary to meet the effluent requirements of this specification, and exhausted to the atmosphere. Exhaust height shall be in accordance with local and state requirements.

3.8 STARTUP AND INITIAL TESTING

3.8.1 General

The Contractor shall provide all startup and testing services, and make all required adjustments.

Groundwater generated during system startup and testing shall be discharged per the direction of the NTR.

Maintain an accurate log of all test procedures and results. Submit a report of procedures and results to the NTR for approval.

Upon completion of startup and testing, treated groundwater shall be discharged to the groundwater treatment building only after the approval of the NTR.

3.9 OPERATIONS

The vacuum extraction system shall be operated and maintained by the Contractor for a period of three months. Three month operational period will start only after all components of the system have been through the startup and initial testing and the NTR has accepted the system in its entirety. A certified professional geologist shall monitor the vacuum extraction system's operation, and provide an initial and a final report containing hours of operation, volume of water recovered, and weekly air quality laboratory analysis. After three months operation by the Contractor, the Government shall assume operation of the equipment. The Contractor shall provide training (four 8 hour days) for Government personnel in how to properly operate and maintain the system.

3.9.1 Air Quality Analyses

Air quality analysis of extraction system influent and effluent shall be for volatile organic compounds as required to evaluate system performance. Contractor shall submit a Sampling and Analysis outlining all sampling and analytical methods, procedures and frequencies.

3.10 FINAL TESTING

Upon completion and before final acceptance of the work, the systems shall be tested as in service to determine compliance with the contract requirements and warranty. Each new piping system and all pressure vessels shall be pneumatically tested at not less than 125 psig and shall show no leakage or reduction in gauge pressure after 4 hours. All equipment shall be tested in operation for a continuous period of not less than 3 months. During the tests, all equipment shall be tested under every condition of operation. All controls shall be tested to demonstrate performance of their required function. All piping shall be thoroughly flushed and cleaned before being placed in operation. The Contractor shall furnish instruments, connecting devices and personnel for the test. Each system shall be completely tested for compliance with specification and all conditions thereof, and all adjusting and balancing shall be completed to the satisfaction of the NTR. Adjustment of controls and balancing of systems shall extend for one year after the completed systems are put in operation.

-- End of Section --

SECTION 03302

CAST-IN-PLACE CONCRETE (MINOR CONSTRUCTION)

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 301	1989 Structural Concrete for Buildings
ACI 304R	1989 Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	1991 Hot Weather Concreting
ACI 306.1	1990 Cold Weather Concreting

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	1990 Concrete Aggregates
ASTM C 94	1990 Ready-Mixed Concrete
ASTM C 143	1990 (Rev. A) Slump of Hydraulic Cement Concrete
ASTM C 150	1989 Portland Cement
ASTM C 171	1991 Sheet Materials for Curing Concrete
ASTM C 172	1990 Sampling Freshly Mixed Concrete
ASTM C 173	1978 Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	1991 Air Content for Freshly Mixed Concrete by the Pressure Method
ASTM C 260	1986 Air-Entraining Admixtures for Concrete
ASTM C 309	1991 Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	1990 Chemical Admixtures for Concrete
ASTM C 595	1993 Blended Hydraulic Cement

ASTM C 618	1991 Fly Ash and Raw or Calcined Natural Pozzolan For Use as a Mineral Admixture in Portland Cement Concrete

1.2 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications, except as modified by this section. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the NTR.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-13, Certificates

a. Cement
b. Aggregates
c. Admixtures
d. Reinforcement
e. Expansion-joint filler
f. Joint sealant

1.4 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until ready for concrete placement. Store concrete aggregates to prevent contamination or segregation. Protect from contaminants such as grease, oil, and dirt. Provide for accurate identification after bundles are broken and tags removed.

PART 2 PRODUCTS

2.1 CONCRETE

2.1.1 Contractor Mix Design

ACI 301, except as modified herein. Unless indicated otherwise, concrete shall have a 28-day compressive strength of 4000 psi. Slump shall be between 2 and 4 inches in accordance with ASTM C 143. Provide ASTM C 33 aggregate Size No. 57 or 67 and 4 to 6 percent air entrainment for concrete exposed to freeze-thaw conditions. Accomplish air-entrainment using an air-entraining admixture.

2.1.2 Ready-Mixed Concrete

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

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type I or II or ASTM C 595, Type IP(MS) or IS(MS) blended cement, except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and one of the following materials: ASTM C 618 pozzolan or fly ash, or ASTM C 989 ground iron blast furnace slag. The pozzolan/fly ash content shall not exceed 25 percent, nor the ground iron blast furnace slag exceed 50 percent by weight of the total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

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

2.2.2 Water

Water shall be potable.

2.2.3 Aggregates

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

2.2.4 Admixtures

ASTM C 260 for air-entrained concrete. ASTM C 494 for water reducing (Type A, D, or E), accelerating (Type C), and retarding (Type B or D), to be used only when approved. Calcium chloride shall not be used as an admixture.

2.2.5 Materials for Curing Concrete

2.2.5.1 Impervious Sheeting

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

PART 3 EXECUTION

3.1 FORMS

ACI 301. Set forms true to line and grade and make mortar-tight. Chamfer above grade exposed joints, edges, and external corners of concrete 3/4 inch, unless otherwise indicated. Before concrete placement, coat the contact surfaces of forms with a nonstaining form coating compound. Do not use mineral oil on formed surfaces to be painted. Prevent concrete damage during form removal. Concrete for footings may be placed in excavations without forms upon inspection and approval by the NTR. Excavation width shall be a minimum of 4 inches greater than the finished dimensions.

3.2 MEASURING, MIXING, TRANSPORTING, AND PLACING CONCRETE

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

3.2.1 Cold Weather

ACI 306.1. Provide and maintain 50 degrees F minimum concrete temperature. Do not place concrete when the ambient temperature is below 40 degrees F. Cover concrete and provide with a source of heat sufficient to maintain 50 degrees F minimum while curing.

3.2.2 Hot Weather

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

3.3 SURFACE FINISHES

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

3.3.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb (including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects) which affect the serviceability or structural strength will be rejected, unless

correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 301. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish, unless otherwise specified.

3.3.2 Floated Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater. Surface shall be level to within 1/4 inch in 10 feet where floor drains are not provided.

3.3.3 Steel Troweled Finish

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

3.3.4 Broomed Finished

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

3.4 MISCELLANEOUS CONSTRUCTION

3.4.1 Concrete Pads

Construct concrete pad a minimum of four (4) inches thick, as indicated.

3.5 CURING AND PROTECTION

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

3.5.1 Moist Curing

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

3.5.1.1 Ponding or Immersion

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

3.5.1.2 Fog Spraying or Sprinkling

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

3.5.1.3 Pervious Sheeting

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

3.5.2 Curing Periods

Allow 7 days.

3.6 SAMPLING AND TESTING

3.6.1 Sampling

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

3.6.2 Testing

3.6.2.1 Slump Tests

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

3.6.2.2 Air Content

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

-- End of Section --

SECTION 04230

REINFORCED MASONRY

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 315	1980 (R 1986) Details and Detailing of Concrete Reinforcement
ACI 318	1989 (R 1992) Building Code Requirements for Reinforced Concrete
ACI 530.1	1992 Masonry Structures (ASCE 6-92)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	1992 Structural Steel
ASTM A 82	1990 (Rev. A) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153	1982 (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	1992 (Rev. B) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 185	1990 (Rev. A) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 366/A 366M	1991 Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 497	1990 (Rev. B) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 525	1991 (Rev. B) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 615/A 615M	1992 (Rev. B) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	1992 Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	1992 Axle-Steel Deformed and Plain Bars

	for Concrete Reinforcement
ASTM A 641	1992 Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 706/A 706M	1992 (Rev. B) Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM B 370	1992 Copper Sheet and Strip for Building Construction
ASTM C 55	1993 Concrete Building Brick
ASTM C 62	1992 (Rev. C) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 90	1993 Load-Bearing Concrete Masonry Units
ASTM C 94	1992 (Rev. A) Ready-Mixed Concrete
ASTM C 216	1992 (Rev. D) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	1992 (Rev. A) Mortar for Unit Masonry
ASTM C 476	1991 Grout for Masonry
ASTM C 652	1992 (Rev. D) Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
ASTM C 744	1992 Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	1991 Preconstruction and Construction Evaluations of Mortar for Plain and Reinforced Unit Masonry
ASTM C 901	1985 (R 1990) Prefabricated Masonry Panels
ASTM C 920	1987 Elastomeric Joint Sealants
ASTM C 1019	1989 (Rev. A) Sampling and Testing Grout
ASTM C 1072	1986 Masonry Flexural Bond Strength
ASTM D 994	1971 (R 1982) Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D 1056	1991 Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 2000	1990 Rubber Products in Automotive Applications

ASTM D 2287	1992 Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 447	1992 (Rev. B) Compressive Strength of Masonry Prisms
ASTM E 514	1990 Water Penetration and Leakage Through Masonry

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC	1991 Uniform Building Code

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

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

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Anchors, ties

b. Wire reinforcement

c. Movement joints

1.2.2 SD-04, Drawings

a. Details of steel reinforcement

b. Lintels

1.2.2.1 Details of Steel Reinforcement

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

1.2.3 SD-08, Statements

a. Cold weather installation

b. Hot weather installation

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

1.2.4 SD-10, Test Reports

a. Unit strength method

b. Prism test

c. Mortar properties

d. Grout

1.2.4.1 Unit Strength Method

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

1.2.4.2 Prism Test

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

1.2.5 SD-11, Factory Test Reports

a. Concrete masonry units

b. Clay or shale bricks

c. Mortar and grout admixtures

1.2.5.1 Mortar and Grout Admixtures

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

1.2.6 SD-12, Field Test Reports

a. Grout strength

b. Mortar strength and properties

1.2.7 SD-13, Certificates

a. Concrete masonry units

b. Clay or shale bricks

d. Movement joints

e. Masonry inspector

1.2.8 SD-14, Samples

a. Concrete masonry units G

b. Brick units G

c. Colored mortar G

1.2.8.1 Brick Units and Concrete Masonry Units

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

1.2.8.2 Colored Mortar

Submit sample of colored mortar with applicable masonry unit.

1.2.9 SD-16, Sample Panels

a. Sample panel

1.3 QUALITY ASSURANCE

1.3.1 Inspection

Inspection is required for structural masonry. Coordinate details the Navy's Technical Representative (NTR).

1.3.1.1 Masonry Inspection

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

1.3.2 Sample Panel

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

1.3.3 Appearance

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

1.3.4 Testing

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

1.4 DELIVERY, STORAGE, AND HANDLING

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

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

1.5 BRACING AND SCAFFOLDING

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

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

2.1.1 Hollow Load and Non-Load Bearing Units

ASTM C 90, Type I, normal weight. Nominal size as required by design.

2.2 CLAY OR SHALE BRICKS

2.2.1 Facing Brick

ASTM C 216, Type FBS, FBX, FBA. Nominal size 4 inches.

2.3 MORTAR

2.3.1 Mortar Properties

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

2.3.2 Admixtures

Do not use admixtures containing chlorides.

2.3.2.1 Air Entrainment

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

2.3.2.2 Water-Repellant Admixture

Polymeric type formulated to reduce porosity and water transmission. When tested in accordance with ASTM C 1072, panel shall have flexural strength not less than that specified or indicated. When tested in

accordance with ASTM E 514, panel shall exhibit no water visible on back and through the panel after 24 hours. Not more than 25 percent of wall area shall be damp after 72 hours.

2.3.2.3 Lime Alternates

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

2.3.2.4 Colored Mortar

Where colored mortar is indicated, add pure mineral oxide pigment materials in proportions recommended by manufacturer and as approved, for mortar color indicated.

a. Quantity of pigment to cementitious content of the masonry cement shall not exceed 5 percent by weight. Carbon black shall not exceed 1 percent by weight.

b. Quantity of pigment to cementitious content of cement-lime mix shall not exceed 10 percent by weight, carbon black no more than 2 percent by weight.

2.3.3 Water

Water for mixing shall be potable.

2.4 GROUT

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

2.4.1 Admixtures

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

2.4.2 Ready Mixed Grout

ASTM C 94.

2.5 ANCHORS, TIES

Stainless steel, ASTM A 167 Type 304 for wire not totally embedded. Optionally, for completely embedded wire, ASTM A 641, Class 1 or 3. Provide cavity wall ties with integral drip located in cavity. Do not use corrugated wall ties.

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

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

c. Wire mesh ties, ASTM A 185.

d. Wire ties and anchors, ASTM A 82.

2.5.1 Wire Reinforcement

2.5.1.1 Horizontal Joint Reinforcement

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

2.5.1.2 Wire Fabric

ASTM A 185 smooth, ASTM A 497 deformed.

2.5.2 Adjustable Anchors

Provide adjustable anchors 3/16-inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 5/16 inch diameter steel bars placed to provide 1/16-inch play between flexible anchors and structural steel members.

2.6 REINFORCING BARS

2.6.1 Deformed Bars

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

2.6.2 Fabrication

ACI 530.1.

2.6.3 Bar Positioners

Provide positioners that prevent displacement of reinforcing during construction.

2.6.4 Design

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

2.6.5 Exposed Surfaces

Provide standard grade surface finish.

2.6.6 Lintels

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

2.7 THROUGH-WALL FLASHING

2.7.1 Stainless Steel

ASTM A 167, Type 304, 0.010 inch minimum thickness. Provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations. Lap seams 3 to 4 inches. Use lead-free solder.

2.8 MOVEMENT JOINTS

2.8.1 Contraction Joint Material

2.8.1.1 Rubber Shear Key

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

2.8.1.2 Elastomeric Joint Sealant

ASTM C 920.

2.8.1.3 Joint Detail

Size and shape as required by design.

2.8.2 Expansion Joint Material

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

2.8.2.1 Joint Detail

Size and shape as required by design.

2.9 WICKING FOR WEEP HOLES

1/4 inch diameter fiberglass or cotton sash cord. Each piece not less than 18 inches long.

2.10 INSERTS FOR WEEP HOLES

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

PART 3 EXECUTION

3.1 INSPECTION

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

3.2 SPECIAL PREPARATION

3.2.1 Cold Weather Installation

When either of the following conditions exist:

a. Ambient temperature falls below 40 degrees F, or

b. Temperature of masonry units is below 40 degrees F,

Implement cold weather procedures of ACI 530.1.

3.2.2 Hot Weather Installation

When either of the following conditions exist:

a. Ambient air temperature exceeds 100 degrees F, or

b. Ambient air temperature exceeds 90 degrees F and wind velocity is more than 8 m.p.h.,

Implement hot weather procedures of ACI 530.1.

3.3 ERECTION OF MASONRY UNITS

3.3.1 Mortar

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

3.3.2 Bond

Construct masonry in running bond pattern.

3.3.3 Solid Units

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

3.3.4 Hollow Units

ACI 530.1.

3.3.5 All Units

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

removed and relaid in fresh mortar.

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

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

3.3.6 Tolerances

ACI 530.1.

3.3.7 Embedded Items and Accessories

a. Construct chases as masonry units are laid.

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

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

3.3.8 Bed and Head Joints

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

3.3.9 Finishing Joints

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

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

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

3.3.10 Collar Joints

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

3.3.11 Through-Wall Flashing

Provide as indicated. Extend flashing from a point 1/4-inch outside of exterior face of walls. Bend down exterior edge to form a drip. Flashing shall be extended beyond interior face of wall and turned up not less than 2 inches. Secure flashing as required. Provide flashing in lengths as long as practicable. Lap ends not less than 1 1/2-inches for interlocking type and 4 inches for other types. Seal laps as necessary to ensure watertight construction. Provide dams at ends of flashing where masonry

abuts concrete and where flashing ends within the masonry. When both wythes are not brought up together, protect flashing from damage until they are fully enclosed in the wall.

3.3.12 Weep Holes

Wherever through-wall flashing occurs, provide weep holes spaced 24 inches o.c. for brick faced wall construction.

3.4 REINFORCEMENT

3.4.1 Preparation

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

3.4.2 Placing Tolerances

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

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

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

3.4.3 Securing Reinforcement

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

3.4.4 Details of Reinforcement

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

b. Get approval from NTR for all splices not indicated.

c. Do not bend embedded reinforcement.

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

3.4.5 Wall Ties

Embed ends of wall ties in mortar joints.

3.4.5.1 Hollow Units

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

3.4.5.2 Solid Units

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

3.4.5.3 Minimum Number of Ties

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

3.4.5.4 Adjustable Ties

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

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

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

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

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

3.4.6 Adjustable Anchors

Weld spacers to roads and columns. Provide shapes standard with the flexible-anchor manufacturer when approved. Clean welds and give one coat of zinc-rich touch up paint.

3.5 GROUTING

3.5.1 Preparation

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

3.5.2 Cleanouts

a. When grout pour exceeds 5 feet in height, provide cleanouts in bottom course of masonry in each grout pour.

b. Provide 3 inch minimum cleanout openings.

c. After cleaning, close cleanout openings and brace to resist grout pressure.

3.5.3 Placing Time

Place grout within 1-1/2 hours of introducing water to mixture. Sample and test grout, ASTM C 1019, for each 5,000 square feet of wall.

3.5.4 Pour Height

ACI 530.1.

3.5.5 Lift Height

Place grout in lifts not exceeding 5 feet. For 8 inch block wall, maximum lift is 2 feet.

3.5.6 Consolidation

Consolidate grout at time of placement.

a. Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.

b. Consolidate pours exceeding 12 inches in height by mechanical vibration. Reconsolidate by mechanical vibration after initial water loss and settlement have occurred.

3.6 FIELD QUALITY CONTROL

3.6.1 Mortar Strength and Properties

ASTM C 780, for the first 3 consecutive days, and each third day thereafter.

3.6.2 Grout Strength

ASTM C 1019, for the first 3 consecutive days, and each third day thereafter, or each batch of ready mixed grout.

3.6.3 Prism Test

Make at least one prism test sample for each 5,000 square feet of wall, but not less than three such samples for any building.

3.7 CLEANING

a. Keep exposed surfaces clean during construction. Avoid smearing mortar on face of units.

b. Clean masonry with potable water. Detergents may be used.

c. Do not use acid, caustic solutions, or sandblasting.

d. Masonry shall be free of stains, efflorescence, mortar or grout droppings, and debris.

-- End of Section --

SECTION 05500

METAL FABRICATIONS

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.

THE ALUMINUM ASSOCIATION, INCORPORATED (AA)

AA 45	1980 Aluminum Finishes
AA 46	1978 Anodized Architectural Aluminum

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S302	1987 Steel Buildings and Bridges
AISC S328	1986 Structural Steel Buildings Load & Resistance Factor Design
AISC S335	1989 Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.3	1985 Powder-Actuated Fastening Systems - Safety Requirements
ANSI A14.3	1984 Ladders - Fixed - Safety Requirements
ANSI B18.2.1	1981 Square and Hex Bolts and Screws Inch Series
ANSI B18.6.2	1972 (R 1983) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws
ANSI B18.6.3	1972 (R 1991) Machine Screws and Machine Screw Nuts
ANSI B18.21.1	1990 Lock Washers
ANSI B18.22.1	1965 (R 1990) Plain Washers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B18.2.2	1987 Square and Hex Nuts (Inch Series)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	1990 Structural Steel
ASTM A 47	1990 Ferritic Malleable Iron Castings
ASTM A 48	1983 (R 1990) Gray Iron Castings
ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 123	1989 (Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	1982 (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	1991 Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 307	1991 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 500	1990 (Rev. A) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 525	1991 (Rev. A) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 687	1989 High-Strength Nonheaded Steel Bolts and Studs
ASTM A 780	1990 Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 786/A 786M	1989 Rolled Steel Floor Plates
ASTM B 26/B 26M	1991 Aluminum-Alloy Sand Castings
ASTM B 108	1991 Aluminum-Alloy Permanent Mold Castings
ASTM B 209	1990 Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	1991 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B 429	1990 (Rev. A) Aluminum-Alloy Extruded Structural Pipe and Tube

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	1990 Structural Welding Code Steel

FEDERAL SPECIFICATIONS (FS)

FS FF-S-325	(Int Am. 3) Shield, Expansion; Nail Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS FF-P-395	(Rev. C) Pin, Drive Guided and Pin Drive, Powder Actuated (Fasteners for Power Actuated and Hand Actuated Fastening Tools)
FS RR-T-650	(Rev. D) Treads, Metallic and Nonmetallic, Skid Resistant
FS TT-P-664	(Rev. D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant
FS GGG-D-777	(Rev. B) Driver, Projectile Unit, Powder Actuated (High Velocity) (Above Water Only); Pin, Drive, Powder Actuated; and Cartridge, Powder Actuated Tool
FS RR-G-1602	(Rev. C) Grating, Metal, Other Than Bar Type (Floor, Except for Naval Vessels)

MILITARY STANDARDS (MIL-STD)

MIL-STD-889	(Rev. B) Dissimilar Metals

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM BG	1988 Metal Bar Grating Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	1991 Code for Safety to Life from Fire in Buildings and Structures

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 3	1989 Power Tool Cleaning
SSPC SP 6	1989 Commercial Blast Cleaning

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Handrails

b. Ladders

c. Structural steel door frames

d. Window guards

1.2.2 SD-04, Drawings

a. Fabrication drawings of structural steel door frames

b. Access doors and panels, installation drawings

c. Cover plates and frames, installation drawings

d. Handrails, installation drawings

e. Ladders, installation drawings

f. Window guards, installation drawings

g. Embedded angles and plates, installation drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC S302.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

1.2.3 SD-13, Certificates

a. Primer Certificate

1.2.3.1 Certificate

Submit a certificate from the manufacturer stating that the primer conforms to requirements of FS TT-P-664. Certify that the product has been tested and approved for inclusion in the Qualified Products List (QPL).

1.2.4 SD-14, Samples

a. Aluminum surfaces

Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1 using procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A 36/A 36M.

2.1.2 Structural Tubing

ASTM A 500.

2.1.3 Steel Pipe

ASTM A 53, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A 47.

2.1.5 Anchors and Fasteners

Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.5.1 Lag Screws and Bolts

ANSI B18.2.1, type and grade best suited for the purpose.

2.1.5.2 Toggle Bolts

ANSI B18.2.1.

2.1.5.3 Bolts, Nuts, Studs and Rivets

ASME/ANSI B18.2.2 and ASTM A 687 or ASTM A 307.

2.1.5.4 Screws

ANSI B18.2.1, ANSI B18.6.2, and ANSI B18.6.3.

2.1.5.5 Washers

Provide plain washers to conform to ANSI B18.22.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ANSI B18.21.1.

2.1.6 Aluminum Alloy Products

Conform to ASTM B 209 for sheet plate, ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings, as applicable. Provide aluminum extrusions at least 1/8-inch thick and aluminum plate or sheet at least 0.050-inch thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123, ASTM A 153 or ASTM A 525 G-90, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved by the Navy's Technical Representative (NTR). Clean areas to be repaired and remove the slag from the welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread the molten material uniformly over surfaces to be coated and wipe the excess material off.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within friction-type joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Unexposed Sheet, Plate, and Extrusions

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA 45, or AA 46.

2.3 GUARD POSTS (BOLLARDS)

Provide 6-inch prime coated standard weight steel pipe as specified in ASTM A 53. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi.

2.4 HANDRAILS

Design handrails to resist a concentrated load of 250 lbs in any direction at any point of the top of the rail or 20 lbs per foot applied horizontally to top of the rail, whichever is more severe.

2.4.1 Steel Handrails, Including Carbon Steel Inserts

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A 53 or structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength. Provide steel railings of 1 1/2-inch nominal size. Railings to be hot-dip galvanized.

a. Fabrication: Joint posts, rail, and corners by one of the following methods:

(1) Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8-inch hexagonal-recessed-head setscrews.

(2) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than 6 inches long.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

b. Provide removable sections as indicated.

2.5 MISCELLANEOUS PLATES AND SHAPES

Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to

support wall loads over openings. Provide with connections, fasteners, or welds. Construct to have at least 8 inches bearing on masonry at each end.

Provide angles and plates, ASTM A 36/A 36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A 123.

PART 3 EXECUTION

3.1 INSTALLATION

Install items at locations indicated, according to manufacturer's instructions. Items listed below require additional procedures.

3.2 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.3 BUILT-IN-WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals as defined by MIL-STD-889 are in contact, or where aluminum is in contact with concrete, mortar, masonry, wood, or absorptive materials subject to wetting, protect surfaces with a coat conforming to FS TT-P-664 to prevent galvanic or corrosive action. Alkyd is not to be used on metal in contact with concrete or masonry.

3.5.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.5.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the NTR.

3.6 COVER PLATES AND FRAMES

Install the tops of cover plates and frames flush with floor.

3.7 HANDRAILS

3.7.1 Steel Handrail

Install in pipe sleeves embedded in concrete and filled with non-shrink grout or quick setting anchoring cement with anchorage covered with standard pipe collar pinned to post or masonry with expansion shields and bolts or toggle bolts. Secure rail ends by steel pipe flanges anchored by expansion shields and bolts or through-bolted to a back plate or by 1/4-inch lag bolts to studs or solid backing.

3.8 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Secure to masonry or concrete with not less than two 1/2-inch diameter expansion bolts. Install intermediate clip angles not over 48 inches on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. In no case shall ends of ladders rest upon floor.

--End of Section--

SECTION 11300

GROUNDWATER FEED TANK AND APPURTENANCES

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A-167-91	Specifications for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet and Strip

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA D-103-87	Factory-Coated Bolted Steel Tanks for Water Storage

1.2 DESCRIPTION OF WORK

Provide a complete and ready for operation a Groundwater Feed Tank and appurtenances to provide a complete and functional system.

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall be the product of one manufacturer.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

Provide manufacturer's data on the Groundwater Feed Tank and level control equipment.

1.3.2 SD-04, Drawings

Prior to obtaining any equipment in connection with this section, the Contractor shall submit detailed shop drawings of the Groundwater Feed Tank and related equipment including:

a. Conical tank roof
b. Vent
c. External connections
d. Liquid level controls mounting brackets
e. Anchor bolt sizing and placement
f. Tank finish
g. Tank grounding
h. Tank foundation/support requirements

Shop drawings shall include quantity, size, material, and locations of all equipment. Shop drawings shall include wiring diagrams of level control equipment.

1.3.3 SD-19, Operation and Maintenance Manuals

Provide O&M manuals for the Groundwater Feed Tank control system. Data Package 3.

1.4 EQUIPMENT DELIVERY, STORAGE, HANDLING

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the equipment.

1.5 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "General Electrical Requirements."

PART 2 - PRODUCTS

2.1 GENERAL TANK REQUIREMENTS

The Groundwater Feed Tank shall be constructed of glass lined steel panels capable of resisting site contaminants (volatile organics) at dilute concentrations. Tank shall meet the standards of AWWA D-103.

2.2 GROUNDWATER FEED TANK

2.2.1 Dimensions

The Groundwater Feed Tank (T-110) shall be 13'-0" overall diameter by 25'-0" overall height with a nominal capacity of approximately 20,000 gallons. The tank shall be flat-bottomed with a conical roof (10 degree slope) suitable for outdoor use.

2.2.2 Cover

The tank shall be equipped with a conical bolt-down cover. The cover shall be designed with a manway to provide access to the tank interior. The cover shall be furnished with one (1) 6" diameter vent to atmosphere.

2.2.3 Flanged Lip

A flanged lip shall be furnished with the tank to allow for installation of the conical bolt-down cover.

2.2.4 Flange Connections

Five (5) 4" diameter, two (2) 2" diameter, one (1) 6" and four (4) 1" flanged pipe connections shall be provided with the tank as shown on the drawings. One of the 4" flanges shall be capped for connection of additional piping in the future. One 24" manway also shall be provided.

All flange connections shall be of the conically gussetted type and shall protrude from the outside tank sidewall.

2.2.5 *Downpipes*

One (1) 8" diameter feedpipe shall be installed inside the tank for the groundwater influent line. Brace supports shall be furnished as part of the installation in accordance with the manufacturer's recommendations.

2.3 CONTROL SYSTEMS

Two (2) ball type, side-mount conductivity based level switches (high and high high) shall be provided for the tank. One (1) level indicator/transmitter also shall be provided. One temperature indicator shall be provided with the tank. All controls shall be configured as depicted on the drawings.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

Installation procedures shall be in accordance with the recommendations of the manufacturer of the material being installed. Installation of the item will not be allowed to proceed until the recommendations are received.

3.2 INSTALLATION

Precision gauges and levels shall be used in setting the tank. Tank shall be properly anchored to the tank pad in accordance with the manufacturer's recommendations.

Tanks and supports shall be grounded to the grounding grid.

Electrical and instrumentation equipment shall be grounded in accordance with local electrical standards.

-- End of Section --

SECTION 11302

INITIAL/FINAL pH ADJUST TANKS AND CHEMICAL FEED SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A-167-91	Specifications for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet and Strip

1.2 DESCRIPTION OF WORK

Provide complete and ready for operation Initial and Final pH Adjust Tanks, NaOH and HCL Feed Systems, and appurtenances to provide complete and functional systems.

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same type shall each be the product of one manufacturer.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

Provide manufacturer's data on the Initial and Final Adjust Tanks, Chemical Feed Systems and related control equipment.

1.3.2 SD-04, Drawings

Prior to obtaining any equipment in connection with this section, the Contractor shall submit detailed shop drawings of the Initial and Final pH Adjust Tanks and Chemical Feed equipment including:

a. Flanged and dished bolt down cover
b. Vent
c. External connections
d. Liquid level controls mounting brackets
e. Anchor bolt sizing and placement
f. Tank finish
g. Tank grounding
h. Tank foundation/support requirements

Shop drawings shall include quantity, size, material, and locations of all equipment. Shop drawings shall include wiring diagrams of control equipment.

1.3.3 SD-06, Instructions

Two printed copies of the installation procedures shall be furnished to the NTR prior to installation. Failure to furnish these recommendations may be cause for rejection of the equipment.

1.3.4 SD-19, Operation and Maintenance Manuals

Provide O&M manuals for the Initial and Final pH Adjust Tanks controls and Chemical Feed Systems/Controls. Data Package 3.

1.4 EQUIPMENT DELIVERY, STORAGE, HANDLING

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the equipment.

1.5 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "General Electrical Requirements."

PART 2 - PRODUCTS

2.1 GENERAL TANK REQUIREMENTS

The Initial (T-130) and Final (T_200) pH Adjust Tanks shall be constructed of carbon steel, the internal surface of which shall be glass lined to resist site contaminants (volatile organics) at dilute concentrations and acidic or caustic environments, as applicable.

2.2 INITIAL AND FINAL pH ADJUSTMENT TANKS

2.2.1 Dimensions

The Initial (T-130) and Final (T-200) pH Adjust Tanks shall each be 9'-0" overall diameter by 16'-0" overall height with a nominal capacity of approximately 6,500 gallons. The tank shall be flat-bottomed with a flanged and dished cover.

2.2.2 Cover

The tanks shall be equipped with carbon steel flanged and dished bolt-down covers, glass lined on the inside surface. Each cover shall be designed with a manway to provide access to the tank interior. Each cover shall be furnished with two (2) 4" diameter non-gussetted flange connections for connection of an air inlet vent and an air exhaust vent to ductwork. In addition, one (1) 8" conically gussetted flange shall be provided at the dome peek for attachment of an agitator.

2.2.3 Flanged Lip

A flanged lip shall be furnished with each tank to allow for installation of bolt-down covers.

2.2.4 Flange Connections

Conically gussetted flange connections shall be furnished on each tank in sizes and locations as indicated. In addition, one (1) 24" manway shall be provided on the tank sidewall.

2.2.5 Tank Agitator

The Contractor shall provide two (2) tank agitators (one for each pH adjustment tank) appropriately sized for the tank volume and dimensions.

2.2.6 Lift Lugs

Two (2) lift lugs shall be furnished with each tank to facilitate on-site handling.

2.2.7 Control Systems

Contractor shall provide one (1) level indicator/transmitter control system as indicated on the drawings. Level sensors should operate on a capacitance basis.

2.3 20% NaOH FEED SYSTEM

2.3.1 Dilution Water Connection

Contractor shall provide and install a block valve for on-off control of dilution water as shown on the drawings.

2.3.2 Pumps (P-121, P-120 A&B)

The NaOH transfer pumps shall be an integral part of the NaOH Feed System, shall have teflon internals, and shall have variable speed remote 4-20 mA control.

2.3.3 NaOH Mix Tank (T-120)

The NaOH mix tank shall provide for intimate mixing of the concentrated NaOH (50%) with water. The tank shall be constructed of a material resistant to caustic solutions. A mechanical mixing devise shall be provided which is adequately sized based on tank dimensions. Tank shall be flat-bottomed, domed-top with a 4" vent to atmosphere.

2.3.4 Controls

Control of chemical feed pumps shall be as indicated.

2.3.5 Accessories

Drum standpipe, and drum adaptor assembly for NaOH Feed System shall be provided by Contractor (refer to Section 11303). In addition, provide one spill containment unit constructed of polyethylene and having a minimum capacity of 60 gallons.

2.4 HCl FEED SYSTEMS

2.4.1 Dilution Water Connection

Contractor shall provide and install a valve for on-off control of dilution water as indicated.

2.4.2 Pumps (P-211, P-212A & B)

The HCl transfer pumps shall be an integral part of the HCl feed system, shall have teflon internals, and shall have variable speed remote 4-20 mA control.

2.4.3 10% HCl Mix Tank (T-211)

The 10% HCl mix tank shall provide for intimate mixing of the concentrated HCl with water and shall have a 24 hour storage capacity. The tank shall be constructed of FRP or other approved a material resistant to acid solutions. A mechanical mixing devise shall be provided which is adequately sized based on the tank dimensions. The tank shall be flat-bottomed, with standard flanged and dished top.

2.4.4 Controls

Control of chemical feed pumps shall be as indicated.

2.4.5 Accessories

Drum standpipe, and drum adaptor assembly for HCl Feed System shall be provided by Contractor (refer to Section 11303). In addition, provide one spill containment unit constructed of polyethylene and having a minimum capacity of 60 gallons.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

Installation procedures shall be in accordance with the recommendations of the manufacturer of the equipment being installed. Installation of the item shall not be allowed to proceed until the recommendations are received.

3.2 INSTALLATION

Tanks shall be installed true and level. Precision gauges and levels shall be used in setting the tanks. Tanks shall be properly anchored to the building floor in accordance with the manufacturer's recommendations.

Tanks and supports shall be grounded to the grounding grid.

Electrical and instrumentation equipment shall be grounded in accordance with local electrical standards and instrument manufacturer's recommendations.

-- End of Section --

SECTION 11303

POLYMER FEED SYSTEM

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167-91	Specifications for stainless and heat-resisting chromium-nickel steel plate, sheet, and strip.

1.2 DESCRIPTION OF WORK

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.2.2 System Composition

Provide, complete, and ready for operation, a compact polymer feed system to automatically meter, blend, mix and emulsify polymer with dilution water. One (1) metering drum pump (P-131) capable of providing 0.5 gpm of concentrated polymer shall be provided. Two (2) metering pumps (P-132A & B) capable of delivering to 3 gpm of diluted polymer solution also shall be included.

1.2.3 System Requirements

The unit shall operate on 120V/60Hz/1 phase power. The entire system shall be tested to 125 psig and able to withstand sustained pressure of 75 psig. The polymer feed system shall be capable of mixing and diluting liquid polymers. The polymer holding tank (T-125) shall provide 24 hour holding capacity of diluted polymer, fully activated, without fish-eyes and without degradation of the long-chain polymer molecules.

1.2.4 Polymer Feed System Requirements

Polymer Feed System shall be an integrated equipment package to automatically meter, dilute, activate, and feed liquid polymer and water. Units that employ thin-film mixing combined with in-line mixing and followed by a detention/aging chamber, providing an environment that prevents degradation of the long-chain polymer molecules are acceptable. Units that rely on the shearing action of a centrifugal mixing pump or a high-speed, high-shear impeller turbine to mechanically mix polymer shall not be allowed.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

Provide manufacturer's data on the polymer feed system.

1.3.2 SD-04, Drawings

The Contractor shall submit for approval shop drawings of the polymer feed system equipment. These drawings shall be submitted prior to the ordering of any polymer feed system equipment.

1.3.3 SD-06, Instructions

Two printed copies of the installation procedures shall be furnished to the NTR prior to installation. Failure to furnish these recommendations may be cause for rejection of the equipment.

1.3.4 SD-19, Operation and Maintenance Manuals

Provide Operation and Maintenance data for the polymer feed system (Data Package 3).

1.4 EQUIPMENT DELIVERY, STORAGE, HANDLING

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the equipment.

1.5 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "Electrical General Requirements."

PART 2 - PRODUCTS

2.1 DILUTION WATER CONNECTION

Each unit shall incorporate a block valve for on-off control of dilution water.

2.2 POLYMER DRUM PUMP (P-131)

The polymer drum pump shall be supplied by the polymer feed system manufacturer as an integral part of the system and shall be 316 stainless steel gear type with variable speed remote 4-20 mA control. The pump shall be capable of pumping highly viscous concentrated polymers without causing excessive shear.

2.3 POLYMER HOLDING TANK (T-125)

The polymer holding tank shall provide for intimate mixing and aging of the concentrated polymer solution with water and shall have a 24 hour polymer storage capacity. The tank shall be constructed of 304 stainless steel inert to polymer solutions. A slow rotating mechanical mixing device shall be provided. Mixers that could excessive shear the polymer shall not be allowed.

2.4 POLYMER FEED PUMPS (P132 A & B)

The polymer feed pumps shall be supplied by the polymer feed system manufacturer as an integral part of the system and shall be 316 stainless steel gear type with variable speed remote 4-20 mA control. The pumps shall be capable of pumping viscous polymer solutions without causing excessive shear.

2.5 CONTROLS

Control of polymer feed pumps shall be as required by the Contractor to complete a fully functional, automatic polymer feed system.

2.6 ACCESSORIES

2.6.1 Calibration Column

Provide a clear plastic or polypropylene calibration column for periodic calibration of the metering pumps. The column shall be 1,000 ml and also include an inlet tee with charging valve.

2.6.2 Drumpipe-Standpipes

Provide three (3) rigid standpipes with adapter fitting for insertion into the bung of a standard 55-gallon drum. The 2-inch fitting on the end of each standpipe shall have a barbed connector to accept 5/8 inch I.D. tubing (one standpipe each for polymer, sodium hydroxide, and acid).

2.6.3 55 Gallon Drum Dolly

Provide one drum dolly to store and move 55 gallon drums while in the vertical position. Dolly shall be 304 stainless steel with four (4) casters consisting of 304 stainless steel rim with a solid rubber tire, unless otherwise approved.

2.6.4 55 Gallon Drum Cart

Provide one (1) combination drum cart and cradle. The cart shall have wheels for moving of drums and a cradles to tilt and hold the drum in the horizontal position for complete draining.

2.6.5 55 Gallon Drum Adaptor Assembly

Provide three (3) adaptor assembly and vents to enable metering from drums when in a horizontal position. The assemblies shall include a 2-inch adaptor to screw into a 55 gallon drum bung, quick-disconnect assembly,

ball valve, site glass to observe drum contents, and a barbed connector to accept a 5/8 inch I.D. hose. A vent assembly also shall be provided for the drum consisting of an adaptor for the small drum opening, a 90 degree elbow and vent pipe (one assembly for polymer, sodium hydroxide, and acid).

PART 3 - EXECUTION

3.1 INSTALLATION

Check-out of final installation, start-up, calibration and instruction of operating personnel shall be performed by an authorized representative of the manufacturer.

-- End of Section --

SECTION 11304

INCLINED PLATE CLARIFIER AND APPURTENANCES

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 176-91	Specifications for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

1.2 DESCRIPTION OF WORK

The Inclined Plate Clarifier and appurtenances shall be furnished and assembled to provide a complete and functional system. Equipment details are provided in Section 2 below and on construction drawings.

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Tank mixers

b. Inclined plate clarifier

1.3.2 SD-04, Drawings

Prior to obtaining any equipment in connection with this section, the Contractor shall submit detailed shop drawings of the inclined plate clarifier and related equipment including:

a. Mixing chamber
b. Flocculation chamber
c. Bolt down cover
d. Plate packs
e. Vents
f. External connections
g. Anchor bolt sizing and placement
h. Tank finish
i. Tank grounding
j. Tank mixers
k. Tank foundation/support requirements

Shop drawings shall include quantity, size, material, and locations of all equipment.

1.3.3 SD-06, Instructions

Two printed copies of the installation procedures shall be furnished to the NTR prior to installation. Failure to furnish these recommendations may be cause for rejection of the equipment.

1.3.4 SD-19, Operation and Maintenance Manuals

Provide O&M manuals for the inclined plate clarifier mixers and control equipment. Data Package 3.

1.4 EQUIPMENT DELIVERY, STORAGE, HANDLING

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the equipment.

1.5 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "Electrical General Requirements."

PART 2 - PRODUCTS

2.1 GENERAL TANK REQUIREMENTS

The inclined plate clarifier shall be constructed of carbon steel, the internal surface of which shall be glass lined to resist site contaminants (volatile organics) at dilute concentrations.

2.2 INCLINED PLATE CLARIFIER

2.2.1 Dimensions

The inclined plate clarifier (X-130C) and associated mixing (X-130A) and flocculation (X-130B) chambers shall not exceed the dimensions shown on the design Drawings, unless approved by the NTR. The tanks shall be constructed of carbon steel. The inclined plate clarifier shall be sized at a flow rate no greater than 1.0 gpm per square foot of settling area.

2.2.2 Filter Plate

Inclined plates shall consist of smooth surfaced polypropylene plates, stainless steel rods, and PVC spacers, assembled into packs. Plate packs shall be cleanable in place and shall be removable, if necessary. Plate packs shall be equipped with lifting eyes. Plates shall be sloped to a 55$\pm$3 degree angle from the horizontal.

2.2.3 Cover

The tank shall be equipped with a carbon steel hinged bolt-down cover. The cover shall be designed with a manway to provide access to the tank interior. The cover shall be provided with an 8" x 8" shaft cutout for a mixer. The cover shall be furnished with two (2) 6" diameter non-gussetted flange connections for connection of an air inlet vent and an air exhaust vent to ductwork.

2.2.4 Flanged Lip

One (1) flanged lip shall be furnished with the tank to allow for installation of the bolt-down cover.

2.2.5 Flange Connections

Conically gussetted flange connections shall be furnished on the outside tank sidewall for connection of the mixing chamber, flocculation chamber and clarifier piping as needed.

2.2.6 Hold Down Legs

The inclined plate clarifier shall be furnished with four (4) equally spaced light duty hold down legs. Legs shall be type 304 stainless steel and shall be welded the tank.

2.3 FLOCCULATION MIXER

The flocculation chamber shall be equipped with a slow variable speed flocculation mixer appropriately sized for the dimensions of the tank. Motor shall be driven, capable of maintaining homogeneous solutions of polyelectrolytes at viscosities up to 500 CP. Mixer shall be suitable for 24 hr/day operation.

2.3.1 AGITATOR

The mixing chamber shall be furnished with an agitator, appropriately sized for the dimensions of the tank.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

Installation procedures shall be in accordance with the recommendations of the manufacturer of the material being installed. Installation of the item will not be allowed to proceed until the recommendations are received.

3.2 INSTALLATION

Precision gauges and levels shall be used in setting the units. The unit shall be properly anchored to the building floor in accordance with the manufacturer's recommendation. Tanks and supports shall be grounded to the grounding grid.

Electrical and instrumentation equipment shall be grounded in accordance

with local electrical standards.

-- End of Section --

SECTION 11305

SAND FILTERS

PART 1 GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A-167-91	Specifications for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet and Strip

1.2 DESCRIPTION OF WORK

Provide and install as indicated a factory assembled vertical pressure type filter system shipped with manifold piping for simple connection to the Final pH Adjust Tank. All equipment and materials shall be supplied per the specifications as intended for a complete and operational system. The filter system is intended for removal of sediment down to 10 microns in size.

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

Provide manufacturer's data for the sand filter units.

1.2.2 SD-04, Drawings

Submit shop drawings on the following:

a. Contractor vessels, including principle dimensions, materials of construction, inlet and outlet fittings.

b. Filter media.

1.2.3 SD-06, Instructions

Two printed copies of the sand filter installation procedures shall be furnished to the NTR prior to installation. Failure to furnish these recommendations may be cause for rejection of the equipment.

1.2.4 SD-19, Operation and Maintenance Manuals

Provide O&M manuals for the Sand Filter System. Data Package 3.

1.3 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "Electrical General Requirements."

PART 2 PRODUCTS

2.1 GENERAL DESCRIPTION

The system, in compliance with equipment specifications will contain three filter units (two operating and one spare) each rated for 225 GPM maximum flowrate. Filter units will have air scour backwash capability.

2.2 PERFORMANCE AND DESIGN DATA

The filter system shall meet the specified effluent quality based on an influent quality of 5 to 10 ppm of suspended solids.

2.2.1 Effluent Water Quality

Filter effluent shall be free of suspended material larger than 10 microns in size; under normal operating conditions (influent of 5 to 10 ppm suspended solids), an effluent of 2 ppm suspended solids shall be achievable.

2.2.2 Design Parameters

Normal System Flow & Pressure Drop	225 GPM @ 5 PSI
Maximum System Flow & Pressure Drop	125 GPM @ 20 PSI
Daily Water Usage	216,000 Gallons/Day
Daily Hours of Water Demand	24 Hours/Day
Backwash Flow	300 GPM per unit
Tank Freeboard	50% Minimum
Operating Temperature Range	40 - 120 degrees F
Operating Pressure Range (System)	30 - 100 PSIG
Electrical Requirements	120/60/1
Diameter of Each Unit	Not to Exceed 6 Feet

(Note pressure drop with unit(s) online and backwashed clean.)

2.2.3 Equipment Schedule

Filter Tank(s) - Qty: 3 Dia. 72 in. (max)
Manifold Pipe - Size: 4 in.
Main Operating Valve - Size: 4 in.

2.3 FILTER TANKS

Tanks shall be of electric welded pressure vessel quality low carbon steel construction rated for 100 psig working pressure and hydrostatically tested at 50% in excess of the working pressure (150 psig design pressure).

Tanks shall have threaded NPT connections on the service inlet and outlet.

Access openings shall include two 4" diameter or 4" x 6" elliptical handholes; one in top head and one in lower side shell.

Supports for tanks shall be structural steel strap legs welded to lower tank head.

Tanks shall be hot dipped galvanized inside and outside after fabrication.

Tanks shall be sandblasted internally to white metal with a 1 to 1-1/2 mil anchor pattern, then coated with 8-10 mils DFT epoxy polyamid. The exterior surface shall be cleaned and coated with 2-3 mils DFT rust resistant primer.

2.4 INTERNAL DISTRIBUTION

Configuration of filter system may be either upflow or downflow; however, the internal distribution system must be such that water is evenly distributed over the entire tank area.

2.5 MAIN OPERATING VALVE

The main operating valve shall be an industrial automatic multiport diaphragm type slow opening and closing, free of water hammer. The diaphragm assembly shall be fully guided on its perimeter when pressure actuated from one position to another to assure a smooth reliable shut-off without sticking. There shall be no contact of dissimilar metals within the valve and no special tools shall be required to service the valve.

The main operating valve shall be manufactured by the manufacturer of the filtration equipment. Valve shall have a treated water sampling cock.

2.6 PIPE AND FITTINGS

Piping shall be in accordance with Section 15401.

2.7 FLOW CONTROL

An automatic flow controller shall be provided to maintain proper backwash and flush rates over wide variations in operating pressures and require no field adjustment. Flow controller shall be of the type most commonly specified by the filter manufacturer.

2.8 FILTER MEDIA

The granular media shall consist of a single filter layer in addition to a support layer. Particle retention shall be 10 micron or larger.

2.9 ACCESSORIES

Pressure gauges for inlet and outlet of each tank. Gauges shall be of the type most commonly provided by the filter manufacturer.

Sampling cocks for inlet and outlet of each tank.

PART 3 EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

The sand filters shall be installed in accordance with the manufacturer's recommendations. Installation of the item will not be allowed to proceed until the recommendations are received.

3.2 INSTALLATION

All piping and hose connections shall be made up tight and shall not leak under operating conditions.

3.3 MANUFACTURER'S REPRESENTATIVE

The services of a trained factory authorized service representative shall be made available to supervise, inspect, and provide operator training as required for initial start-up and system operation. Two (2) full working days of training will be provided.

-- End of Section --

SECTION 11307

AIR STRIPPER AND HOLDING TANK

PART 1 - GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167-91	Specifications for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM D 2103	Specification for Polyethylene Film and Sheeting

1.2 DESCRIPTION OF WORK

Provide a complete and ready for operation one packed column air stripping system, complete with effluent holding tank cover with mist eliminator, high efficiency packing material, blower, holding tank level controls, gauges, pressure switches.

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

Provide manufacturer's data on the air stripper and related equipment.

1.3.2 SD-04, Shop Drawings

The Contractor shall submit for approval shop drawings of the air stripper, air stripper effluent holding tank, blower, level control devices and other appurtenances.

1.3.3 SD-06, Instructions

Two printed copies of the air stripper and holding tank installation procedures shall be furnished to the NTR prior to installation. Failure to furnish these recommendations may be cause for rejection of the

equipment.

1.3.4 SD-19, Operation and Maintenance Manuals

Provide O&M manuals for the Air Stripper package. Data Package 3.

1.4 DELIVERY, STORAGE, AND HANDLING MATERIALS

1.4.1 Delivery

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

1.4.2 Storage and Handling

Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.5 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "General Electrical Requirements".

PART 2 - PRODUCTS

2.1 AIR STRIPPER AND HOLDING TANK

2.1.1 Performance Requirements

The air stripper shall meet all of the following treatment criteria based on each respective influent contaminant concentration, temperature, and flow rates:

If any effluent efficiency limit is not met at any time during a period of one year after start of operations of the facility controlled by the unit, the Contractor will be responsible for retrofitting or replacing the non-complying unit as required to meet the effluent discharge requirements specified above.

Contaminant	Air Stripper Influent Concentration (ppb)	Air Stripper Effluent Concentration (ppb)
1,2-Dichloroethane	30	0.38
1,2-Dichloroethylene (T)	30,000	70
Ethylbenzene	52	29
Tetrachloroethene	920	0.7

Trichloroethylene	58,000	2.8
Vinyl Chloride	800	0.015

Temperature: 55 Degrees F
Input Flow Rate: 430 Gal/Min
Air Flow Rate: Not to exceed 4,000 SCFM

2.1.2 Components

The Air Stripper system consists of the packed tower (C-200), effluent holding tank (T-220), cover with mist eliminator, blower (fan), pump controls and gauges. The blower shall be protected by a removable shroud. The holding tank packing supports, cover and shroud shall be constructed of carbon steel.

2.1.3 Blower

The blower shall be a 25 HP, 230VAC, 3-phase regenerative system to push air through the column.

2.1.4 Level

The system shall be equipped with a HI-LO/HI-OVERRIDE sump level sensors that control air stripper effluent pumps. The top sensor shall actuate the HI-OVERRIDE. If the sump should become full, the rising water level will activate the secondary air stripper effluent pump. The other level sensors shall control operation of the primary transfer pump by actuating HI and LO switches. The primary transfer pump shall start when receiving a signal from the HI switch and continue to run until the water level drops to the LO switch.

2.1.5 Air Stripper Effluent Holding Tank (T-220)

The holding tank (sump) shall serve to collect treated water. It shall have a minimum volume of 6500 gallons. This tank shall be attached to the bottom of the air stripping column and shall have fittings as indicated.

2.1.6 Junction Box

A junction box shall be provided to permit the holding tank level sensors and the low pressure switch to interface with the air stripper effluent pump controls.

2.1.7 Packing Material

Packing material shall be constructed of polyethylene (conforming to ASTM D-2103) . Packing shall be randomly placed within the column after installation, but prior to start-up. Water shall be redistributed over the cross sectional area of the tower at least once to minimize the effects of channelling on removal efficiency.

2.1.8 Cover

The cover shall contain the polypropylene mist eliminator and fit on top of the unit. The cover shall be equipped with fittings for attachment of the

influent water and effluent air plumbing.

2.1.9 Gauges

The air stripper manufacturer shall provide gauges to monitor both static pressure in inches of water column and air flow rate in SCFM.

2.1.10 Pressure Switches

Low and High Pressure switches shall monitor the pressure generated by the blower. In the event of a blower failure, the Low Pressure switch shall shut off the blower. If fouling or water entrainment caused the pressure in the system to rise, the High Pressure switch shall shut off the blower.

2.1.11 System Controls

System controls shall be as indicated.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

Installation procedures shall be in accordance with the recommendations of the manufacturer of the material being installed. Installation of the air stripper and holding tank will not be allowed to proceed until the recommendations are received.

3.2 INSTALLATION

The air stripper and holding tank shall be installed true and level. Precision gauges and levels shall be used in setting all equipment.

3.3 MANUFACTURER'S REPRESENTATIVE

Air stripper manufacturer shall furnish the services of a qualified and experienced representative for two (2) eight-hour working days to inspect, test, and start-up the installation and to instruct operating personnel in the generation and maintenance of component equipment.

3.4 FIELD TESTING AND INSPECTION

All work shall be in accordance with the drawings and specifications. All defects disclosed by the tests shall be corrected by the Contractor. Equipment shall be subjected to an operational test to demonstrate compliance with specification requirements. The NTR shall be notified in writing 14 days prior to field testing. Tests shall be conducted under design conditions to ensure proper operation of all equipment. All appliances, materials, and equipment for testing shall be provided by the Contractor, and all expenses in connection with the testing shall be borne by him. Testing shall be conducted after all equipment is properly installed and electrical services are installed. All defects discovered shall be corrected to the satisfaction of the NTR, and all tests repeated at the expense of the Contractor, until the equipment is in proper working order.

-- End of Section --

SECTION 11308

CARTRIDGE FILTERS

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167-91	Specifications for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strips

1.2 DESCRIPTION OF WORK

Provide complete and ready for operation, cartridge filter units as described and as shown on the construction drawings.

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

Provide manufacturer's data for the cartridge filter units.

1.3.2 SD-04, Drawings

The Contractor shall submit for approval shop drawings of the cartridge filter units. These drawings shall be submitted prior to the ordering of any material and/or equipment.

1.3.3 SD-06, Instructions

Two printed copies of the installation procedures shall be furnished to the NTR prior to installation. Failure to furnish these recommendations may be cause for rejection of the equipment.

PART 2 - PRODUCTS

2.1 CARTRIDGE FILTER UNITS

Three (3) cartridge filters, each capable of handling one-half the design flow rate (250 gpm each) and a maximum operating pressure of 150 psi shall be provided. The vessel, bag support, standpipe, and piping of the filter housing units shall be constructed of 304 stainless steel. The filter

housing units shall be equipped with an air relief vent in the lid.

The Contractor shall supply two dozen spare filters used with the cartridge filter units rated at 10 micron.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

Installation procedures shall be in accordance with the recommendations of the manufacturer of the material being installed. Installation of the item will not be allowed to proceed until the recommendations are received.

--End of Section--

SECTION 11309

CARBON ADSORBERS

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53-90b	Specifications for Pipe, Steel, Black, and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM A 197-87	Specifications for Cupola Malleable Iron
ASTM A 181	Specification for Forgings, Carbon Steel for General Purpose Piping

1.2 DESCRIPTION OF WORK

Provide complete and ready for operation a liquid phase carbon adsorption system as described herein and as shown on the construction drawings.

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.3 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "General Electrical Requirements".

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

Provide manufacturer's data for the carbon adsorption units.

1.4.2 SD-04, Drawings

Submit shop drawings on the following: Contactor vessels, including principle dimensions, materials of construction, inlet and outlet fittings.

1.4.3 SD-06, Instructions

Two printed copies of the installation procedures shall be furnished to the NTR prior to installation. Failure to furnish these recommendations

may be cause for rejection of the equipment.

1.4.4 SD-19, Operation and Maintenance Manuals

Provide O&M manuals for a Liquid-Phase Carbon Adsorption system. Data Package 3.

PART 2 - PRODUCTS

2.1 CONTACTOR VESSELS

2.1.1 Performance Requirements

The contactor vessels each shall be capable of handling up to 225 GPM at an internal pressures of 10 psig.

2.1.2 Carbon Adsorption Equipment Description

The adsorption equipment provided shall consist of four (4) adsorber vessels (X-220), pre-piped with all process, carbon transfer and utility piping to comprise a complete two-train, two-stage adsorption system.

2.1.2.1 Adsorber Vessel

The adsorbers shall be 4 foot diameter, vertical, cylindrical pressure vessels with flanged and dished ASME Code top and bottom heads. The vessels shall be designed, constructed, and stamped in accordance with the ASME Code, Section VIII for a design pressure rating of 75 psig at 150 degrees F.

Each adsorber unit shall be equipped with a manway for maintenance access. The adsorber also shall be provided with handholes, with a quick opening cover, located on the top shell for ease of dry media fill. The top nozzles shall be flanged with Class 150 lap joint flanges, and side and bottom nozzles shall be Class 150 pad flanges. The top center nozzle shall be equipped with 4" diameter carbon steel and a carbon steel full cone spray nozzle, to wash the vessel sides during transfer operation.

Adsorber units shall be constructed of carbon steel and shall have all welds and any other sharp edges ground smooth, and all imperfections such as skip welds, delaminations, scabs, slivers, and slag shall be corrected prior to abrasive blasting. All surfaces are degreased prior to abrasive blasting. The adsorber internal surface shall be blasted to a white metal surface to provide an anchor pattern in the metal corresponding to approximately 4 mil. The exterior of the adsorber shall be sandblasted to a commercial blast cleaning (SSPC-SP6).

The interior surface shall be lined with light gray (Plasite 4110 Abrasion-Resistant or equivalent) Protective Coating in two multi-pass spray coatings per manufacturer's instructions to produce a 35 to 40 mil dry film thickness.

2.1.2.2 Underdrain Distribution System

The underdrain distribution system shall be constructed of Schedule 80 solid PVC pipe with all joints to be solvent cemented. The water shall be collected by polypropylene slotted nozzles located in the underdrain piping. These nozzles shall retain the granular activated carbon, allow water flow with a minimum of pressure drop, and shall be installed in a threaded pipe tap for ease of replacement.

2.1.2.3 Process and Utility Piping

The process and utility piping on the adsorption system shall include influent water to the system and treated water adsorber vent lines and granular activated carbon supply and discharge piping. Backwash connections are provided at flange connections to vent line (backwash outlet) and underdrain (backwash inlet).

With the exception of GAC discharge piping, all piping shall be carbon steel piping, constructed of ASTM A53 carbon steel rated for 100 spig at 220 degrees F for water service. Pipe shall be threaded Schedule 80 pipe, fittings and unions are 150 pound ASTM A197 malleable iron, with unions having integral iron seat and threaded ends. Flanges shall be 150 pound ANSI B16.5, ASTM A181, Grade I, forged carbon steel. Gaskets, as required, shall be provided as red rubber.

GAC discharge piping to the shut-off valve shall be polypropylene lined steel pipe, rated for 150 psig service at 75 degrees F.

Valving for all services, with the exception of the GAC discharge valve shall be ductile iron regular port ball valves with chrome plated steel ball, TFE seats, graphite stem packing and steel wrench handle. The granular activated carbon discharge piping shall be provided with a TFE lined plug valve.

The granular activated carbon fill and discharge piping shall be equipped with 2" nylon male "Kamlok" style hose connectors for hose transfer operations. Flush connections, consisting of 3/4" hose connectors and 3/4" ball valves shall be provided between the plug valves and hose connectors.

The system vent line shall be equipped with a rupture disk for emergency pressure relief. The rupture disk shall be constructed of impervious graphite and shall be designed to relieve pressure at 75 psig +0/-5 percent.

2.1.2.4 Steel Skid Installation

Two (2) sets of two (2) adsorbers and all associated piping shall be preassembled on steel skids for unitized shipment and installation. The steel skid shall be constructed of C6x13 channel iron with holes provided in the corner gussets for installation on a flat surface (or piers) as required. The system shall be anchored by anchor bolts, clamps, or bolts added after the system is set. Connections to the skid piping network shall be the only additional field installation required.

2.2 GRANULATED ACTIVATED CARBON

The contactor vessels shall be factory filled with granulated activated carbon meeting the following specifications:

a.	Iodine Number (min.)	900
b.	Abrasion Number (min.)	75
c.	Moisture (max.)	2.0%
d.	Effective Size (mm)	0.8-1.0
e.	Water Soluble Ash (max.)	0.5%
f.	U.S. Standard Series Sieve Size:	
	Larger than No. 8 (max.)	15%
	Smaller than No. 30 (max.)	4%

PART 3 - EXECUTION

3.1 INSTALLATION

Installation procedures shall be in accordance with the recommendations of the manufacturer of the material being installed. Installation of the item will not be allowed to proceed until the recommendations are received.

3.2 MANUFACTURER'S REPRESENTATIVE

The carbon adsorption equipment manufacturer shall provide the services of a factory trained representative for four (4) full working days to inspect, test, and start-up the installation and to instruct operating personnel on the operation and maintenance of the equipment.

3.3 FIELD TESTING AND INSPECTION

All work shall be in accordance with the drawings and specifications. All defects disclosed by the tests shall be corrected by the Contractor. Equipment shall be subjected to an operational test to demonstrate compliance with specification requirements. The NTR shall be notified in writing 14 days prior to field testing. Tests shall be conducted under design conditions to ensure proper operation of all equipment. All appliances, materials, and equipment for testing shall be provided by the Contractor, and all expenses in connection with the testing shall be borne by him. Testing shall be conducted after all equipment is properly installed, electrical services are installed, and the denitrification systems are ready for operation. All defects discovered shall be corrected to the satisfaction of the NTR and all tests repeated, at the expense of the Contractor, until equipment is in proper working order.

-- End of Section --

SECTION 11310

SPENT BACKWASH HOLDING TANK AND APPURTENANCES

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 176-91	Specifications for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA D-103	Factory-Coated Bolted Steel Tanks for Water Storage

1.2 DESCRIPTION OF WORK

Provide, furnish and install a complete and ready for operation spent backwash holding tank (T-205) and appurtenances.

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

Provide manufacturer's data for the spent backwash holding tank and appurtenances.

1.3.2 SD-04, Drawings

Prior to obtaining any equipment in connection with this section, the Contractor shall submit detailed shop drawings of the spent backwash holding tank and related equipment including:

a. External connections
b. Liquid level controls mounting bracket
c. Anchor bolt sizing and placement
d. Tank finish
e. Tank grounding
f. Tank foundation/support requirements

Shop drawings shall include quantity, size, material and locations of all equipment. Shop drawings shall include wiring diagrams of level control equipment.

1.3.3 SD-06, Instructions

Two printed copies of the installation procedures shall be furnished to the NTR prior to installation. Failure to furnish these recommendations may be cause for rejection of the equipment.

1.3.4 SD-19, Operation and Maintenance Manuals

Provide O&M manuals for the spent backwash holding tank level control system. Data Package 3.

1.4 EQUIPMENT DELIVERY, STORAGE, HANDLING

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the equipment.

1.5 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "General Electrical Requirements".

PART 2 - PRODUCTS

2.1 GENERAL TANK REQUIREMENTS

The spent backwash holding tank shall be constructed of glass lined steel panels capable of resisting site contaminants (volatile organics) at dilute concentrations. Tank shall meet the standards of AWWA D-103.

2.2 SPENT BACKWASH HOLDING TANK

2.2.1 Dimensions

The spent backwash holding tank (T-205) shall be 13'-0" diameter by 23'-0" overall height with a nominal capacity of 20,000 gallons. The tank shall be a flat bottomed with a conical roof (10 degree slope) suitable for outdoor use.

2.2.2 Cover

The tank shall be equipped with a stainless steel conical bolt-down cover. The cover shall be designed with a manway to provide access to the tank interior. The cover shall be furnished with one (1) 6" diameter vent to the atmosphere.

2.2.3 Flanged Lip

A flanged lip shall be furnished with the tank to allow for installation of the conical bolt-down cover.

2.2.4 Flange Connections

One (1) 8" diameter conically gussetted flange connection shall be furnished on the outside tank sidewall for connection of a 4" diameter effluent pipe.

One (1) 8" diameter conically gussetted flange connection shall be furnished on the outside tank sidewall for connection of the sand filter/ liquid-phase carbon units backwash discharge line.

One (1) 4" diameter conically gussetted siphon drain flange connection shall be furnished on the outside tank sidewall for connection of a drainage line.

2.2.5 Lift Lugs

Two (2) lift lugs shall be furnished with the service tank to facilitate on-site handling.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

Installation procedures shall be in accordance with the recommendations of the manufacturer of the material being installed. Installation of the item will not be allowed to proceed until the recommendations are received.

3.2 INSTALLATION

The tanks shall be installed true and level. Precision gauges and levels shall be used in setting all tanks.

Tank and supports shall be grounded to the grounding grid.

Electrical and instrumentation equipment shall be grounded in accordance with local electrical requirements.

-- End of Section --

SECTION 11311

TREATED EFFLUENT TANK AND APPURTENANCES

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A-167-91	Specifications for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet and Strip

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA D-103	Factory-Coated Bolted Steel Tanks for Water Storage

1.2 DESCRIPTION OF WORK

Provide a complete and ready for operation a Treated Effluent Tank (T-240) and appurtenances to provide a complete and functional system.

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

Provide manufacturer's data on the Treated Effluent Tank and level control equipment.

1.3.2 SD-04, Drawings

Prior to obtaining any equipment in connection with this section, the Contractor shall submit detailed shop drawings of the Treated Effluent Tank and related equipment including:

a. Conical bolt down cover
b. Vent
c. External connections
d. Liquid level controls mounting brackets
e. Anchor bolt sizing and placement
f. Tank finish
g. Tank grounding

h. Tank foundation/support requirement

Shop drawings shall include quantity, size, material, and locations of all equipment. Shop drawings shall include wiring diagrams of level control equipment.

1.3.3 SD-06, Instructions

Two printed copies of the installation procedures shall be furnished to the NTR prior to installation. Failure to furnish these recommendations may be cause for rejection of the equipment.

1.3.4 SD-19, Operation and Maintenance Manuals

Provide O&M manuals for the Treated Effluent Tank control system. Data Package 3.

1.4 EQUIPMENT DELIVERY, STORAGE, HANDLING

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the equipment.

1.5 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "General Electrical Requirements."

PART 2 - PRODUCTS

2.1 TREATED EFFLUENT TANK

2.1.1 Dimensions

The Treated Effluent Tank (T-240) shall be 15'-0" overall diameter by 28'-0" overall height with a nominal capacity of approximately 30,000 gallons. The Treated Effluent Tank shall be constructed of carbon steel. The tank shall meet the standards of AWWA D-103.

2.1.2 Cover

The tank shall be equipped with a conical bolt-down cover. The cover shall be designed with a manway to provide access to the tank interior. The cover shall be furnished with a 6" diameter non-gussetted flange vent to atmosphere.

2.1.3 Flanged Lip

A flanged lip shall be furnished with the tank to allow for installation of a bolt-down cover.

2.1.4 Flange Connections

Conically gussetted flange connections of the sizes shown on the drawings shall be furnished on the outside tank sidewall for connection of influent,

and effluent, and backwash lines.

2.1.5 Downpipe

A 6" diameter feedpipe shall be installed inside the tank. Brace supports shall be furnished as part of the installation in accordance with the manufacturer's recommendations.

2.2 CONTROL SYSTEM

Control systems for the Treated Effluent Tank shall be as indicated. Level sensors shall be conductivity based.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

Installation procedures shall be in accordance with the recommendations of the manufacturer of the material being installed. Installation of the item will not be allowed to proceed until the recommendations are received.

3.2 INSTALLATION

The tank shall be installed true and level. Precision gauges and levels shall be used in setting the tank. Tank shall be properly anchored to the tank pad in accordance with the manufacturer's recommendations.

Tank and supports shall be grounded to the grounding grid.

Electrical and instrumentation equipment shall be grounded in accordance with local electrical standards.

-- End of Section --

SECTION 11313

SLUDGE THICKENING TANK AND APPURTENANCES

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167-91	Specification for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet and Strip

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA D-103	Factory-Coated Bolted Steel Tanks for Water Storage

1.2 DESCRIPTION OF WORK

The sludge thickening tank and appurtenances shall be furnished and installed to provide a complete and functional system.

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

Provide manufacturer's data on the sludge thickening tank, level control equipment and floating skimmer assemblies.

1.3.2 SD-04, Drawings

Prior to obtaining any equipment in connection with this section, the Contractor shall submit detailed shop drawings of all sludge thickening tank related equipment including:

a. Bolt down cover
b. Vent
c. External connections
d. Liquid level controls mounting bracket
e. Anchor bolt sizing and placement
f. Tank finish
g. Tank grounding
h. Tank foundation/support requirements

i. Floating skimmer assembly

Shop drawings shall include quantity, size, material, and locations of all equipment. Shop drawings shall include wiring diagrams of level control equipment.

1.3.3 SD-06, Instructions

Two printed copies of the installation procedures shall be furnished to the NTR prior to installation. Failure to furnish these recommendations may be cause for rejection of the equipment.

1.3.4 SD-19, Operation and Maintenance Manuals

Provide O&M manual for the sludge thickening tank, control equipment and floating skimmer assemblies. Data Package 3.

1.4 EQUIPMENT DELIVERY, STORAGE, HANDLING

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the equipment.

1.5 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "General Electrical Requirements."

PART 2 - PRODUCTS

2.1 GENERAL TANK REQUIREMENTS

The sludge thickening tank (T-140) shall be constructed of carbon steel and glass lined to resist site contaminants (volatile organics) at dilute concentrations. Tank shall meet the requirements of AWWA D-103.

2.2 SLUDGE THICKENING TANK

2.2.1 Dimensions

The sludge thickening tank shall be approximately 6'-0" diameter by 11'-0" overall height with a nominal capacity of 2,000 gallons. The sludge thickening tank shall be a 30 degree cone bottom, flat top tank, furnished with a hinged bolt-down cover. The tank shall be constructed of carbon steel.

2.2.2 Cover

The tank shall be equipped with a bolt-down cover. The cover shall be furnished with a 2" diameter conically gussetted flange connection on the inside and outside of the tank cover at the location shown on Drawings. This connection will be used to connect a 2" diameter sludge inlet pipe to the tank.

2.2.3 Flanged Lip

A flanged lip shall be furnished with the tank to allow for installation of a bolt-down cover.

2.2.4 Flanges

A 2" diameter conically gussetted external flange with a 2" diameter non-gussetted internal flange shall be furnished for connection of a floating skimmer assembly.

A 4" diameter conically gussetted flange connection shall be furnished on the tank cone bottom for connection of the filter press feed line.

Two (2) 6" diameter non-gussetted flange connections shall be furnished on the tank cover for connection of an air inlet vent and an air exhaust vent to ductwork.

2.2.5 Downpipe

A 2" diameter, 4' long carbon steel downpipe shall be installed on the inside tank sidewall. The downpipe will accommodate the 2" diameter sludge inlet pipe to the sludge thickening tank. Two (2) brace supports shall be furnished as part of the installation in accordance with the manufacturer's recommendations.

2.2.6 Legs

The sludge thickening tank shall be equipped with three (3) steel pipe angles allowing 12 inch clearance.

2.2.7 Lift Lugs

Two (2) lift lugs shall be furnished with the sludge thickening tank to facilitate on-site handling.

2.3 FLOATING SKIMMER ASSEMBLY

The sludge thickening tank shall be equipped with a floating skimmer assembly that will function as a supernatant overflow. The floating skimmer assembly shall be designed to collect supernatant as the level of sludge and supernatant vary within the tank.

The floating suction strainer shall consist of a hard plastic strainer housing a polyurethane foam to provide buoyancy over molded hard plastic housing for removable strainer plates.

The strainer shall be attached to a ten-foot long rubber hose with two stainless steel clamps.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

Installation procedures shall be in accordance with the recommendations of the manufacturer of the material being installed. Installation of the item will not be allowed to proceed until the recommendations are received.

3.2 INSTALLATION

Precision gauges and levels shall be used in setting the tank. Tank shall be anchored to the building floor in accordance with the manufacturer's recommendation. Tanks and supports shall be grounded to the grounding grid.

Electrical and instrumentation equipment shall be grounded in accordance with local electrical codes.

-- End of Section --

SECTION 11314

DEWATERING PRESS

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167-91	Specifications for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet and Strip
ASTM A 53-90b	Specifications for Pipe, Steel, Black, and Hot-Dipped, Zinc Coated Welded and Seamless.
ASTM A 197-87	Specifications for Cupola Malleable Iron
ASTM A 181	Specification for Forgings, Carbon Steel for General Purpose Piping

1.2 DESCRIPTION OF WORK

The dewatering press (X-140) and appurtenances shall be furnished and installed to provide a complete and functional system.

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

Provide manufacturer's data for the dewatering press and related control equipment, safety features, and appurtenances.

1.3.2 SD-04, Drawings

The Contractor shall submit for approval shop drawings of the dewatering press layout and installation. These drawings shall be submitted prior to ordering any equipment.

1.3.3 SD-06, Instructions

Two printed copies of the installation procedures shall be furnished to the NTR prior to installation. Failure to furnish these recommendations may be cause for rejection of the equipment.

1.3.4 SD-19, Operation and Maintenance Manuals

Provide O&M manuals for the Dewatering Press and control systems. Data Package 3.

1.4 DELIVERY, STORAGE, AND HANDLING

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.5 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "General Electrical Requirements".

PART 2 - PRODUCTS

2.1 DEWATERING PRESS

2.1.1 Dewatering Press Description

The dewatering press (X-140) shall be a fully mechanized, hydraulically opened and closed, side bar plate support, caulked, gasketed and recessed plate, floor standing filter press designed to efficiently dewater metal hydroxide slurry for handling as a dry cake and shall include all components necessary for a complete operating unit as specified herein. All components shall be new, free of defects or mechanical damage and in operating condition.

The dewatering press shall be manufactured to meet the following design parameters:

Design Operating Pressure	100 psi
Total Volume	6 ft^3 (expandable to 8 ft^3)
Total Filtration Area	133 ft^2 (expandable to 178 ft^2)
Plate Size	630 x 630 mm
Number of Chambers	21 (expandable to 28)
Cake Thickness	1.25 inches (32 mm)

Volume per Chamber	0.28 ft^3
Filtration Area per Chamber	6.35 ft^2

2.1.2 Dewatering Press Components

The dewatering press shall be supplied complete in all respects and shall be supplied with the following components, features, appurtenances, and accessories.

a. Polypropylene, gasketed recessed chamber plates

b. Fabricated steel skeleton

c. Automatic, pneumatic-hydraulic opening and closing system

d. Filter press controls

e. Sidebar plate suspension system

f. Semi-automatic, pneumatic plate shifting system

g. Air blow feed and discharge liner pipes with manifold.

h. Bombay doors with integral drainage launder.

i. Safety guard on non-operating side of filter press.

2.1.2.1 Dewatering Press Skeleton

The dewatering press skeleton and related sub-components shall be designed to maintain the filter pack in a closed position against an internal operating pressure of 100 psi plus a minimum clamping factor of 25% greater than the maximum internal operating pressure multiplied times the filter area of the tail filter plate. Minimum closure force shall be 28 tons.

The dewatering press frame shall be fabricated of ASTM A 36 carbon steel plate and structures. Weldments shall be totally enclosed box construction for maximum strength and ease of maintenance. All weldments shall be designed to evenly distribute the operational forces developed during filtration over the entire component. All components shall be continuously welded with a fillet weld for maximum strength. Intermittent welding of joints shall not be acceptable. Enclosed compartments within the head end weldment shall have drain holes. All components shall be designed with a minimum safety factor of 1.5 times the maximum closure force. Critical assembly points such as sidebar/end weldment shall be machined to close tolerances to ensure uniform load distribution at all stress bearing areas.

All edges and welds shall be deburred and ground smooth. All weld splatter, weld slag, and mill scale shall be removed before painting.

The head end weldment and the cylinder bracket shall be connected at two points each. Two side bars of hot rolled steel shall connect the head and cylinder bracket at the horizontal centerline of the plate pack so as not to interfere with cake discharge. Each connection point shall be designed with a minimum safety factor of 1.5 times the maximum closure force.

Each connection point shall have the intersecting components machined to tolerances that shall ensure proper fit.

The side bars shall be of sufficient size and weight to support the full operational weight of the filter plate pack including the follower head, plate pack, plate shifter, and filter cake with a maximum deflection of 1/900 of the length of the filter press assembly.

To prevent corrosion of the sidebars due to surface finish erosion, the side bars shall come completer with 304 SS wear strips on the contact surface with plate suspension handles and follower head rollers.

The follower head sub-assembly shall be suspended from the side bars. The follower shall ride on rollers on stainless steel axles. Grease nipples shall be provided on the axles for periodic interspacial flushing of the roller/axle assembly.

All non-stainless steel metallic surfaces shall be finished for maximum corrosion resistance in accordance with manufacturer's recommendations.

2.1.2.2 Filter Plates

Filter plates shall be off the center feed, alternating corner discharge design for operation at 100 psi pressure at ambient temperature. Plates shall be of the gasketed design. Gasketing shall be on the perimeter sealing surface and around each of the corner eyes. Plates shall come complete with filter cloths installed.

Recessed plates shall be molded from virgin, gray polypropylene and shall contain no fillers. Plates shall have a drainage surface design that shall provide adequate support for filter cloths and shall have integrally molded stayboss supports equally spaced on the drain field. Plate sealing surfaces shall be machined to a maximum parallel plane tolerance of 0.3 mm. Chamber recess depth dimension shall have a tolerance not to exceed 0.5mm.

Plates shall have a round bottomed caulking groove machined around the perimeter of each drainfield for installation of filter cloths. Grooves of the dovetail design shall be machined around each corner port and around the cake chamber on the sealing surface for the installation of gasketing.

2.1.2.3 Filter Cloths

Provide two sets of filter cloths for the dewatering press. Filter cloths shall be made of polypropylene fabric.

Cloths shall be held in place on the filter plates by a woven, high density polypropylene cord sewn into the perimeter of the cloth. It shall be pressed or caulked into place on the filter plate and held there by an interference fit.

Gasketing shall be molded of EPDM elastomer compound and shall be of the O-ring-type design. Gasketing shall have a minimum 70 A durometer hardness.

2.1.2.4 Core Blow Connections

Provide the press with a flexible air hose and manual air shut-off valve and check valve to blow the center core back to the process. The air shall be introduced into the follower and shall have all piping rigidly mounted and easily accessible on the frame of the filter press.

2.1.2.5 Air Blow Down Manifold

Provide discharge piping containing a valve manifold. The manifold shall be designed to allow air to be blown through the press to remove any residual moisture at the end of the filtration cycle. Valves shall be of the type most commonly supplied by the press manufacturer.

2.1.2.6 Pneumatic/Hydraulic Closure System

The pneumatic/hydraulic opening and closing system shall include one (1) double acting hydraulic cylinder and one (1) hydraulic power pack. The system shall be designed to automatically compensate for any thermal expansion or contraction of the plate stack as well as maintain the proper clamping force throughout the process cycle.

The hydraulic cylinder shall be capable of producing 28 tons of clamping pressure at an hydraulic input pressure of 100 psi. The cylinder shall have a 4 inch diameter bore and a 18 inch stroke to provide a filter pack cake discharge cleanout space of 16 inches. The cylinder shall be of the tie rod design for ease of servicing hydraulic seals. The piston rod shall be covered by a flexible neoprene bellow to protect the rod from contamination. The piston rod shall be connected to the follower head by means of a rod eye and clevis arrangement that allows follower head movement only in a vertical plane perpendicular to the length of the press. The rod eye and clevis shall be equipped with grease fittings. The cylinder, rod eye and clevis shall be designed with a minimum safety factor of 3.0 times the maximum cylinder capacity. The cylinder shall meet all JIC requirements.

The pneumatic/hydraulic power pack shall contain an air driven hydraulic pumping module that shall clamp the press by pressurizing the hydraulic system after the plate pack is fully closed. The hydraulic pumping module shall be designed to only operate after the hydraulic cylinder has been fully extended through the use of a pressurized oil reservoir. To minimize the use of the hydraulic pumping module, the press shall be opened by means of pressurizing the retraction stroke of the cylinder with compressed air. All hydraulic tubing, subject to system pressure, within the power pack and to and from the cylinder shall be of 304 SS and shall have minimum burst pressure rating of 3.5 times the maximum operating pressure of the power pack. The power pack shall be fully enclosed in a fabricated steel cabinet for protection from damage and shall be easily accessible for maintenance from a full width hinged cabinet door. All components shall be modular for ease of maintenance. Air requirements shall be 100 scfm at 100 psi.

2.1.2.7 Controls

The filter press control panel shall be mounted to the hydraulic cylinder bracket and shall be NEMA 4. The control panel shall contain all necessary

motor starters, relays, wiring and/or transformers. The panel shall come complete with a panel mounted PLC control with a four line LED readout and a touch-sensitive membrane switch pad. An emergency stop mushroom button also shall be included. The following functions shall be controlled from the panel:

a. Air supply, on/off

b. Filter press, open/close

c. Hydraulic pump, on/off

d. Bombay doors, open/close/auto

e. Automatic feed pump system, on/off/auto

f. Core blow valve sequence, on/off/auto

g. Air blow down valve sequence, on/off/auto

2.1.2.8 Plate Shifter

The dewatering press shall be supplied with a semi-automatic plate shifter system that shall be designed to assure each plate is straightened and is perpendicular to the side bars prior to shifting. To maintain proper alignment, the shifter shall have rollers (V-notch on one side and spool type on the opposite) with sealed roller bearings and stainless steel shafts. The rollers shall ride on 304 stainless steel rails. The plate shifter shall operate in a semi-automatic mode, requiring operator initiation of each plate shifting sequence. The plate shifting shall be accomplished with pneumatic operators. The plate shifter shall have the capability to shift individual or multiple plates per shifting sequence.

2.1.2.9 Feed and Discharge Piping

Feed and discharge liner piping shall be supplied. The Contractor shall provide the connections through the head from the center feed slurry port and the corner filtrate discharge ports in the filter pact through the stationary head. All threads shall be NPT standard.

The feel and discharge manifolding shall be of the air blow type.

2.1.2.10 Future Expandability

A distance piece shall provide for the future expansion of the filter press capacity to 8 cubic feet. The distance piece shall be make of ASTM A 36 carbon steel and mount between the hydraulic cylinder piston rod and the piston rod end. The distance piece shall be supported by a roller assembly from the sidebars to prevent undue stress on the piston rod. Filter press capacity expansion shall be accomplished by removal of the distance piece and installing additional filter plates in its place.

2.1.2.11 Bombay Doors With Drainage Launder

One set of automatically actuated bombay door style drip trays shall be provided. the trays shall consist of two shelf sections that are located under the filter pack and run the length of the press. The purpose of the trays shall be to direct dripping filtrate to a drain.

The tray frame shall be of structural steel with 14 gauge 304 stainless steel panels. The trays shall open downward to a vertical position to allow discharge of the filter cake without interference.

The trays shall be mounted to the stationary head and cylinder bracket legs. Pivot bearings shall mount the trays to the legs.

Actuation of trays shall be by means of a double acting hydraulic cylinder. The cylinder shall meet all JIC standards. Filter press controls shall automatically interlock drip tray closure with opening and closing of the press. A manual override shall be provided for maintenance purposes.

A drainage launder shall be provided as an integral component of the lower drip tray. Discharge capacity of the launder shall be not less than 80 gpm. Launder materials shall be as that of the drip trays.

2.1.3 Dewatering Press Accessories

2.1.3.1 Safety Screen

A steel framed expanded metal safety screen 6 feet tall shall be provided for the non-operating side.

2.1.3.2 Cake Dumpster

Provide one cake dumpster capable of holding a minimum of eighteen (18) cubic feet of filter cake. The dumpster shall have ball bearing casters and have a fork lift self-dumping feature.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

Installation procedures shall be in accordance with the recommendations of the manufacturer of the material being installed. Installation of the item will not be allowed to proceed until the recommendations are received.

3.2 INSTALLATION

Precision gauges and levels shall be used in setting all equipment.

Dewatering press manufacturer shall furnish the services of a qualified and experienced representative for two (2) eight hour working days to inspect, test, and start-up the installation and to instruct operating personnel in the generation and maintenance of component equipment.

-- End of Section --

SECTION 11315

PUMPS: WATER, CENTRIFUGAL

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 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 283	(1988) Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 307	(1990) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM D 975	(1990) Diesel Fuel Oils

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(1989; B1.1a-1984) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	(1988; Errata Oct 1988) Pipe Flanges and Flanged Fittings
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C203	(1986) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	(Jul 1986) Rules and Regulations: Radio Frequency Devices

FEDERAL SPECIFICATION (FS)

FS TT-E-489	(Rev H) Enamel, Alkyd, Gloss, Low Voc Content FEDERAL STANDARD (FED-STD) FED-STD 595 (Rev B) Colors HYDRAULIC INSTITUTE (HI) HI-01 (1983; 14th Ed) Standards for Centrifugal, Rotary & Reciprocating Pumps

MILITARY SPECIFICATIONS (MS)

MS MIL-R-7575	(Rev C; Am 2; Notice 1) Resin, Polyester, Low-Pressure Laminating
MS MIL-Y-1140	(Rev H; Am 1) Yarn, Cord, Sleeving, Cloth, and Tape-Glass

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1987; Rev 1) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1990) Flammable and Combustible Liquids
NFPA 70	(1990) National Electrical Code

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC-Paint 16	(1982) Coal-Tar Epoxy-Polyamide Black (or Dark Red) Paint
SSPC-SP 6	(1989) Commercial Blast Cleaning
SSPC-SP 8	(1982) Pickling
SSPC-SP 10	(1989) Near-White Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL 448	(Nov 27, 1984; 7th Ed; Rev thru Sep 19, 1990) Pumps for Fire Protection Service

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.2.2 Description

The pumps shall be horizontal and vertical centrifugal water pumps of the types indicated and specified herein. The single driving units for the pumps shall be electric motors as indicated and specified.

1.2.3 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.

1.2.4 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.

1.2.5 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 16402, "INTERIOR WIRING SYSTEMS". Electrical characteristics shall be as indicated. 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.

1.2.6 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.

1.2.7 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 NTR.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

Materials and Equipment;

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 2 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.

1.3.2 SD-04, Drawings

Centrifugal Pump System;

A complete listing of equipment and materials. 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.

1.3.3 SD-19, Operation and Maintenance Manuals

Provide O&M package for centrifugal pump systems. Data Package 3.

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 the centrifugal, horizontal single-stage or multi-stage type, designed for waterworks service in the configurations and capacities listed below.

2.2.1 Pump Characteristics

Groundwater Feed Pumps (P-110 A/B): Each shall draw water from the groundwater feed tank (T-110) at a maximum rate of 430 GPM and overcoming 40 feet total head.

pH Adjustment Pumps (P-130 A/B): Each shall draw water from the initial pH adjustment tank (T-130) at a maximum rate of 430 GPM and overcoming 40 feet total head.

Air Stripper Feed Pumps (P-200 A/B): Each shall draw water from the final pH adjustment tank (T-200) at a maximum rate of 430 GPM and overcoming 100 feet total head.

Air Stripper Effluent Pumps (P-220 A/B): Each shall draw water from the air stripper effluent holding tank (T-220) at a maximum rate of 430 GPM and overcoming 80 feet total head.

Backwash Water Pump (P-205): Shall draw water from the backwash holding tank (T-205) at a rate of 250 GPM when overcoming 120 feet total head.

Pumps shall operate at optimum efficiencies to produce the most economical pumping system under the conditions encountered. 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. The shutoff total head shall be not greater than 120 percent of total rated head.

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):

Groundwater Feed Pump Motors (2)

Rated speed: 1,760 rpm
Rated horsepower: 10 hp
Rated voltage: 480 VAC
Phase: 3

pH Adjustment Pump Motors (2)

Rated speed: 1,760 rpm
Rated horsepower: 10 hp
Rated voltage: 480 VAC
Phase: 3

Air Stripper Feed Pump Motors (2)

Rated speed: 1,760 rpm
Rated horsepower: 20 hp
Rated voltage: 480 VAC
Phase: 3

Air Stripper Effluent Pump Motors (2)

Rated speed: 1,760 rpm
Rated horsepower: 15 hp
Rated voltage: 480 VAC
Phase: 3

Backwash Water Pump Motor (1)

Rated speed: 1,760 rpm
Rated horsepower: 10 hp
Rated voltage: 480 VAC
Phase: 3

2.2.3 Pump Construction

Except as below specified, centrifugal water pumps including required priming equipment shall be constructed in accordance with the Hydraulic Institute HI-01.

2.3 PUMP CASINGS

Pump casings shall be cast iron, horizontal shaft, and vertical or horizontal split casing, of the following design:

The casings shall be designed to permit replacement of wearing parts. Horizontal-split casings shall have the suction and discharge nozzles cast integrally with the lower half, so that the upper part of the casings may be removed for inspection of the rotating parts without disturbing pipe connections or pump alignment. 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 or double 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. A brass or bronze umbrella or vent cock shall be furnished for venting except where automatic air vents are indicated. Drain openings in the volute, intake, or other passages capable of retaining trapped water shall be located in the low point of such passages.

2.3.1 Impellers

Impellers shall be of enclosed design and shall be constructed of bronze carefully finished with smooth water passageways, and shall be statically and dynamically balanced. Impellers shall be securely keyed to the pump shaft. Impellers on vertical-split pumps shall be additionally secured with a self-locking nut.

2.3.2 Wearing Rings

Wearing rings of bronze shall be provided for impellers. Wearing rings of a different composition or of a suitable ferrous material shall be provided for pump casings. Casing rings shall be securely fixed in position to prevent rotation. Rings shall be renewable and designed to ensure ease of maintenance.

2.3.3 Shaft

Shaft shall be of high grade steel, accurately machined, and shall be of sufficient size and strength to perform the work required. Bronze renewable shaft sleeves shall be provided for protection of the shaft in contact with water, and in the stuffing boxes. Shaft sleeves shall be keyed to the pump shaft.

2.3.4 Packing Seals

Packing shall be non-asbestos. Pump shall be shipped to the site without the packing inserted and shall be packed onsite in the presence of the pump or packing manufacturer's representative. At no time during startup or run-in shall the gland drip less water than 80 drops per minute. After not less than 40 operating hours and upon permission of the NTR, leakage rate may be reduced to 50 drops per minute or to the rate recommended by packing manufacturer.

2.3.4.1 Gland

Gland shall be split-bronze type with AISI 18-8 stainless steel eyebolts and pins or studs. Hex-nuts shall be bronze or nongalling stainless steel.

2.3.4.2 Stuffing boxes

Stuffing boxes exposed to below atmospheric pressure at any operating condition, including starting, shall be provided with a water seal. Water seal shall consist of nonferrous lantern ring or a seal cage and required connections to the pump case.

2.3.5 Mechanical Seals

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.

2.3.6 Couplings

Couplings shall be of the heavy-duty flexible type, keyed and locked to the shaft. The outside surface of the couplings for horizontal pumps and close-coupled vertical pumps shall be machined parallel to the axis of the shaft. The faces of the couplings shall be machined perpendicular to the axis of the shaft. Disconnecting the couplings shall be accomplished without removing the driver half or the pump half of the couplings from 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.

2.3.7 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 1/2 percent of W times R squared, where W equals weight and R equals impeller radius. 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.

2.3.8 Bearings

Bearings shall be ball or roller type, and the main bearings shall take all radial and end thrust. Pumps that depend only on hydraulic balance to overcome end thrust will not be acceptable.

2.3.9 Lubrication

Bearings on horizontal-shaft pumps shall be either oil-bath type or grease type. Each oil reservoir shall be liberal in size and provided with an opening for filling, an overflow opening at the proper location to prevent overfilling, an oil-level sight glass, and a drain at the lowest point. 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.

2.3.10 Base Plates

Horizontal-shaft centrifugal pumps shall be provided with a common base for mounting each pump and driving unit of the pump on the same base. Each base shall be constructed of cast iron with a raised lip tapped for drainage, or of welded steel shapes with suitable drainage pan. Horizontal-shaft end suction pumps shall be mounted on a factory furnished channel steel frame. With the exception of close-coupled Pumps, horizontal-shaft end suction pumps shall be frame mounted. The drainage structure shall collect the packing box leakage and shall have a 1/2-inch NPT connection to connect it to a drain.

2.3.11 Cocks, Plugs, and Accessories

The pumps shall be equipped with air cocks, drain plugs, and single gauges indicating discharge pressures for all pumps and suction pressures for pumps without suction lift. Gauges, equipped with a shutoff cock and snubber, shall conform to ASME B40.1, and shall be calibrated in pounds per square inch and feet of water in not more than 2 psi, 5-foot, increments. Gauge ranges shall be appropriate for the particular installation. Normal operating suction and discharge pressures of the pump shall be indicated on the mid-point range of the gauges. Pressure relief valve shall be furnished and installed where indicated.

2.3.12 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. Provide eccentric reducers as necessary to make pump connections compatible with piping arrangement shown.

2.3.13 Finish

Pump shall have rust-inhibiting painted or enameled finish as is standard with the manufacturer.

2.4 ELECTRICAL EQUIPMENT

Electrical equipment shall conform to Section 16402, "INTERIOR WIRING SYSTEMS". 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.

2.4.1 Electric Motors

Each electric motor-driven pump shall be driven by a weather-protected, totally-enclosed fan cooled continuous-duty electric motor. Motor shall have a 1.15 service factor. 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 and under variable pumping head conditions specified. Motors shall be rated 480 volts, 3 phase, 60 Hz and such rating shall be stamped on the nameplate.

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 tanks and shall shut the pump off when the water level in the well reaches the level shown.

2.5 EQUIPMENT APPURTENANCES

2.5.1 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 B1.1. Bolts, nuts, and washers specified to be galvanized or not otherwise indicated or specified, shall be zinc coated after being threaded, by the hot-dip process conforming to ASTM A 153 as appropriate. Bolts, nuts, and washers specified or indicated to be stainless steel shall be Type 316.

2.5.2 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.

2.5.3 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 also shall 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 NTR.

2.5.4 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 shall be installed in accordance with the written instructions of the manufacturer and under the direct supervision of the manufacturer's representative.

3.1.1 Concrete Foundations

Concrete for equipment foundations shall be as specified in Section 03302, "CAST-IN-PLACE CONCRETE (MINOR 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 3,000 psi shall be used in foundations that are entirely separated from the surrounding floor. An expansion joint shall be installed between the foundation and floor slab. Foundation bolts, as required, shall be furnished for proper positioning during the placement of the concrete.

3.2 TESTS

3.2.1 Field Equipment Test

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 NTR 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 NTR. 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 in accordance with the enamel paint manufacturer's recommendations.

3.4 MANUFACTURER'S FIELD SERVICES

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 3 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 NTR, the services of one or more competent engineers shall be provided by the Contractor for a period of not less than 4 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 11316

AIR OPERATED PUMPS

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 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 283	(1988) Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 307	(1990) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM D 975	(1990) Diesel Fuel Oils

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(1989; B1.1a-1984) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	(1988; Errata Oct 1988) Pipe Flanges and Flanged Fittings
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

FEDERAL SPECIFICATION (FS)

FS TT-E-489	(Rev H) Enamel, Alkyd, Gloss, Low Voc Content

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC-Paint 16	(1982) Coal-Tar Epoxy-Polyamide Black (or Dark Red) Paint
SSPC-SP 6	(1989) Commercial Blast Cleaning
SSPC-SP 8	(1982) Pickling

SSPC-SP 10 (1989) Near-White Blast Cleaning

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.2.2 Description

The pumps shall be air driven positive displacement double-diaphragm pumps as specified.

1.2.3 Nameplates

Pumps 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. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.2.4 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 NTR.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

Materials and Equipment

Manufacturer's descriptive data and technical literature, performance charts and curves for all pump 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 2 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.

1.3.2 SD-04, Drawings

Positive Displacement Pump System

A complete listing of equipment and materials. Drawings containing complete 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.

1.3.3 SD-19, Operation and Maintenance Manuals

Provide O&M manual for air operated double-diaphragm pumps. Data package 3.

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 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 AIR OPERATED DOUBLE-DIAPHRAGM PUMPS

Pumps shall be provided complete and ready for operation from a manufacturer regularly involved in the manufacture of this product.

The Contractor shall provide four (4) air operated double-diaphragm pumps (P-140A & B, P-143, and P-141) with suction and discharge flange connections. Each pump shall be self-priming, capable of operating safely unattended.

Each unit shall be provided with quick opening ball check valves, neoprene diaphragms, air inlet, air cylinder, air pressure regulator, and control package.

2.2.1 Design Data

2.2.1.1 Sludge Recycle Pumps (P-140 A & B)

Maximum pumping capacity (water) - gpm	20
Maximum discharge head - ft.	30
Maximum sphere size passing (lined) - inch	1/8
Inlet size	1" male NPT
Outlet size	3/4" male NPT

Maximum air requirement	10 SCFM
Required air supply pressure	35 psig

2.2.1.2 Sludge Blow Down Pump (P-143)

Maximum pumping capacity (water) - gpm	10
Maximum discharge head - ft.	50
Maximum sphere size passing (lined) - inch	1/8
Inlet size	1" male NPT
Outlet size	3\4" male NPT
Maximum air requirement	4 SCFM
Required air supply pressure	30 psig

2.2.1.3 Filter Press Feed Pump (P-141)

Maximum pumping capacity (water) - gpm	50
Maximum discharge head - ft.	220
Maximum sphere size passing (lined) - inch	1/8
Inlet size	3" male NPT
Outlet size	3" male NPT
Maximum air requirement	63 SCFM
Required air supply pressure	100 psig

2.2.2 Pump Casing and Wetted Parts

The pump casing and other wetted parts shall be constructed of 316 stainless steel.

2.2.3 Air Valve

Air valve shall be provided and shall be of brass construction. An air valve cap of nylon construction shall be included.

2.2.4 Other Non-Wetted Parts

Center block, inner piston, and air chamber shall be of aluminum construction.

2.2.5 Pump Diaphragms

The pump diaphragms shall be constructed of neoprene, resistant to metal hydroxide sludges.

2.2.6 Suction and Discharge Check Valves

Suction and discharge check valves shall be ball check type of teflon construction. Valve seats (O-rings) also shall be teflon. Quick opening yoke shall be used for easy access to the valve internals. Valves shall be considered an integral part of the pump.

2.2.7 Logic Controller

A programmable logic controller (to be provided by dewatering press manufacturer) shall be used to adjust the air pressure to meet the discharge pressure requirement. As the discharge pressure changes, the controller increases or decreases the pump inlet pressure to meet demand. The maximum desired pressure is 100 PSIG and also is adjustable throughout its range. When the press cycle is complete the controller will accept a signal to relieve system pressure and reset the pump for the next cycle.

2.2.8 Finish

Pump assembly shall have a rust-inhibiting paint or enamel finish as is standard with the manufacturer.

2.2.9 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. 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 NTR.

PART 3 - EXECUTION

3.1 INSTALLATION

Each pump shall be installed in accordance with the written instructions of the manufacturer and under the direct supervision of the manufacturer's representative. Set, shim, and grout pump in strict accordance with the manufacturers published instructions.

3.1.1 Concrete Foundations

Concrete for equipment foundations shall be as specified in Section 03302, "CAST-IN-PLACE CONCRETE (MINOR 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 3,000 psi shall be used in foundations that are entirely separated from the surrounding floor. An expansion joint shall be installed between the

foundation and floor slab. Foundation bolts, as required, shall be furnished for proper positioning during the placement of the concrete.

3.1.2 Finishing

Set, shim, and grout pump in strict accordance with the manufacturers published instructions.

3.2 TESTS

3.2.1 Field Equipment Test

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 NTR for a minimum of 1 hour. Each pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the NTR. 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 in accordance with the enamel paint manufacturer's recommendations.

3.4 MANUFACTURER'S FIELD SERVICES

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 one (1) day of 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 NTR, the services of one or more competent engineers shall be provided by the Contractor for a period of not less than 4 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 13121

PREENGINEERED METAL BUILDINGS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S335	1989 Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	1988 Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	1991 Structural Steel
ASTM A 446/A 446M	1991 Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 463	1988 Steel Sheet, Cold-Rolled, Aluminum-Coated Type 1 and Type 2
ASTM A 755/A 755M	1989 Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating for Exterior Exposed Building Products
ASTM A 792M	1985 (Rev. A) Steel Sheet, Aluminum-Zinc Alloy-Coated by the Hot Dip Process (Metric)
ASTM B 117	1990 Salt Spray (Fog) Testing
ASTM B 209	1990 Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	1992 Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM E 84	1991 (Rev. A) Surface Burning Characteristics of Building Materials
ASTM E 96	1992 Water Vapor Transmission of Materials

ASTM G 23	1990 Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA LRMBSM	1986 Low Rise Metal Building Systems Manual

STEEL DECK INSTITUTE (SDEI)

SDEI DDM	1990 Steel Deck Institute Diaphragm Design Manual

UNDERWRITERS LABORATORIES INC. (UL)

UL 580	1988 (R 1989) Uplift Resistance of Roof Assemblies

1.2 DESCRIPTION OF BUILDING

1.2.1 Dimensions

Building dimensions shall be as standard with manufacturer, not less than those indicated, but exceeding the indicated dimensions only by the amount of the closest standard size thereto. Eave height shall be measured from the top of the eave strut at the sidewall steel line to the bottom of the rigid frame column base plate. The clear height between finished floor and bottom of roof steel shall be as indicated.

1.2.2 Framing

Provide building with vertical walls and gable roof. Building shall be single-span structures with rigid frame type, similar to AISC S335, Type I construction. End walls shall be of rigid frame. Roof slope shall be a minimum of 1/2 inch per foot to a maximum of 4 inches per foot. Design framed openings structurally.

1.2.3 Foundation Requirements

Design foundations for allowable soil bearing pressure and a minimum bottom of footing depth as indicated. Use a factor of safety of 1.5 for overturning, sliding and uplift, and a concrete compressive strength as specified in Section 03302, "Cast-in-Place Concrete, Minor Construction." The foundation loads are supplied by the building manufacturer.

1.3 EXPERIENCE

1.3.1 Manufacturer

Provide the metal building that is the product of a recognized metal building systems manufacturer who has been in the practice of manufacturing metal buildings for a period of no less than 5 years. The manufacturer shall be chiefly engaged in the practice of designing and fabricating metal

building systems. The manufacturer shall have AISC FCD, category MB certification.

1.3.2 Installer

Erector shall have specialized experience in the erection of metal building systems for a period of at least 3 years.

1.4 DESIGN REQUIREMENTS

MBMA LRMBSM, for loading combinations and definitions with the exceptions of wind load and special collateral loads. Design for each material shall be as specified by the Design Authority as listed in MBMA LRMBSM.

1.4.1 Roof Dead and Live Loads

Design loads shall include dead loads and live loads. The minimum roof design live load shall be 40 pounds per square foot (psf) applied on the horizontal projection of the roof.

Structural roof members shall be designed to withstand loads imposed by the chosen HVAC equipment.

1.4.2 Wind Loads

Wind pressures shall be computed and applied in accordance with ASCE 7. Basic wind speed of 80 miles per hour (mph) shall be used in computing the wind load.

1.4.3 Seismic Loads

As required for Seismic Zone 1.

1.4.4 Deflection

1.4.4.1 Structural Members

The maximum deflection of main framing members shall not exceed 1/240th of their respective spans. The maximum deflection due to live load in roof panels and purlins shall not exceed 1/180th of their respective spans.

1.4.4.2 Roof Panels

UL 580, Class 90. The design analysis shall establish that the roof when deflected under dead plus live or snow loads, will not result in a negative gradient. Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect. In addition, the roof decking shall be designed for a 200-pound concentrated load at midspan on a 12-inch wide section of deck.

1.4.4.3 Openings

Limit deflections of steel framing above and along the side of rolling door openings to a maximum of 1/2 the allowable movement in the telescoping top

roller of the doors to ensure proper operation. Frame all equipment openings over 12 inches by 12 inches.

1.5 SUBMITTALS

Submit the following in accordance with Section 7, Part C, of the Basic Contract.

1.5.1 SD-02, Manufacturer's Catalog Data

a. Preengineered metal building materials

Submit sufficient data indicating conformance to specified requirements on materials provided under this section.

1.5.2 SD-03, Manufacturer's Standard Color Charts

a. Factory color finish G

Submit one sample of each color indicated for verification that the color matches the colors indicated. Where colors are not indicated, submit not less than four different samples of manufacturer's standard colors for selection by the NTR.

1.5.3 SD-04, Drawings

a. Preengineered framing

b. Template for anchor bolts

c. Structural connections

d. Roofing connections

e. Roof penetrations and flashings

f. Accessories

Submit as necessary to erect the building and install components.

1.5.3.1 Preengineered Building

Submit complete design drawings for the preengineered building. Submit drawings for the foundations and anchorage.

1.5.4 SD-05, Design Data

a. Building

b. Foundation loads

c. Anchor bolts

d. Purlins and girts

e. Bracing

1.5.4.1 Building

Submit design calculations for the entire preengineered building, masonry walls and foundations, prepared and stamped by a professional engineer. Also submit for components requested, and stamp with the seal of a professional engineer. Include sizes and location of anchor bolts.

1.5.5 SD-11, Factory Tests

a. Factory Color Finish

b. Insulation

1.5.6 SD-13, Certificates

a. Preengineered metal building materials

Submit certificates attesting that materials comply with this specification.

1.5.7 SD-19, Operation and Maintenance Manuals

a. Preengineered Building, data package 1

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle manufactured items so that materials remain dry and undamaged. Do not store in contact with materials that might cause staining.

1.7 WARRANTY

Provide warranty against water leaks arising out of or caused by ordinary wear and tear by the elements for a period of 20 years. Such warranty shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier.

PART 2 PRODUCTS

2.1 ROOF MATERIALS

MBMA LRMBSM except as specified otherwise herein. Design roof panels, accessories, and flashings to be completely weathertight and free of abrasions, loose fasteners, and deformations.

2.1.1 Minimum Thickness

As required to conform to design requirements but not less than the following:

Items	Minimum Thickness (Uncoated)
Steel Structural Members Other Than Roof Panels	16 Manufacturer's Standard (MFG STD) gage, .0478 inch
Roof Panels	
Steel	26 MFG STD gage, .0179 inch
Aluminum	0.032 inch
Gable and Eave Trim, Fascia Closure Strips, Rake Flashings, Copings	
Steel	26 MFG STD gage, .0179 inch
Aluminum	0.032 inch
Eave Gutters and Downspouts	
Steel	26 MFG STD gage, .0179 inch
Aluminum	0.032 inch
Roof Ventilators	
Steel	26 MFG STD gage, .0179 inch
Aluminum	0.032 inch
Louvers	
Steel	18 MFG STD gage, .0478 inch
Aluminum	0.064 inch

2.1.2 Panels

a. Fabricated of zinc-coated steel, aluminum-coated steel or aluminum/zinc-coated steel.

b. Preformed, depth shall be manufacturer's standard for selected profile.

2.1.2.1 Zinc-Coated Steel Sheet

ASTM A 755/A 755M, Coating Class G-90 or ASTM A 446 Grade B/A 446M, Grade A.

2.1.2.2 Aluminum-Coated Steel Sheet

ASTM A 463, Type 1 or Type 2.

2.1.2.3 Aluminum/Zinc-Coated Steel Sheet

ASTM A 792M, AZ 55.

2.1.2.4 Aluminum Sheet

Alloy 3004 Alclad conforming to ASTM B 209.

Items	Minimum Thickness (Uncoated)

2.2 FRAMING AND STRUCTURAL MEMBERS

2.2.1 Steel

ASTM A 36/A 36M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M.

2.2.2 Aluminum

ASTM B 221 or ASTM C 308.

2.2.3 Structural Tube

ASTM A 500 or ASTM B 221.

2.3 MISCELLANEOUS ITEMS

2.3.1 Caps, Strips, and Plates

Form ridge caps, eave and edge strips, fascia strips, miscellaneous flashings, and miscellaneous sheet metal accessories from the same material and gage as the roof panels. Wall plates, base angles or base channels, and other miscellaneous framing members may be standard structural steel shapes, or may be formed from steel not lighter than 18-gage.

2.3.2 Closure Strips

Provide closure strips of closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the covering. Closure strips shall not absorb or retain water.

2.3.3 Sealant

Provide elastomeric type sealant containing no oil or asphalt. Exposed sealant shall cure to a rubberlike consistency. Concealed sealant may be the nonhardening type.

2.3.4 Gaskets and Insulating Compounds

Provide nonabsorptive gaskets and insulating compounds suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.3.5 Fasteners

Provide fasteners for steel wall and roof panels of zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for aluminum wall and roof panels shall be aluminum or corrosion resisting steel. Fasteners for structural connections shall provide both tensile and shear strength of not less than 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior

Items Minimum Thickness (Uncoated)

side of the covering to waterproof the fastener penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8-inch thick. When wall covering is factory color finished, exposed wall fasteners shall be color finished or provided with plastic color caps to match the covering. Nonpenetrating fastener system using concealed clips shall be manufacturer's standard for the system provided.

2.3.5.1 Screws

Provide self-tapping screws not less than No. 14 diameter and not less than No. 12 diameter if self-drilling/self-tapping type.

2.3.5.2 End-Welded Studs

Provide automatic shouldered type studs with a shank diameter of not less than 3/16 inch and cap or nut for holding covering against the shoulder.

2.3.5.3 Explosive Actuated Fasteners

Fasteners for use with explosive actuated tools shall have a shank diameter of not less than 0.145 inch with a shank length of not less than 1/2 inch for fastening panels to steel and not less than 1 inch for fastening panels to concrete.

2.3.5.4 Blind Rivets

Provide aluminum rivets with 3/16-inch nominal diameter shank or stainless steel rivets with 1/8-inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Provide hollow stem rivets with closed ends.

2.3.5.5 Bolts

Provide bolts not less than 1/4-inch diameter, shouldered or plain shank as required, with nuts.

2.4 GUTTERS

Provide complete with mitered corners, end pieces, and special pieces that may be required. Expansion-type slip joints shall be provided at the center of the runs and at intervals of not more than 32 feet for aluminum and not more than 40 feet for steel. Provide water tight seal at all other joints. Provide gutters below the slope line of the roof, to allow snow and ice to slide clear. Provide hangers and fastenings from a metal compatible with the gutters. Space hangers not more than 36 inches apart.

2.5 DOWNSPOUTS

Provide cross sectional area not less than the size of gutter indicated and complete including elbows and offsets. Provide downspouts in approximately

Items Minimum Thickness (Uncoated)

10-foot lengths; end joints shall telescope not less than 1/2 inch, and longitudinal joints shall be locked. Provide gutter outlets with stainless steel wire ball strainers of a standard type. Position downspouts not less than 1/2 inch away from walls and fasten to the walls at top, bottom, and at not to exceed 5-foot centers intermediately between with manufacturer's standard type leader straps, or concealed type fasteners. Form straps and fasteners from a metal compatible with the downspouts.

2.6 ROOF CURBS

Provide roof curbs fabricated of zinc-coated steel of manufacturers standard factory finish, color as indicated complete with braces for supporting scheduled equipment. Height of curb shall be a minimum of 12 inches. Provide a sponge rubber mounting pad for a weather seal connection to equipment.

2.7 LOUVERS

Provide louvers and frames of the sizes and color indicated. Provide manufacturer's standard factory finish. Fold or bead blades at the edges, fixed at an angle to exclude driving rains, and secure to the frames by riveting or welding as standard with manufacturer. Provide woven wire bird screening, not less than 3- by 3-mesh per square inch in rewirable frames, on the exterior of louvers; install screen frames by means of clips to allow easy removal for cleaning and rewiring. The screens and frames shall be of the same type metal as the louvers; screen and frames shall be of the same type metal as the louvers; screen wire shall be not less than 0.0475 inch in diameter. Free area of louver shall be a minimum of 49 percent. Static pressure drop across louver shall be not more than .07 inches water gauge.

2.8 INSULATION

Blanket type 0.6-pound fiber-glass as standard with the metal building manufacturer having a factory-applied facing on one side and a permeance rating of 0.05 or less when tested in accordance with ASTM E 96.

a. Facing on insulation shall be vinyl-scrim foil. Vinyl-scrim foil shall have a tensile strength of not less than 40 pounds machine direction and 30 pounds cross machine direction when tested in accordance with ASTM D 828.

b. The insulation, including facings, shall have a flame spread rating of 75 or less and a smoke development factor of 150 or less when tested in accordance with ASTM E 84.

c. Roof insulation shall have an "R" value as required to comply with governing energy and building codes.

d. Provide insulation containing 20 percent or greater recovered material which has been diverted from solid waste, but not including material reused in a manufacturing process. Where two materials have the same price and performance, provide the one

Items Minimum Thickness (Uncoated)

containing the higher recovered material content.

2.9 FINISH

2.9.1 Shop Painting

Ferrous metal work, except factory-finished work, zinc-coated work, aluminum-coated work, and work specified to be painted herein, shall be (1) cleaned of dirt, rust, scale, loose particles, grease, oil, and other deleterious substances; (2) phosphate treated; and (3) then be given one coat of an approved rust-inhibiting primer paint of the type standard with the metal building manufacturer.

2.9.2 Factory Color Finish

Provide exterior and interior exposed surfaces of metal roof and roof ventilators, louvers, gutters, downspouts, and metal accessories with a thermal-cured factory finish. Color shall be selected from manufacturer's standard colors. Provide an exterior finish top coat of the building manufacturer's standard paint. Provide standard dry film thickness of 0.8 mil for exterior coating exclusive of primer. Provide exterior primer thickness standard with building manufacturer. Interior color finish shall consist of the same coating and dry film thickness as the exterior. Provide interior and exterior color finish meeting the test requirements specified below. Tests shall have been performed on the same factory finish and thickness provided.

a. Salt Spray Test: ASTM B 117, minimum 500 hours. Undercutting of the paint film from the score line shall not exceed 1/16 inch.

b. Accelerated Weathering Test: ASTM G 23, Method 2, Type D apparatus minimum 2000 hours or Type EH apparatus minimum 500 hours, no checking, blistering or loss of adhesion; color change less than 5 NBS units by ASTM D 2244 and chalking less than #8 rating by ASTM D 4214.

c. Flexibility: ASTM D 522, Method A, 1/8 inch diameter, 180 degree bend, no evidence of fracturing to the naked eye.

d. Adhesion: ASTM D 3359, Method B, for laboratory test and film thickness less than 5 mil and Method A for site tests. There shall be no film removed by tape applied to 11 parallel cuts spaced 1/8 inch apart plus 11 similar cuts at right angles.

e. Impact: ASTM D 2794, no loss of adhesion after direct and reverse impact equal to 1.5 times metal thickness in mils, expressed in inch-pounds.

f. Humidity Resistance: ASTM D 2247, 1000 hours, no signs of blistering, cracking, creepage or corrosion on score panel.

g. Specular Gloss: ASTM D 523, finished surfaces exposed to the building exterior shall have a specular gloss of 10 measured at an

Items Minimum Thickness (Uncoated)

angle of 85 degrees.

h. Abrasion: ASTM D 968, Method A, falling sand shall not expose substrate when tested in quantities 30-40 liters of sand per mil of thickness.

PART 3 EXECUTION

3.1 INSPECTION

Check concrete dimensions, anchor bolt size and placement, and slab elevation with the metal building manufacturer's templates and drawings before setting any steel.

3.2 ERECTION

Erect in accordance with the manufacturer's approved erection instructions and diagrams. Correct defects and errors in the fabrication of building components in a manner approved by the Navy's Technical Representative (NTR). If defects or errors in fabrication of components cannot be corrected, remove and provide nondefective components. When installing wall and roof systems, install closure strips, flashing, sealing material, and other accessories in accordance with building manufacturer's instructions to provide a weathertight system, free of abrasions, loose fasteners, and deformations. After erection is complete, repair and coat abraded and damaged, primed or factory-finished surfaces to match adjacent surfaces.

3.2.1 Dissimilar Materials

Prevent direct contact between aluminum surfaces, and ferrous or other incompatible metals, by one of the following methods:

a. Paint the incompatible metal with a coating of manufacturer's standard heavy-bodied paint.

b. Paint the incompatible metal with a prime coat of corrosion inhibitive primer followed by one or two coats of aluminum metal-and-masonry paint, or other suitable protective coating, excluding products containing lead and chromium pigmentation.

c. Provide an approved nonabsorptive gasket.

d. Apply an approved caulking between the aluminum and the incompatible metal.

If drainage from incompatible metal passes over aluminum, paint the incompatible metal by method (a) or (b). Paint aluminum surfaces in contact with concrete or masonry materials by method (a). Paint green or wet wood, or wood treated with incompatible wood preservatives, by method (a) or use two coats of aluminum paint.

Items Minimum Thickness (Uncoated)

3.2.2 Rigid Frames, Bases, and Sill Members

Brace frames as necessary to ensure safety. Set accurately, using a nonshrink grout to obtain uniform bearing on the concrete and to maintain a level base line elevation. Clean surfaces to receive the mortar and thoroughly moisten immediately before placement of mortar. Water cure exposed surfaces of mortar with wet burlap for 7 days.

3.2.2.1 Field Welding

Steel, AWS D1.1. Aluminum, AA 30.

3.2.2.2 Field Bolting

AISC S329

3.2.3 Roof Construction

Apply the roofing panels in full lengths from ridge to eaves with no transverse joints except at the junction of ventilators, curbs, chimneys, and similar openings. Lay side laps away from the prevailing wind, and seal side and end laps with joint sealing material. Flash and seal the roof at the ridge, at eaves and rakes, at projections through the roof, and elsewhere as necessary. Minimum side lap shall be one corrugation, configuration, or interlocking rib.

3.2.4 Minimum Fastener Spacing

Space fasteners according to manufacturer's instructions, but not to exceed:

a. 8 inches o.c. at end laps of covering,

b. 12 inches o.c. at connection of covering to intermediate supports,

c. 12 inches o.c. side laps of roof coverings, 18 inches o.c. at side laps of wall.

3.2.5 Installation of Insulation

Provide the following insulation only if thermal panels were not used on the building walls.

3.2.5.1 Roof Insulation

Install over purlins before roof coverings are applied. Hold insulation rigid until secured in place. Insulation facing shall be exposed on the interior side of the building. Fold and staple facing tabs of insulation on 6-inch centers to completely seal joints. If folding and stapling is accomplished from the inside, push the tabs neatly up between the edges of adjoining blankets. Cover side laps of insulation with metal strips formed for this purpose and paint to match the facing material. Install the strips spanning from purlin to purlin and in accordance with the metal

Items Minimum Thickness (Uncoated)

building manufacturer's recommendations.

3.3 FIELD PAINTING

Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same color and material used for the shop coat. Section 09900, "Painting," for painting of shop-primed ferrous surfaces exposed on the outside of the building and all shop-primed surfaces of doors and windows.

3.4 FIELD QUALITY CONTROL

At the discretion of the NTR, sample panels may be taken at random from each delivery or from stockpiles on the site at any time during the construction period, and tests may be made to check the conformance of the materials to the requirements specified in paragraph entitled "Factory Color Finish." Failure of the sample sheets to pass the required tests shall be cause for rejection of all sheets represented by the samples and replacement of the entire shipment.

-- End of Section --

SECTION 15011

MECHANICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

a. General:

1. Provide all labor, materials, tools, equipment, design services, supervision and coordination to perform all mechanical work required, in accord with provisions of the contract documents.

2. Completely coordinate with the work and requirements of all other trades.

3. Although such work is not specifically indicated, furnish and install all supplementary items or appurtenances and devices necessary for a sound, secure and complete installation.

b. Drawings Use and Interpretation:

1. Drawings are diagrammatic and indicate general arrangement of systems and equipment, except when specifically dimensioned or detailed.

2. Intention is to show approximate sizes, capacities, locations, direction and general relationship of one work phase to another. But not exact detail or arrangement.

3. Field verify locations, arrangements and capacities of all existing systems and equipment to be utilized at this site.

c. Installation of all systems and equipment is subject to clarification as indicated in reviewed shop drawings, design-build drawings and field coordination drawings.

d. Description of Systems: Furnish and Install all materials to provide functioning systems in compliance with performance requirements specified, and any modifications resulting from reviewed shop drawing, design-build drawings or field coordination drawings.

e. Scope of Work: Without limiting or restricting the volume of work and solely for the convenience of the contractor, the work to be performed, in general, comprises of the following:

1. Provide a complete and operating mechanical installation in accordance with these specifications, performance requirements and accompanying contract drawings. This shall include all required labor, materials, apparatus, design and construction supervision.

2. Apparatus, appliance or work not shown on the plans, but mentioned in the specifications or vice versa, or any accessories necessary to make the work complete and ready for operation, even though not specified or shown on the plans, shall be furnished and installed without additional expense to the owner.

3. Furnish and install heating ventilation and air conditioning systems to meet the requirements of the Basis of Design report, these specifications, and as indicated. Design criteria for equipment sizing and load calculations shall be as described in the 1993 ASHRAE Fundamentals Handbook, and as described in the Basis of Design report.

4. Furnish and install propane piping system including interior and exterior piping, storage tank, and pressure regulators.

5. Furnish and install process system industrial exhaust system.

6. Furnish and install interior plumbing system as described in the Basis of Design report.

1.2 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	1993 National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	1990 Salt Spray (Fog) Testing

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	1987 (Rev. 1-2) Motors and Generators
NEMA MG 10	1983 (R 1988) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA MG 11	1977 (R 1992) Energy Management Guide for Selection and Use of Single-Phase Motors
NFPA 70	1993 National Electrical Code

1.3 RELATED REQUIREMENTS

This section applies to Division 2, "Site Work"; and all sections of Division 15, "Mechanical" of this project specification, unless specified otherwise in the individual section.

1.4 QUALITY ASSURANCE

1.4.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.2 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.4.3 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 DELIVERY, STORAGE, AND HANDLING

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

1.6 SAFETY REQUIREMENTS

1.6.1 Equipment Safety

Provide positive means of locking out equipment so that equipment cannot be accidentally started during maintenance procedures. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of the type specified. Provide catwalks, maintenance platforms, and guardrails where required for safe operation and maintenance of equipment. Provide ladders or stairways to reach catwalks and maintenance platforms. Ensure that access openings leading to equipment are large enough to carry through routine maintenance items such as filters and tools.

1.6.2 Lockout of Energy Sources

Provide appropriate lockout devices for energy isolating valves and for machines or other equipment to prevent unexpected start-up or release of stored electrical, mechanical, hydraulic, pneumatic, thermal, chemical, or other energy in accordance with 29 CFR 1910.147. Lockout devices for

valves shall provide a means of attachment to which, or through which, a lock can be affixed or shall have a locking mechanism built into it so that the valve cannot be moved from the lockout position until the lock is removed. Electrical isolation of machines or other equipment shall be accordance with requirements of DIVISION 16 "Electrical."

1.7 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Section 16402, "Interior Wiring Systems." Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 16402, "Interior Wiring System."

1.7.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.7.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

Equipment painting, factory applied or shop applied, shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Immediately after cleaning, metal surfaces shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

-- End of Section --

SECTION 15116

WELDING PRESSURE PIPING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1	1989 (Addenda 1989) Power Piping
ASME/ANSI B31.9	1988 (Addenda 1991) Building Services Piping
ASME BPVC SEC IX	1989 (Addenda 1989, 1990 and 1991) Boiler and Pressure Vessel Code: Section IX Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS A2.4	1986 Symbols for Welding, Brazing and Nondestructive Examination
ANSI/AWS Z49.1	1988 Safety in Welding and Cutting

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements" applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-04, Drawings

a. Welding pressure piping

1.3.2 SD-08, Statements

a. Welding procedures qualification

1.3.2.1 Welding Procedures and Qualifications

a. Specifications and Test Results: Submit copies of the welding procedure specifications and procedure qualification test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds. Submit this information on the forms printed in ASME BPVC SEC IX or their equivalent.

b. Certification: Before assigning welders or welding operators to the work, submit their names, together with certification that each individual is performance qualified as specified. Do not start welding work prior to procedure qualification. 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.

1.3.3 SD-18, Records

a. Weld identifications

1.3.3.1 Weld Identifications

Submit a list of the welders' names and symbol for each welder. To identify welds, submit written records indicating the location of welds made by each welder or welding operator.

1.4 QUALITY ASSURANCE

1.4.1 Procedures

Develop and qualify procedures for welding metals included in the work. Do not start welding until welding procedures, welders, and welding operators have been qualified. Perform qualification testing by an approved testing laboratory, or by the Contractor if approved by the Contracting Officer in accordance with the qualified procedures. Notify the Contracting Officer at least 24 hours in advance of the time and place of the tests. When practicable, perform the qualification tests at or near the work site. Maintain current records of the test results obtained in welding procedure, welding operator/welder performance qualifications. These records shall be readily available at the site for examination by the Contracting Officer. Unless otherwise specified, the choice of welding process shall be the responsibility of the Contractor.

1.4.2 Symbols

Conform to AWS A2.4.

1.4.3 Safety

Conform to ANSI/AWS Z49.1, 29 CFR 1910-SUBPART Q, "Welding, Cutting, and Brazing," 29 CFR 1926-SUBPART J, "Welding and Cutting."

1.5 ENVIRONMENTAL

Do not perform welding when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Contracting Officer will determine when weather or working conditions are unsuitable for welding.

1.6 DELIVERY AND STORAGE

Deliver filler metals, electrodes, fluxes and other welding materials to the site in manufacturers' original packages and store in a dry space until used. Label and design packages properly to give maximum protection from moisture and to assure safe handling.

PART 2 PRODUCTS

2.1 WELDING MATERIALS

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

Do not deviate from applicable codes, approved procedures and approved shop drawings without prior written approval from the Contracting Officer. Materials or components with welds made off the site will not be accepted if the welding does not conform to the requirements of this specification unless otherwise specified. Assign each welder or welding operator an identifying number, letter, or symbol that shall be used to identify his welds. Each welder or welding operator shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, place identification marks adjacent to the welds at 3-foot intervals. Confine identification by die stamps or electric etchers to the weld reinforcing crown, preferably in the finished crater.

3.2 WELDING OPERATORS

Perform welding in accordance with qualified procedures using qualified welders and welding operators.

3.3 EXAMINATIONS

Visual shall be performed by the Government to detect surface and internal discontinuities in completed welds. Visually examine welds as indicated in Table IV attached to this Section. When examination and testing

indicates defects in a weld joint, a qualified welder shall repair the weld in accordance with the paragraph entitled "Corrections and Repairs" of this section.

3.3.1 Visual Examination

Visually examine welds as follows:

a. Before welding -- for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alinement and fit-up, and cleanliness.

b. During welding -- for conformance to the qualified welding procedure.

c. After welding -- for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

3.4 ACCEPTANCE STANDARDS

3.4.1 Visual

The following indications are unacceptable:

a. Cracks--external surface.

b. Undercut on surface which is greater than 1/32 inch (1.0 mm) deep or 12.5 percent for ASME/ANSI B31.9 of the wall thickness, whichever is less, provided that the remaining wall thickness is not less than the minimum design thickness.

c. Weld reinforcement:

(1) ASME B31.1, conform to Table I.

TABLE I
REINFORCEMENT OF GIRTH AND LONGITUDINAL BUTT WELDS

Thickness of Base Metal, inches (mm)	Maximum Thickness of Reinforcement for Design Temperature					
	Greater than 750°F (400°C)		350°F-750°F (175°C-400°C)		Less Than 350°F (175°C)	
	inch	mm	inch	mm	inch	mm
Up to 1/8 (3.0), incl.	1/16	2.0	3/32	2.5	3/16	5.0
Over 1/8 to 3/16 (3.0 to 5.0), incl.	1/16	2.0	1/8	3.0	3/16	5.0
Over 3/16 to 1/2 (5.0 to 13.0), incl.	1/16	2.0	5/32	4.0	3/16	5.0
Over 1/2 to 1 (13.0 to 25.0), incl.	3/32	2.5	3/16	5.0	3/16	5.0
Over 1 to 2 (25.0 to 50.0), incl.	1/8	3.0	1/4	6.0	1/4	6.0
Over 2 (50.0)	5/32	4.0	The greater of 1/4 in.			

TABLE I
REINFORCEMENT OF GIRTH AND LONGITUDINAL BUTT WELDS

Thickness of Base Metal, inches (mm)	Maximum Thickness of Reinforcement for Design Temperature					
	Greater than 750°F (400°C)		350°F-750°F (175°C-400°C)		Less Than 350°F (175°C)	
	inch	mm	inch	mm	inch	mm
						(6 mm) or 1/8 times the width of the weld in inches (millimeters).

NOTES:
1. For double welded butt joints, this limitation on reinforcement given above shall apply separately to both inside and outside surfaces of the joint.
2. For single welded butt joints, the reinforcement limits given above shall apply to the outside surface of the joint only.
3. The thickness of weld reinforcement shall be based on the thickness of the thinner of the materials being joined.
4. The weld reinforcement thicknesses shall be determined from the higher of the abutting surfaces involved.
5. Weld reinforcement may be removed if so desired.

3.6 CORRECTIONS AND REPAIRS

Remove defects and replace welds as specified in ASME B31.1 unless otherwise specified. Repair defects discovered between weld passes 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, reexamine the area by the same test methods which first revealed the defect to ensure that the defect has been eliminated. After rewelding, reexamine the repaired area by the same test methods originally used for that area. For repairs to base material, the minimum examination shall be the same as required for butt welds. Indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no unacceptable indications are present. The use of foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

TABLE IV
EXAMINATIONS AND TESTS FOR VARIOUS MATERIALS AND SERVICES

Examinations or Tests Required

Material or Application	Visual	Radiographic	Magnetic Particle or Liquid Penetrant	Ultra-sonic
Carbon steel piping systems				
a. Tack welds	Yes	No	No	No
b. Root passes	Yes	No	No	No
c. Intermediate passes	Yes	No	No	No
d. Completed weld	Yes	No	No	No

-- End of Section --

SECTION 15250

MECHANICAL INSULATION

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 B 209	1992 (Rev. A) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 552	1991 Cellular Glass Thermal Insulation
ASTM C 553	1992 Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 612	1993 Mineral Fiber Block and Board Thermal Insulation
ASTM E 84	1991 (Rev. A) Surface Burning Characteristics of Building Materials

1.2 SYSTEM DESCRIPTION

Provide field-applied mechanical insulation for mechanical systems and existing insulated mechanical systems affected by the Contractors operations. Mechanical systems include heating and ventilating equipment, ducts, and piping which is located within, on, under, and adjacent to the building; and for plumbing systems. Obtain NTR's written approval of each system before applying field-applied insulation.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.3.1 SD-02, Manufacturers Catalog Data

a. Duct insulation and jacket

b. Equipment insulation and jacket

1.4 IDENTIFICATION OF NEW ASBESTOS-FREE INSULATION

PART 2 PRODUCTS

2.1 INSULATION MATERIALS

Provide new asbesbos-free insulation materials.

2.2 DUCT INSULATION AND JACKET

2.2.1 Blanket Type Duct Insulation

ASTM C 553, minimum density of one pcf. Provide duct insulation jacket.

2.2.2 Rigid Type Duct Insulation

ASTM C 612, minimum density of 3 pcf. Provide duct insulation jacket.

2.2.3 Duct Insulation Jacket

Provide manufacturer's standard fire-retardant vapor barrier jacket, except vapor barrier is not required for heating only ducts. Jacket shall be suitable for painting.

PART 3 EXECUTION

3.1 INSTALLATION OF MECHANICAL INSULATION

Clean exterior of mechanical systems prior to the application of field-applied insulation. Install field-applied mechanical insulation in accordance with the manufacturer's recommendations and as specified herein. The completed installation shall have a fire hazard rating in accordance with ASTM E 84; flame-spread rating shall not exceed 25 and smoke developed rating shall not exceed 50 except as specified herein; smoke developed rating shall not exceed 150 for polyurethane insulations. Insulation shall be clean and dry when installed and prior to the application of jackets and coatings. Do not use short pieces of insulation materials where a full length section will fit. Provide insulation materials and jackets with smooth and even surfaces, with jackets drawn tight, and smoothly secured on longitudinal laps and end laps. Provide insulation continuous through hangers, supports, sleeves, wall openings, and ceiling openings, except at fire dampers in duct systems.

3.2 DUCT INSULATION

Provide duct insulation and jacket on exterior of supply ducts, return ducts, outside air intake ducts, and plenums for HVAC units, including metal on back of diffusers and registers. Apply insulation with joints tightly butted. Space pins or anchors at maximum of 12-inch centers; secure insulation with washers and clips. Pins or anchors shall be metal electrically welded to duct surface or shall be metal attached to duct surface with waterproof adhesive especially designed for attachment to metal surfaces. Sagging of duct insulation shall not be permitted. Insulation shall be tightly and smoothly applied to the ducts. Secure insulation to metal ducts with a fire-resistant, waterproof bonding adhesive applied in 4 inch wide strips on 12-inch centers. Provide minimum

thickness of 1.5 inches of rigid type duct insulation in mechanical equipment rooms and where indicated; provide minimum thickness of 2 inches of blanket type duct insulation in other locations. Both exterior duct insulation and acoustical duct lining are required when acoustical duct lining is indicated.

3.2.1 Blanket Type Duct Insulation

Secure blanket type insulation to bottom of rectangular horizontal and sloping ducts more than 24 inches wide, in addition to adhesive, by impaling over pins or anchors.

3.2.2 Rigid Type Duct Insulation

Secure rigid type insulation to duct by impaling over pins or anchors located not more than 3 inches from edge of insulation and spaced at maximum 12-inch centers.

3.2.3 Vapor Barrier

Fill joints, breaks, punctures, and voids with vapor barrier coating compound and cover with vapor barrier jacket. At joints, the vapor barrier jacket for insulation shall be covered with 4 inch wide pressure-sensitive vapor seal tape of material identical to jackets, or shall have 2 inch wide laps drawn tight and secured with vapor seal adhesive. The joints and openings where the facing is pierced or punctured by pins, staples, or other means shall be brush coated with 2 inch wide strips of vapor barrier coating compound.

3.3 FIELD INSPECTIONS

Visually inspect the insulation installation of all mechanical systems to ensure that materials conform to requirements specified herein.

-- End of Section --

SECTION 15400

PLUMBING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A112.36.2M	1991 Cleanouts
ANSI B16.18	1984 Cast Copper Alloy Solder Joint Pressure Fittings
ANSI B16.23	1992 Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ANSI Z21.22	1986 (Addenda 1990) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems
ANSI Z358.1	1990 Emergency Eyewash and Shower Equipment

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 1010	1984 Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.6.1M	1979 Supports for the Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.18.1M	1989 Plumbing Fixture Fittings
ASME/ANSI A112.19.1M	1987 Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	1990 Vitreous China Plumbing Fixtures
ASME A112.19.5	1979 (R 1990) Trim for Water-Closet Bowls, Tanks, and Urinals
ASME A112.21.1M	1991 Floor Drains
ASME/ANSI B16.1	1989 Cast Iron Pipe Flanges and Flanged Fittings
ANSI/ASME B16.3	1985 Malleable Iron Threaded Fittings

	Classes 150 and 300
ASME/ANSI B16.22	1989 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B16.26	1988 Cast Copper Alloy Fittings for Flared Copper Tubes
ANSI/ASME B16.29	1986 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ANSI/ASME B16.32	1984 Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	1990 Ferritic Malleable Iron Castings
ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 74	1992 Cast Iron Soil Pipe and Fittings
ASTM B 32	1992 Solder Metal
ASTM B 42	1992 (Rev. A) Seamless Copper Pipe, Standard Sizes
ASTM B 88	1992 Seamless Copper Water Tube
ASTM B 306	1992 Copper Drainage Tube (DWV)
ASTM C 564	1991 (Rev. A) Rubber Gaskets for Cast Iron Soil Pipe and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500	1986 Gate Valves for Water and Sewerage Systems
AWWA C651	1986 (Addendum 1990) Disinfecting Water Mains

BUILDING OFFICIALS & CODE ADMINISTRATORS INTERNATIONAL, INC. (BOCA)

BOCA NPC	1990 (Am. 1991) National Plumbing Code

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI HSN	1985 Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings
CISPI 301	1990 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

CISPI 310	1990 Couplings for Use in Connection with Hubless Cast Iron Soil Pipe and Fitting

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-USC	1992 List of Approved Backflow Prevention Assemblies

MILITARY SPECIFICATIONS (MIL)

MIL-R-6855	(Rev. E) (Supp. 1) Rubber, Synethic, Sheets, Strips, Molded or Extruded Shapes

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	1988 Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	1991 Pipe Hangers and Supports - Selection and Application
MSS SP-80	1987 Bronze Gate, Globe, Angle and Check Valves

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Provide plumbing systems, complete and ready for operation. Plumbing systems including manufacturer's products shall be in accordance with the required and advisory provisions of the Plumbing Code (BOCA NPC) Plumbing systems include piping less than 5 feet outside of building walls and piping beyond 5 feet outside of building walls including connections to existing exterior distribution systems.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Pipe and fittings

b. Valves

c. Plumbing fixtures

d. Water heaters

e. Pipe hangers and supports

f. Drains

g. Backflow preventers

h. Electric water coolers

1.4.2 SD-19, Operation and Maintenance Manuals

a. Water heaters, Data Package 2

b. Electric water coolers, Data Package 2

1.5 QUALITY ASSURANCE

Plumbing systems including fixtures, equipment, materials, installation, and workmanship shall be in accordance with the Plumbing Code except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears; reference to the "authority having jurisdiction," the Administrative Authority, the Plumbing Official, and the Design Engineer shall be interpreted to mean the Contracting Officer. Capacity of equipment shall be not less than that indicated.

PART 2 PRODUCTS

2.1 DRAIN, WASTE, AND VENT (DWV) PIPE AND FITTINGS

Fittings shall be long radius fittings, except fittings in vent piping may be short radius fittings. Minimum size piping shall be 2 inches for buried piping and 1.5 inches for aboveground piping.

2.1.1 Buried Piping

Provide piping up to but not more than 6 inches aboveground or floor slab on grade.

2.1.1.1 Cast-Iron Hubless Pipe and Fittings

CISPI 301 with CISPI 310 couplings.

2.1.1.2 Cast-Iron Hub and Spigot Pipe and Fittings

ASTM A 74 with ASTM C 564 or CISPI HSN rubber compression gasket joints.

2.1.2 Aboveground Piping

2.1.2.1 Cast-Iron Hubless Pipe and Fittings

CISPI 301 with CISPI 310 couplings.

2.1.2.2 Cast-Iron Hub and Spigot Pipe and Fittings

ASTM A 74 with ASTM C 564 or CISPI HSN rubber compression gasket joints.

2.1.2.3 Copper Tubing

ASTM B 306, with ANSI B16.23, ANSI/ASME B16.29, or ANSI/ASME B16.32 solder joint fittings using ASTM B 32, 95-5 tin-antimony or Grade Sn96 tin-silver solder, and flux containing not more than 0.2 percent lead.

2.1.3 Cleanouts

ANSI A112.36.2M; provide threaded bronze cleanout plugs.

2.1.3.1 Floor Cleanouts

Provide cast-iron or ductile-iron floor cleanout with flange, adjustable height polished bronze, nickel bronze, stainless steel, or chromium-plated copper alloy rim and scoriated floor plate with "CO" cast in the plate, and countersunk screws for installing floor plate flush with finished floor.

2.1.3.2 Wall Cleanouts

Provide polished stainless steel or chromium-plated copper alloy cover plate and secure to cleanout plug with countersunk stainless steel screw.

2.1.3.3 Cleanouts Exterior to Buildings

Provide cast-iron cleanouts and countersunk plugs. Provide 24- by 24- by 4-inch thick concrete slab with top one inch above grade with cleanout located in center of slab.

2.2 DOMESTIC WATER PIPING

2.2.1 Buried Piping and Aboveground Piping

2.2.1.1 Copper Tubing

ASTM B 88, Type L or M for aboveground piping, Type K for buried piping, with ASME/ANSI B16.22 solder joint fittings; or with ASME/ANSI B16.26 flared joint fittings. Provide ASTM B 42 copper pipe nipples with threaded end connections. Provide ASTM B 32, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder. Provide copper tubing for pipe sizes 4 inches or smaller.

2.2.2 Water Valves

Provide valves suitable for minimum of 125 psig and minimum of 180 degrees F hot water. Valves shall have solder end connections for connections between bronze valves and copper tubing. Ball valves may be provided in lieu of gate valves. Provide blue finish and red finish on handwheels for valves in cold domestic water piping and hot domestic water piping, respectively.

2.2.2.1 Gate Valves

MSS SP-80, Class 125

2.2.2.2 Globe and Angle Valves

MSS SP-80

2.2.2.3 Check Valves

MSS SP-80, Class 125, swing check.

2.2.2.4 Ball Valves

Full port design, copper alloy valves shall have two-position lever handles.

2.2.2.5 Hose Bibbs

Provide angle type copper alloy hose bibb with lockshield and removable handwheel. Inlet shall have internal threads. Outlet shall have vacuum breaker with 0.75-inch external hose threads.

2.2.2.6 Nonfreeze Wall Hydrant

ASSE 1019, cast bronze, with lockshield and removable handwheel one-inch external thread inlet, 0.75-inch external hose thread outlet with automatic draining vacuum breaker. Hydrant shall be of sufficient length to extend through walls and place the valve seat inside the building or in the crawl space. Bonnet and valve stem shall be removable from outside of the building.

2.2.3 Strainers

Strainers shall have blow off outlet with pipe nipple and gate valve and discharge pipe nipple. Copper alloy or cast-iron body. Provide stainless steel strainer element with perforations of 0.047 inch.

2.2.4 Dielectric Connections

Provide at connections between copper and ferrous metal piping materials.

2.2.5 Valve Boxes

For each buried valve provide cast-iron, ductile-iron, or plastic box of a suitable size. Provide cast-iron, ductile-iron, or plastic cover for the box with the word "WATER" cast on the cover. Plastic boxes shall be constructed of ABS plastic or inorganic fiber-reinforced black polyolefin plastic. Coat cast-iron and ductile-iron boxes with bituminous paint.

2.2.6 Backflow Preventers

Reduced pressure principle type. Furnish proof that each make, model/design, and size of backflow preventer being furnished for the

project is approved by and has a current "Certificate of Approval" from the local code. Listing of the particular make, model/design, and size in the current local code will be acceptable as the required proof.

2.3 MISCELLANEOUS PIPING MATERIALS

2.3.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated or polished stainless steel finish on copper alloy plates in finished spaces. Provide paint finish on metal in unfinished spaces.

2.3.2 Pipe Sleeves

2.3.2.1 Sleeves in Masonry and Concrete Walls, Floors, Roofs

ASTM A 53, Schedule 40 or Standard Weight, hot-dip galvanized steel pipe sleeves.

2.3.2.2 Sleeves in Non-Masonry or -Concrete Walls, Floors, and Roofs

Provide 26 gage hot-dip galvanized steel sheet.

2.3.3 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors. Provide one-inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

a. Sleeves in masonry and concrete walls, floors, and roofs: Provide steel pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

b. Sleeves in other than masonry and concrete walls, floors, and roofs: Provide 26 gage galvanized steel sheet.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of plumbing systems including fixtures, equipment, materials, and workmanship shall be in accordance with the Plumbing Code, except as modified herein. When fixtures require both hot water and cold water

supplies, provide the hot water supply to the left of the cold water supply. Plastic piping shall not penetrate fire walls or fire floors and shall be used on one side of fire walls and fire floors not closer than 6 inches to the penetration.

3.1.1 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil.

3.1.2 Solder End Valves

Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive arts do not require disassembly but shall be opened at least two turns during soldering.

3.1.3 Pipe Supports (Hangers)

Provide additional supports at the concentrated loads in piping between supports, such as for inline water pumps and flanged valves.

3.1.3.1 Piping to Receive Insulation

Provide temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations. Temporary wood spacers shall be of the same thickness as the insulation to be provided under Section 15250, "Insulation of Mechanical Systems."

3.1.3.2 Maximum Spacing Between Supports

a. Vertical Piping: Support metal piping at each floor, but at not more than 10-foot intervals.

b. Horizontal Piping: Support cast-iron piping at 5-foot intervals, except for pipe exceeding 5-foot length, provide supports at intervals equal to the pipe length but not exceeding 10 feet. Support steel piping and copper tubing as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Steel Pipe	7	8	9	10	11	12	13	14	16	17
Copper Tube	6	7	8	8	9	10	11	12	13	14

3.1.4 Ductile Iron Pipe Aboveground

Provide flanged joints.

3.1.5 Encased Buried Piping

Completely encase buried copper water piping and cast iron DWV and water piping with polyethylene tube or sheet in accordance with AWWA C105/A21.5.

3.1.6 Installation of Pipe Sleeves

Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25-inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material. Extend sleeves in floor slabs 3 inches above the finished floor, except sleeves are not required where DWV piping passes through concrete floor slabs located on grade.

3.1.7 Copper Tube Extracted Joint

An extracted mechanical tee joint may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to ensure a free flow joint. Braze extracted joints using a copper phosphorus classification brazing filler metal. Soldered joints shall not be permitted.

3.2 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers, and valves; stop valves in supplies to fixtures will not require nameplates. Laminated plastic shall be 0.125-inch thick melamine plastic, black with white center core. Surface shall be a matte finish. Corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information:

a. Manufacturer, type, and model number

b. Contract number and accepted date

c. Capacity or size

d. System in which installed

e. System which it controls

3.3 FIELD QUALITY CONTROL

3.3.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.3.2 Field Testing

Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the following tests in addition to the tests specified in the Plumbing Code, except as modified herein. Correct defects in the work provided by the Contractor, and repeat tests until work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for performing tests.

3.3.2.1 Domestic Water Piping

Before applying insulation, hydrostatically test each piping system at not less than 100 psig with no leakage or reduction in gage pressure for 2 hours.

3.3.2.2 DWV Piping

Before the installation of fixtures, cap ends of each system, fill piping with water to the roof, and allow to stand until a thorough inspection has been made. If the system is tested in sections, each opening shall be plugged and each section tested with not less than a 10-foot head or water. After plumbing fixtures have been set and their traps filled with water, subject the entire sanitary system to a final air pressure test of not more than 1.0 inch of water column. Perform the air and smoke test with an approved smoke testing machine which shall show a clear passage of smoke and air throughout the entire system. The entire system shall be proven absolutely tight under such test.

3.3.2.3 Backflow Preventers

Backflow preventers shall be tested by a locally approved and certified backflow assembly tester. A copy of the test report shall be provided to the Contracting Officer prior to placing the domestic water system into operation, or no later than 5 days after the test.

3.4 DISINFECTION

Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping

systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplied by nonpotable water is not required.

-- End of Section --

SECTION 15401

CONTAMINATED GROUNDWATER PIPING AND VALVING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.18.1M	1989 Plumbing Fixture Fittings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1019	1978 Wall Hydrants, Frost Proof Automatic Draining, Anti-Backflow Types

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 183	1983 (R 1990) Carbon Steel Track Bolts and Nuts
ASTM B 32	1991 Solder Metal

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500	1986 Gate Valves for Water and Sewerage Systems
AWWA C701	1988 Cold-Water Meters - Turbine Type, for Customer Service

BUILDING OFFICIALS & CODE ADMINISTRATORS INTERNATIONAL, INC. (BOCA)

BOCA NPC	1990 (Am. 1991) National Plumbing Code

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-USC	1992 List of Approved Backflow Prevention Assemblies

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO UPC	1991 Uniform Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS

INDUSTRY, INC. (MSS)

MSS SP-58	1988 Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	1991 Pipe Hangers and Supports - Selection and Application
MSS SP-71	1990 Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	1987 Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	1985 Cast Iron Globe & Angle Valves Flanged and Threaded Ends

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC NSPC	1990 (Supp. 1991 and 1992) National Standard Plumbing Code - Illustrated

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI G101	1985 Testing and Rating Procedure for Grease Interceptors
PDI WH201	1983 Water Hammer Arrestors

SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL (SBCCI)

SBCCI SPC	1991 Standard Plumbing Code

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Provide new contaminated groundwater piping system, complete and ready for operation. Piping system including manufacturer's products shall be in accordance with the required and advisory provisions of the Plumbing Code (NAPHCC NSPC). Piping systems include piping less than 5 feet outside of building walls and piping beyond 5 feet outside of building walls including connections to existing exterior distribution systems.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Pipe and fittings

b. Valves

c. Plumbing fixtures

d. Pipe hangers and supports

e. Pressure gages

f. Water meters

g. Water hammer arresters

h. Backflow preventers

1.5 QUALITY ASSURANCE

Contaminated groundwater piping systems including fixtures, equipment, materials, installation, and workmanship shall be in accordance with the Plumbing Code except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears; reference to the "authority having jurisdiction," the Administrative Authority, the Plumbing Official, and the Design Engineer shall be interpreted to mean the NTR.

PART 2 PRODUCTS

2.1 PIPING AND VALVING FOR CONTAMINATED WATER SERVICE

All piping and valving (above and below ground) to be rated for 150 psig ambient.

2.1.1 Pipe

4" and smaller	-	Steel, ASTM A 54, Type F (welded).
6" to 20" inclusive	-	Steel, ASTM A 53, Grade B, Type E (ERW).

API 5L, Grade B line pipe and rolled steel plate pipe (A 283/A 283M, Grade C) are approved equal.

Pipe to be of the following Schedule or wall thickness.

2" and smaller	-	Schedule 80, PE
2 1/2" to 6" inclusive	-	Schedule 80, BE
8" to 12" inclusive	-	Schedule 40, BE

2.1.2 Fittings

2" and smaller	-	300# MI, screwed.
2 1/2" to 6" inclusive	-	Schedule 80, FS, weld reducers and LR weld ells.

8" to 12" inclusive	-	Schedule 40, FS, weld reducers and LR weld ells.

2.1.3 Unions

2" and smaller	-	300# MI, iron to iron seat, screwed.

2.1.4 Branch Connections

2" and smaller on pipe 2 1/2" and larger	-	3000# thredolet, extra heavy full coupling, or welded offtake.
2 1/2" and larger on pipe 2 1/2" and larger	-	Fabricated flanged nozzle, welded offtake or weld tee if dictated by design.

2.1.5 Flanges

2 1/2" to 12" inclusive	-	ANSI Class 150 slip-on flg., RF, FS

Welding neck flanges may be specified when dictated by design or availability. Specify flat face flanges as companion to CI flanges as at CI valves and pump nozzles.

2.1.6 Gaskets

2 1/2" to 12" inclusive	-	Ring type, 1/16" thick, compressed non-asbestos, Garlock 3200.

Specify full face gaskets at all cast iron flanges.

2.1.7 Bolts and Nuts

Bolts	-	ASTM A 307, Grade B, heavy hex-head.
Nuts	-	ASTM A 307, cold punched, heavy hex, series.

2.1.8 Angle Valves

2" and smaller	-	Use Globe Valve - 150#, AI, ISRS, screwed.
2 1/2" to 6" inclusive	-	125#, AI, OS&Y, flanged.

2.1.9 Ball Valves

2" and smaller	-	150#, AI, screwed.
2 1/2" to 8"	-	150#, AI, flanged.

2.1.10 Check Valves

2" and smaller	-	300#, MI, alloy trim, swing check, screwed.
2 1/2" to 12" inclusive	-	125#, AI, swing check, flanged.

2.1.11 Gate Valves

2" and smaller	-	125#, AI, ISRS, screwed.
2 1/2" to 36" inclusive	-	125#, AI, OS&Y, flanged.

2.1.12 Globe Valves

2" and smaller	-	150#, AI, ISRS, screwed.
2 1/2" to 6" inclusive	-	125#, AI, OS&Y, flanged.
8" to 14" inclusive	-	125#, AI, OS&Y, flanged.

2.2 INSULATION

Above ground piping outside of the treatment system building shall be provided with an appropriate layer of insulation. Flanges, valves, couplings and any other elements in the outside piping lines also shall be appropriately insulated.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of contaminated groundwater piping system including materials and workmanship shall be in accordance with the Plumbing Code.

3.1.1 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil.

3.1.2 Solder End Valves

Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.

3.1.3 Pipe Supports (Hangers)

Provide additional supports at the concentrated loads in piping between supports, such as for flanged valves.

3.1.3.1 Piping to Receive Insulation

Provide temporary wood spacers between the insulation protection shield and above ground outside piping in order to properly slope the piping and to establish final elevations. Temporary wood spacers shall be of the same thickness as the insulation.

3.1.3.2 Maximum Spacing Between Supports

a. Vertical Piping: Support metal piping at not more than 10-foot intervals, with pipe riser clamps or offset pipe clamps.

b. Horizontal Piping: Support steel piping as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Steel Pipe	7	8	9	10	11	12	13	14	16	17

3.1.4 Installation of Pipe Sleeves

Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than one inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material.

3.2 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers, and valves. Laminated plastic shall be 0.125-inch thick melamine plastic, black with white center core. Surface shall be a matte finish. Corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information:

a. Manufacturer, type, and model number

b. Contract number and accepted date

c. Capacity or size

d. System in which installed

e. System which it controls

3.3 FIELD QUALITY CONTROL

3.3.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.3.2 Field Testing

Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the tests specified in the Plumbing Code. Correct defects in the work and repeat tests until work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for performing tests.

-- End of Section --

SECTION 15402

CAUSTIC PIPING AND VALVING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.18.1M	1989 Plumbing Fixture Fittings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 183	1983 (R 1990) Carbon Steel Track Bolts and Nuts
ASTM B 32	1991 Solder Metal

BUILDING OFFICIALS & CODE ADMINISTRATORS INTERNATIONAL, INC. (BOCA)

BOCA NPC	1990 (Am. 1991) National Plumbing Code

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-USC	1992 List of Approved Backflow Prevention Assemblies

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO UPC	1991 Uniform Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	1988 Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	1991 Pipe Hangers and Supports - Selection and Application

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC NSPC	1990 (Supp. 1991 and 1992) National Standard Plumbing Code - Illustrated

SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL (SBCCI)

SBCCI SPC 1991 Standard Plumbing Code

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Provide new caustic piping system, complete and ready for operation. Plumbing systems including manufacturer's products shall be in accordance with the required and advisory provisions of the Plumbing Code (NAPHCC NSPC).

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Pipe and fittings

b. Valves

c. Plumbing fixtures

d. Pipe hangers and supports

e. Backflow preventers

1.5 QUALITY ASSURANCE

Caustic piping systems including fixtures, equipment, materials, installation, and workmanship shall be in accordance with the Plumbing Code except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears; reference to the "authority having jurisdiction," the Administrative Authority, the Plumbing Official, and the Design Engineer shall be interpreted to mean the NTR.

PART 2 PRODUCTS

2.1 PIPING AND VALVING FOR CAUSTIC SERVICE

All piping and valving to be rated for 150 psig ambient.

2.1.1 Pipe

2" and smaller - Teflon tubing encased in steel, ASTM A 53, type F (welded), glavanized,

Schedule 40, PE.

2.1.2 Fittings

2" and smaller - As recommended by pipe manufacturer.

2.1.3 Unions

2" and smaller - As recommended by pipe manufacturer.

2.1.4 Branch Connections

Use fittings.

2.1.5 Check Valves

2" and smaller - Kynar or Teflon.

2.1.6 Plug Valves: (preferred)

2" and smaller - Kynar or Teflon.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of caustic piping system including materials and workmanship shall be in accordance with the Plumbing Code.

3.1.1 Pipe Supports (Hangers)

Provide additional supports at the concentrated loads in piping between supports, such as for flanged valves.

Vertical Piping: Support steel containment piping at not more than 10-foot intervals, with pipe riser clamps or offset pipe clamps.

Horizontal Piping: Support steel containment piping as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Steel Pipe	7	8	9	10	11	12	13	14	16	17

3.2 FIELD QUALITY CONTROL

3.2.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.2.2 Field Testing

Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the tests specified in the Plumbing Code. Correct defects in the work and repeat tests until work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for performing tests.

-- End of Section --

SECTION 15403

ACID PIPING AND VALVING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.18.1M	1989 Plumbing Fixture Fittings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 183	1983 (R 1990) Carbon Steel Track Bolts and Nuts
ASTM B 32	1991 Solder Metal

BUILDING OFFICIALS & CODE ADMINISTRATORS INTERNATIONAL, INC. (BOCA)

BOCA NPC	1990 (Am. 1991) National Plumbing Code

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-USC	1992 List of Approved Backflow Prevention Assemblies

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO UPC	1991 Uniform Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	1988 Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	1991 Pipe Hangers and Supports - Selection and Application

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC NSPC	1990 (Supp. 1991 and 1992) National Standard Plumbing Code - Illustrated

SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL (SBCCI)

SBCCI SPC 1991 Standard Plumbing Code

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Provide new acid piping system, complete and ready for operation. Piping system including manufacturer's products shall be in accordance with the required and advisory provisions of the Plumbing Code (NAPHCC NSPC).

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Pipe and fittings

b. Valves

c. Plumbing fixtures

d. Pipe hangers and supports

e. Backflow preventers

1.5 QUALITY ASSURANCE

Acid piping systems including fixtures, equipment, materials, installation, and workmanship shall be in accordance with the Plumbing Code except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears; reference to the "authority having jurisdiction," the Administrative Authority, the Plumbing Official, and the Design Engineer shall be interpreted to mean the NTR.

PART 2 PRODUCTS

2.1 PIPING AND VALVING FOR ACID SERVICE

All piping and valving to be rated for 150 psig ambient.

2.1.1 Pipe

2" and smaller	-	Teflon tubing encased in steel, ASTM A 53, type F (welded), galvanized, Schedule 40, PE.

2.1.2 Fittings

2" and smaller - As recommended by pipe manufacturer.

2.1.3 Unions

2" and smaller - As recommended by pipe manufacturer.

2.1.4 Branch Connections

Use fittings.

2.1.5 Check Valves

2" and smaller - Kynar or Teflon.

2.1.6 Plug Valves (preferred)

2" and smaller - Kynar or Teflon.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of acid piping system including materials and workmanship shall be in accordance with the Plumbing Code.

3.1.1 Pipe Supports (Hangers)

Provide additional supports at the concentrated loads in piping between supports, such as for flanged valves.

Vertical Piping: Support steel containment piping at not more than 10-foot intervals, with pipe riser clamps or offset pipe clamps.

Horizontal Piping: Support steel containment piping as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Steel Pipe	7	8	9	10	11	12	13	14	16	17

3.2 FIELD QUALITY CONTROL

3.2.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.2.2 Field Testing

Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the tests specified in the Plumbing Code. Correct defects in the work and repeat tests until work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for performing tests.

-- End of Section --

SECTION 15404

CONTAMINATED SLUDGE PIPING AND VALVING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.18.1M	1989 Plumbing Fixture Fittings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 183	1983 (R 1990) Carbon Steel Track Bolts and Nuts
ASTM B 32	1991 Solder Metal

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500	1986 Gate Valves for Water and Sewerage Systems
AWWA C701	1988 Cold-Water Meters - Turbine Type, for Customer Service

BUILDING OFFICIALS & CODE ADMINISTRATORS INTERNATIONAL, INC. (BOCA)

BOCA NPC	1990 (Am. 1991) National Plumbing Code

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-USC	1992 List of Approved Backflow Prevention Assemblies

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO UPC	1991 Uniform Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	1988 Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69	1991 Pipe Hangers and Supports - Selection and Application
MSS SP-71	1990 Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	1987 Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	1985 Cast Iron Globe & Angle Valves Flanged and Threaded Ends

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC NSPC	1990 (Supp. 1991 and 1992) National Standard Plumbing Code - Illustrated

SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL (SBCCI)

SBCCI SPC	1991 Standard Plumbing Code

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Provide new contaminated sludge piping systems, complete and ready for operation. Piping systems including manufacturer's products shall be in accordance with the required and advisory provisions of the Plumbing Code (NAPHCC NSPC).

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Pipe and fittings

b. Valves

c. Plumbing fixtures

d. Pipe hangers and supports

e. Pressure gages

1.5 QUALITY ASSURANCE

Contaminated sludge piping system including fixtures, equipment, materials, installation, and workmanship shall be in accordance with the Plumbing Code except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears; reference to the "authority having jurisdiction," the Administrative Authority, the Plumbing Official, and the Design Engineer shall be interpreted to mean the NTR.

PART 2 PRODUCTS

2.1 PIPING AND VALVING FOR CONTAMINATED SLUDGE SERVICE

All piping and valving to be rated for 150 psig ambient.

2.1.1 Pipe

4" and smaller	-	Steel, ASTM A 53, Type F (welded).
6" to 20" inclusive	-	Steel, ASTM A 53, Grade B, Type E (ERW).

API 5L, Grade B line pipe and rolled steel plate pipe (A 283/A 283M, Grade C) are approved equal.

Pipe to be of the following Schedule or wall thickness.

2" and smaller	-	Schedule 80, PE
2 1/2" to 6" inclusive	-	Schedule 80, BE
8" to 12" inclusive	-	Schedule 40, BE

2.1.2 Fittings

2" and smaller	-	300# MI, screwed.
2 1/2" to 6" inclusive	-	Schedule 80, FS, weld reducers and LR weld ells.
8" to 12" inclusive	-	Schedule 40, FS, weld reducers and LR weld ells.

2.1.3 Unions

2" and smaller	-	300# MI, iron to iron seat, screwed.

2.1.4 Branch Connections

2" and smaller on pipe 2 1/2" and larger	-	3000# thredolet, extra heavy full coupling, or welded offtake.
2 1/2" and larger on pipe 2 1/2" and larger	-	Fabricated flanged nozzle, welded offtake or weld tee if dictated by design.

2.1.5 Flanges

2 1/2" to 12" inclusive	-	ANSI Class 150 slip-on flg, RF, FS.

Welding neck flanges may be specified when dictated by design or availability. Specify flat face flanges as companion flanges to CI flanges as at CI valves and pump nozzles.

2.1.6 Gaskets

2 1/2" to 12" inclusive	-	Ring type, 1/16" thick, compressed non-asbestos, Garlock 3200.

Specify full face gaskets at all cast iron flanges.

2.1.7 Bolts and Nuts

Bolts	-	ASTM A 307, Grade B, heavy hex-head.
Nuts	-	ASTM A 307, cold punched, heavy hex, series.

2.1.8 Angle Valves

2" and smaller	-	Use Globe Valve - 150#, AI, ISRS, screwed.
2 1/2" to 12" inclusive	-	125#, AI, swing check, flanged.

2.1.9 Ball Valves

2" and smaller	-	150#, AI, screwed.
2 1/2" to 8"	-	150#, AI, flanged.

2.1.10 Check valves

2" and smaller	-	300#, MI, alloy trim, swing check, screwed.
2 1/2" to 12" inclusive	-	125#, AI, swing check, flanged.

2.1.11 Gate Valves

2" and smaller	-	125#, AI, ISRS, screwed.
2 1/2" to 36" inclusive	-	125#, AI, OS&Y, flanged.

2.1.12 Globe Valves

2" and smaller	-	150#, AI, ISRS, screwed.
2 1/2" to 6" inclusive	-	125#, AI, OS&Y, flanged.
8" to 14" inclusive	-	125#, AI, OS&Y, flanged.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of contaminated sludge system including materials and workmanship shall be in accordance with the Plumbing Code.

3.1.1 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil.

3.1.2 Solder End Valves

Remove stems and washers and other items subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.

3.1.3 Pipe Supports (Hangers)

Provide additional supports at the concentrated loads in piping between supports, such as flanged valves.

Vertical Piping: Support metal piping at not more than 10-foot intervals, with pipe riser clamps or offset pipe clamps.

Horizontal Piping: Support steel piping as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Steel Pipe	7	8	9	10	11	12	13	14	16	17

3.1.4 Installation of Pipe Sleeves

Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than one inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material.

3.2 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers, and valves. Laminated plastic shall be 0.125-inch thick melamine plastic, black with white center core. Surface shall be a matte finish. Corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Key

nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information:

a. Manufacturer, type, and model number

b. Contract number and accepted date

c. Capacity or size

d. System in which installed

e. System which it controls

3.3 FIELD QUALITY CONTROL

3.3.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.3.2 Field Testing

Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the tests specified in the Plumbing Code. Correct defects in the work and repeat tests until work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for performing tests.

-- End of Section --

SECTION 15405

AIR PIPING AND VALVING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.18	1984 Cast Copper Alloy Solder Joint Pressure Fittings
ANSI B16.23	1984 Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ANSI B16.24	1991 (Errata 1991) Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500
ANSI Z358.1	1990 Emergency Eyewash and Shower Equipment

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.18.1M	1989 Plumbing Fixture Fittings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 183	1983 (R 1990) Carbon Steel Track Bolts and Nuts
ASTM B 32	1991 Solder Metal

BUILDING OFFICIALS & CODE ADMINISTRATORS INTERNATIONAL, INC. (BOCA)

BOCA NPC	1990 (Am. 1991) National Plumbing Code

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO UPC	1991 Uniform Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	1988 Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69 1991 Pipe Hangers and Supports - Selection and Application

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC NSPC 1990 (Supp. 1991 and 1992) National Standard Plumbing Code - Illustrated

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 1988 National Fuel Gas Code

SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL (SBCCI)

SBCCI SPC 1991 Standard Plumbing Code

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Provide new air piping system, complete and ready for operation. Piping systems including manufacturer's products shall be in accordance with the required and advisory provisions of the Plumbing Code (NAPHCC NSPC).

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Pipe and fittings

b. Valves

c. Fixtures

d. Pipe hangers and supports

e. Pressure gages

1.5 QUALITY ASSURANCE

Air piping systems including materials, installation, and workmanship shall be in accordance with the Plumbing Code except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears; reference to the "authority having jurisdiction," the Administrative Authority, the Plumbing Official, and the Design Engineer shall be interpreted to mean the NTR.

PART 2 PRODUCTS

2.1 PIPING AND VALVING FOR AIR SERVICE

All piping and valving to be rated for 150 psig ambient.

2.1.1 Pipe

4" and smaller	-	Steel, ASTM A 53, Type F (welded).
6" to 20" inclusive	-	Steel, ASTM A 53, Grade B, Type E (ERW).

API 5L, Grade B line pipe and rolled steel plate pipe (A 283/A 283M, Grade C) are approved equal.

2.1.2 Fittings

2" and smaller	-	300# MI, screwed.
2 1/2" to 6" inclusive	-	Schedule 40, FS, weld reducers and LR weld ells.
8" to 12" inclusive	-	Schedule 20, FS, weld reducers and LR weld ells.

2.1.3 Unions

2" and smaller	-	300# MI, brass to iron seat, screwed, Stockham 895.

2.1.4 Branch Connections

2" and smaller on pipe 2 1/2" and larger	-	3000# thredolet, extra heavy full coupling, or welding offtake.
2 1/2" and larger on pipe 2 1/2" and larger	-	Fabricated flanged nozzle, welded offtake or weld tee if dictated by design.

2.1.5 Flanges

2 1/2" to 12" inclusive	-	ANSI Class 150 slip-on fig., RF, FS.

Welding neck flanges may be specified when dictated by design or availability. Specify flat face flanges as companion flanges to CI flanges as at CI valves and pump nozzles.

2.1.6 Gaskets

2 1/2" to 12" inclusive	-	Ring type, 1/16" tick, compressed non-asbestos, Garlock 3200.

Specify full face gaskets at valves with flat face flanges.

2.1.7 Bolts and Nuts

Bolts	-	ASTM A 307, Grade B, heavy hex-head.
Nuts	-	ASTM A 307, cold punched, heavy hex, series.

2.1.8 Angle Valves

2" and smaller	-	125#, bronze, ISRS, screwed.
2 1/2" to 6 " inclusive	-	125#, IBBM, OS&Y, flanged.

2.1.9 Ball Valves (preferred)

2" and smaller	-	200#, bronze, Buna-N seats, screwed.

2.1.10 Butterfly Valves

2 1/2" to 24" inclusive	-	125#, CI Buna-N seats, wafer valve, with gear operator.

2.1.11 Check Valves

2" and smaller	-	125#, bronze, swing check, screwed.
2 1/2" to 24" inclusive	-	125#, IBBM, swing check, flanged.

2.1.11 Gate Valves

2" and smaller	-	125#, bronze, ISRS, screwed, Crane 428.
2 1/2" to 36" inclusive	-	125#, IBBM, OS&Y, flanged, Crane 465 1/2.

2.1.12 Globe Valves

2" and smaller	-	125#, bronze, ISRS, screwed.
2 1/2" to 10" inclusive	-	125#, IBBM, OS&Y, flanged.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of air piping system including materials and workmanship shall be in accordance with the Plumbing Code.

3.1.1 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil.

3.1.2 Solder End Valves

Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.

3.1.3 Pipe Supports (Hangers)

Provide additional supports at the concentrated loads in piping between supports, such as for flanged valves.

Vertical Piping: Support steel piping at not more than 10-foot intervals, with pipe riser clamps or offset pipe clamps.

Horizontal Piping: Support steel piping as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Steel Pipe	7	8	9	10	11	12	13	14	16	17

3.1.4 Installation of Pipe Sleeves

Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than one inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material.

3.2 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers, and valves. Laminated plastic shall be 0.125-inch thick melamine plastic, black with white center core. Surface shall be a matte finish. Corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information:

a. Manufacturer, type, and model number

b. Contract number and accepted date

c. Capacity or size

d. System in which installed

e. System which it controls

3.3 FIELD QUALITY CONTROL

3.3.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.3.2 Field Testing

Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the tests specified in the Plumbing Code. Correct defects in the work and repeat tests until work is in compliance with contract requirements. Furnish air, electricity, instruments, connecting devices, and personnel for performing tests.

-- End of Section --

SECTION 15487

COMPRESSED AIR SYSTEM

PART 1 - GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTES (ANSI) PUBLICATIONS:

B16-18-84	Cast Bronze Solder Joint Pressure Fittings
B16.22-80	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.26-83	Cast Copper Alloy Fittings for Flared Copper Tubes
B31.1-86	Power Piping
B40.1-85	Gauges, Pressure Indicating, Dial Type, Elastic Element
Z21.22-86	Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems
Z49.1-83	Safety in Welding and Cutting

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS:

B 32-87	Solder Metal
B 88-86	Seamless Copper Water Tube

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) PUBLICATION:

1986	Boiler and Pressure Vessel Code and Interpretations Section VIII Division 1, Pressure Vessels Section IX Welding and Brazing Qualifications

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS) PUBLICATIONS:

SP-80-87 Bronze Gate, Globe, Angle, and Check Valves

OCCUPATIONAL SAFETY HEALTH ACT (OSHA) STANDARD:

29 CFR 1910.219	Mechanical Power-Transmission apparatus

1.2 COMPRESSED AIR SYSTEM

Provide compressed air system complete and ready for operation. Compressed air system, including air compressor, receiver, internal piping, equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME Boiler and Pressure Vessel Code, and ANSI B31.1 except as modified herein. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the work "should" wherever it appears; reference to the "authority having jurisdiction," shall be interpreted to mean the NTR. Section titled "Mechanical General Requirements" applies to this section with the additions and modifications specified herein.

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 operation since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall each be the product of one manufacturer.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Air Compressor
b. Receiver
c. Alternator Panel and Pressure Controls
d. Pipe and fittings
e. Valves
f. Drain traps
g. Intake filters
h. Silencer
i. Compressor Motor
j. Refrigerated Dryer

1.3.2 SD-04, Shop Drawings

a. Air Compressor
b. Receiver
c. Alternator Panel and Pressure Controls
d. Pipe and fittings
e. Valves
f. Drain traps
g. Intake filters
h. Silencer
i. Compressor Motor
j. Refrigerated Dryer

1.3.3 SD-13, Certificates of Compliance

a. Pipe and fittings
b. Valves
c. Coatings
d. Welding and brazing

1.3.4 SD-19, Operation and Maintenance Manuals

a. Air compressor, Data Package 4

b. Air dryer, Data Package 4

1.4 GENERAL REQUIREMENTS

Provide in accordance with Section 15011, "Mechanical General Requirements" and Section 16011, "General Electrical Requirements".

PART 2 - PRODUCTS

2.1 AIR COMPRESSOR

Provide one duplex tank mounted, electric motor driven, air cooled, two stage, reciprocating type air compressor including motors, controllers, alternator, pressure switches, belt guards, air intake filters, and silencers. Piston speed shall not exceed 450 fpm. Pressure switches shall start compressor at 75 psig and stop compressor at 100 psig. Each compressor shall be rated to supply 100 cfm at 75 psig continuously. Centrifugal unloader mechanism shall be provided with each compressor. All controls shall be suitable for wet locations.

2.1.1 Compressed Air Receiver

Provide galvanized steel receiver constructed and labeled in accordance with the ASME Boiler and Pressure Vessel Code for not less than 125 psig service. Provide a pressure gauge, a pressure relief (safety) valve, a service valve (3/4" ball), a pressure reducing valve, and a receiver drain valve. Set pressure relief valve at 125 psig. Set pressure reducing valve in accordance with recovery system manufacturer's recommendation. Two pressure switches shall be provided on the receiver to provide a "lead-lag" mode of control.

2.1.2 Alternator Panel

A surface-mounted alternator panel shall be provided. Panel shall include an alternator that shall alternate the two compressors between a "lead" and "lag" mode. Panel shall include motor controllers, control power transformer, disconnect switches and controls for each compressor. A panel mounted red run light shall be provided for each compressor. A selector switch shall be provided for control of the compressors, and shall have the selections "Compressor A - Compressor B - Alternate." Alternator panel shall be suitable for use in wet locations.

2.1.3 Intake Air Filter and Silencer

Provide dry-type combination intake air filter and silencer with baked enamel steel housing. Filter shall be 99 percent efficient at 10 micron rating. Provide residential class intake air silencer.

2.1.4 Oil Level Switch

Each compressor shall be provided with a low oil level switch in an explosion-proof enclosure.

2.1.5 Belt Guard

Compressor shall be provided with a totally enclosed belt guard.

2.1.6 Compressor Motor

Each compressor motor shall be 25 horsepower (maximum), 480 VAC, 3-phase, TEFC. Motors shall be pre-wired to conjunction boxes.

2.2 COMPRESSED AIR PIPING

Compressed air piping shall be provided in accordance with Section 15405, "Air Piping and Valving."

2.2.1 Pressure Relief Valves

ANSI Z21.22 and ASME bronze or cast-iron body, with test lever, and shall be suitable for the intended service.

2.2.2 Ball Valves

Full port design, copper alloy body, except sizes 2.5 inches and larger shall be cast-iron body. Valves shall have two-position lever handles. Ball valves may be provided in lieu of gate valves.

2.2.3 Pressure Reducing Valves

Spring loaded type, with nominal pressure rating of not less than inlet system pressure indicated. Provide pressure reducing valves capable of being adjusted to indicated flow and pressure, and suitable for intended service.

2.3 PIPING ACCESSORIES

2.3.1 Pressure Gauges

ANSI B40.1, steel or brass case, nonshatterable safety glass, and a pressure blowout back to prevent glass from flying out in case of an explosion. Gauges shall have a 3.5-inch minimum diameter dial and a dial range of approximately twice working pressure. Provide gauge, snubber, and cock.

2.3.2 Pipe Nipples

Copper alloy for use in copper tubing and Schedule 80 steel pipe for use in steel piping.

2.3.3 Traps

Steel Body, internals of stainless steel, minimum of ANSI Class 150, and of the types indicated.

2.3.4 Flexible Connections

Vibration isolation, wire braid reinforced corrugated metal hose type, line-sized, with bronze end connections, suitable for pressure indicated.

2.3.5 Quick Disconnect Couplings

Provide all brass suitable for a working pressure of not less than indicated system pressure. Female side of coupling (fixed end) shall have male thread connection with automatic shutoff. Provide male side of coupling with hose stem and ball check to bleed pressure from hose and prevent hose whipping.

2.4 LOW PRESSURE COMPRESSED AIR DRYER

Provide low pressure compressed air dryer of the mechanical refrigeration type, equipped with an automatic temperature shutdown switch to prevent freezing, a regenerative air to air exchanger (in capacity sizes above 10 or 60 scfm as standard with the manufacturer), and a main compressed air cooling exchanger. Refrigeration system shall cool compressed air to dry the air. Dryer shall have no internal traps or filters and shall have pressure drop not greater than (3 psi). Air shall leave the dryer at a temperature of 70 degrees F and dew point of 35 degrees F, based on an inlet temperature of 100 degrees F. Provide internal tubing, wiring, and piping complete, such that only connections to air inlet and outlet, to refrigerant compressor contractor, and to condensate drain are necessary.

2.4.1 Air Circuit

a. Regenerative Heat Exchanger: Inlet compressed air to outlet compressed air heat exchanger designed to reduce cooling load at design conditions 20 degrees F by inlet air precooling.

b. Main Heat Exchanger: Single-pass, with air in the tubes, heat sink, direct expansion, or flooded cooler type.

c. Separator: Fabricated in accordance with ASME B31.1; code stamp not required; moisture separator low velocity type incorporating change of air flow direction to prevent moisture carryover.

d. Dryer Operating Pressure: 125 psig working pressure.

e. Drain Line: Provide with exterior mounted condensate trap to facilitate servicing.

2.4.2 Refrigeration System

a. Refrigeration Compressor: ARI 520. Hermetic, semi-hermetic, or open reciprocating type equipped with automatic start-stop or unloading capacity control; standard components include inherent motor protection, crankcase oil strainer, and suction screen.

b. Dryer Controls: Capable of automatic 0 to 100 percent capacity control. Refrigeration controls shall maintain pressure dew point within the specified range without freezing of condensate. Controls shall include such devices as capillary tube, expansion valve, suction pressure regulator, thermostat, or other approved devices as standard with the manufacturer. Dryer shall have automatic shutdown switch sensor located at point of lowest temperature to prevent freezing.

c. Refrigerant dryer and suction line strainer.

d. Air-cooled condenser, with condenser fan and motor.

2.4.3 Instrumentation and Control

a. Indicators for the Following Services: Inlet air pressure gage, discharge air pressure gage, inlet air temperature gage, main exchanger temperature gage, refrigeration compressor suction pressure gage, refrigeration compressor discharge pressure gage, green "Power On" light, power interruption light, and high temperature light.

b. Electrical Relays: Locate in an enclosed portion of the panel, accessible for ease of servicing.

c. Controls and Interlocks: To maintain required compressed air dew point and to cycle air-cooled condenser with refrigeration compressor (while maintaining head pressure control with low ambient temperature).

PART 3 3 - EXECUTION

3.1 INSTALLATION

Installation of compressed air system including air compressor, receiver, internal piping, equipment, materials, workmanship, fabrication, assembly, erection, internal examination, inspection, and testing in accordance with the ASME and ANSI B31.1 except as modified herein.

3.2 DRAINAGE AND FLEXIBILITY

Compressed air piping and hoses shall be free of unnecessary pockets and pitched approximately 1-inch per 100 feet in the direction of flow to low points. Provide flexibility by use of fittings, loops, and offsets in piping. Install branches at top of a main to prevent carryover of condensate and foreign matter.

3.3 FOUNDATIONS FOR EQUIPMENT

Provide foundations for equipment conforming to recommendation of the manufacturer of equipment unless specified otherwise. Provide anchor bolts of ample length with plates on bottom ends, and set by using accurately constructed templates. Level equipment on foundations by means of jacks or steel wedges. Fill spaces between equipment bases and concrete foundation solid with cement mortar. Provide rubber mounting pads between anchor belt and frame, and frame and foundation.

3.4 FLEXIBLE METAL HOSE

Install 3/4" flexible metal hose from air compressor pressure reducing valve to 3/4" x 3/4" x 3/4" tee at casing pipe, as shown on the contract drawings. Clamp metal hose to pipe support as shown such that metal hose vibration is limited to the compressor side of the clamp. Use saddle clamp such that hose is not crimped. Remaining piping shall be of reinforced single ply high tensile strength braided synthetic cord.

3.5 CLEANING

Clean piping, hoses, fittings, valves, unions and other components of the systems of dirt, oil and other contaminants before assembly and installation.

3.6 THREADED CONNECTIONS

Jointing compound for pipe threads shall be tetrafluoroethylene (TFE) pipe thread tape or TFE powder and oil; apply only on male threads.

3.7 WELDING AND BRAZING

Qualified welders and brazers shall weld and braze joints in piping. Qualifications for welding and brazing procedures, welders, brazers, and welding operators shall be in accordance with ANSI B31.1. Contractor shall furnish six copies of qualifications to the NTR for approval.

3.7.1 Equipment and Protection

Protect welders and brazers from the light of the arc or flame by approved goggles, shields, helmet, and gloves. Closed spaces shall be properly ventilated when welding or brazing is being done therein. Take care to avoid risk of fire.

3.7.2 Surface to be Welded

Surface to be welded shall be free from loose scale, slag, rust, point, oil, and other foreign material. Joint surfaces shall be smooth and free from defects which might affect proper welding. Clean each layer of weld metal thoroughly by wire brushing, grinding or chipping prior to inspection or deposition of additional weld metal.

3.7.3 Finished Welds

Surface of finished welds shall have a bright metallic luster after cleaning, fairly smooth with regular, even ripples, and uniform in contour. Except as necessary to correct defects, do not dress, smooth, or finish surfaces for improving their appearance. Provide sound welds throughout and fuse thoroughly. Free inside of pipe from globules of weld metal which would restrict pipe area or might become loose. Visual examination of welds and acceptance standards shall be in accordance with ANSI B31.1.

3.7.4 Brazed Joints

Prepare brazed joints in accordance with a qualified and approved brazing procedure. Defective joints may be repaired. However, no more than two attempts to repair by reheating and additional face feeding of brazing filler metal will be permitted, after which defective joint shall be unsweated, reprepared as a new joint, inspected for defects on pipe and fittings, and rebrazed.

3.8 SAFETY PRECAUTIONS

3.8.1 Welding

Safety in welding and cutting of pipe shall conform to ANSI Z49.1

3.8.2 Rotating Equipment

Provide full guarded couplings, motor shafts, gears, and other exposed rotating or rapidly moving parts in accordance with OSHA 29 CFR 1910.219. Provide rigid and suitably secured guard parts readily removable without disassembling guarded unit.

3.9 FIELD INSPECTIONS AND TESTS

3.9.1 Inspections

Prior to initial testing, inspect compressed air system for compliance with drawings, specifications, and manufacturer's submittals.

3.9.2 Hydrostatic and Leak Tightness Tests

After installation, hydrostatically test piping systems (and hoses) for 30 minutes with water at 1.5 times design working pressure. No leakage or reduction in gauge pressure shall occur. Remove or isolate from the system equipment which would be damaged by water during hydrostatic tests and reinstall after successful completion of tests.

After satisfactory completion of hydrostatic pressure tests, blow systems dry with clean, oil-free compressed air and test with clean, dry air at design working pressure. Brush joints with soapy waste solution to check for leaks. Install a calibrated test pressure gauge in piping system to observe any loss in pressure. Calibrate the test pressure gauge with a dead weight tester and certify by initial and date on dial before using. Maintain required test pressure for a sufficient length of time to enable an inspection of joints and connections.

3.9.3 Operational Tests

Test equipment as in service to determine compliance with contract requirements and warranty. Test equipment under every condition of operation. Test safety controls to demonstrate performance of their required function. Completely tests system for compliance with specifications. Hydrostatically test the pressure vessel. Test shall be witnessed by the Base's Pressure Vessel Certifier.

-- End of Section --

SECTION 15492

FUEL GAS PIPING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.11	1980 Forged Steel Fittings, Socket-Welding and Threaded
ANSI B16.33	1981 (Errata 1982) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (Sizes 1/2 Through 2)
ANSI B18.2.1	1981 Square and Hex Bolts and Screws Inch Series
ANSI Z21.41	1989 (Addenda 1990) Quick-Disconnect Devices for Use with Gas Fuel
ANSI Z21.45	1985 (Addenda 1989) Flexible Connectors of Other Than All-Metal Construction for Gas Appliances
ANSI Z21.69	1987 (Addenda 1990) Connectors for Movable Gas Appliances

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	1989 Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI/ASME B1.20.1	1983 Pipe Threads, General Purpose (Inch)
ANSI/ASME B16.3	1985 Malleable Iron Threaded Fittings
ASME/ANSI B16.5	1988 (Errata 1988) Pipe Flanges and Flanged Fittings
ASME/ANSI B16.9	1986 Factory-Made Wrought Steel Buttwelding Fittings
ANSI/ASME B16.38	1985 Large Metallic Valves for Gas Distribution (Manually Operated, NPS 2 1/2 to 12, 125 psig Maximum)
ASME/ANSI B16.39	1986 Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

ASME/ANSI B18.2.2	1987 Square and Hex Nuts (Inch Series)
ASME B31.8	1989 (Addenda 1990) Gas Transmission and Distribution Piping Systems
ASME BPVC SEC VIII D1	1989 (Addenda 1989 and 1990) Boiler and Pressure Vessel Code: Section VIII Pressure Vessels, Division 1

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 193/A 193M	1990 (Rev. A) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	1991 Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM D 2513	1990 (Rev. B) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D 2683	1990 Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR PT 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Supply Standards
49 CFR PT 195	Transportation of Hazardous Liquids by Pipeline

MILITARY STANDARDS (MIL-STD)

MIL-STD-101	(Rev. B) Color Code for Pipelines and for Compressed Gas Cylinders

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	1988 Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	1991 Pipe Hangers and Supports - Selection and Application
MSS SP-89	1985 Pipe Hangers and Supports - Fabrication and Installation Practices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	1988 National Fuel Gas Code
NFPA 58	1989 Storage and Handling of Liquified Petroleum Gases

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section, with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Pipe and fittings

b. Hangers and supports

c. Pressure regulator

d. Gas equipment connectors

e. Valves

f. Warning and identification tape

g. Risers

h. Transition fittings

i. LPG containers and accessories

1.3.2 SD-06, Instructions

a. PE pipe and fittings

Submit manufacturer's installation instructions and manufacturer's visual joint appearance chart.

1.3.3 SD-08, Statements

a. Welder's qualifications

b. PE welder's qualifications

c. Welder's identification symbols

Submit a copy of a certified ASME B31.8 qualification test report for each welder and welding operator. Submit the assigned number, letter, or

symbol that shall be used in identifying the work of each welder.

1.3.4 SD-13, Certificates

a. PE pipe and fittings

b. Transition fittings

c. LPG containers and accessories

1.4 QUALITY ASSURANCE

1.4.1 Welder's Qualifications

Comply with ASME B31.8. The steel welder shall have a copy of a certified ASME B31.8 qualification test report. The PE welder shall have a certificate from a PE pipe manufacturer's sponsored training course. Contractor shall also conduct a qualification test. Submit each welder's identification symbols, assigned number, or letter, used to identify work of the welder. Affix symbols immediately upon completion of welds. Welders making defective welds after passing a qualification test shall be given a requalification test and, upon failing to pass this test, shall not be permitted to work this contract.

1.4.2 PE Welder's Qualifications

Prior to installation, Contractor shall have supervising and installing personnel trained by a PE pipe manufacturer's sponsored course of not less than one week duration, or present proof satisfactory to the Contracting Officer that personnel are currently working in the installation of PE gas distribution lines.

1.4.3 Safety Standards

49 CFR PT 192 and 49 CFR PT 195.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe ends during transportation or storage to minimize dirt and moisture entry. Do not subject to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have been damaged.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Conform to NFPA 54 and with requirements specified herein. Supply piping to appliances or equipment shall be at least as large as the inlets thereof.

2.2 PIPE AND FITTINGS

2.2.1 Aboveground and Within Buildings and Vaults

a. Pipe: Black steel in accordance with ASTM A 53, Schedule 40, threaded ends for sizes 2 inches and smaller; otherwise, plain end beveled for butt welding.

b. Threaded Fittings: ANSI/ASME B16.3, black malleable iron.

c. Socket-Welding Fittings: ANSI B16.11, forged steel.

d. Butt-Welding Fittings: ASME/ANSI B16.9, with backing rings of compatible material.

e. Unions: ASME/ANSI B16.39, black malleable iron.

f. Flanges and Flanged Fittings: ASME/ANSI B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVC SEC VIII D1. Flange faces shall have integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.

2.2.2 Underground Polyethylene (PE)

PE pipe and fittings are as follows:

a. Pipe: ASTM D 2513, 100 psig working pressure, Standard Dimension Ratio (SDR), the ratio of pipe diameter to wall thickness, 11.5 maximum.

b. Socket Fittings: ASTM D 2683.

c. Butt-Fusion Fittings: ASTM D 2513, molded.

2.2.3 Risers

Manufacturer's standard riser, transition from plastic to steel pipe with 7-to-12 mil thick epoxy coating. Use swaged gas-tight construction with O-ring seals, metal insert, and protective sleeve. Provide remote bolt-on or bracket or wall-mounted riser supports as indicated.

2.2.4 Transition Fittings

a. Steel to Plastic (PE): As specified for "riser" except designed for steel-to-plastic with tapping tee or sleeve. Coat or wrap exposed steel pipe with heavy plastic coating.

b. Plastic to Plastic: Manufacturer's standard fused tapping (PE-to-PE) tee assembly with shut-off feature.

2.3 VALVES, ABOVEGROUND

Provide lockable valves where indicated.

2.3.1 Shutoff Valves, Sizes Larger Than 2 Inches

Cast-iron or steel body ball valve with flanged ends in accordance with ANSI/ASME B16.38. Provide PTFE seats.

2.3.2 Shutoff Valves, Sizes 2 Inches and Smaller

Bronze body ball valve in accordance with ANSI B16.33, full port pattern, reinforced PTFE seals, threaded ends, and PTFE seat.

2.3.3 Pressure Regulator

Self-contained with spring-loaded diaphragm pressure regulator, psig to inches water reduction, pressure operating range as required for the pressure reduction indicated, volume capacity not less than indicated, and threaded ends for sizes 2 inches and smaller, otherwise flanged.

2.4 GAS EQUIPMENT CONNECTORS

a. Flexible Connectors: ANSI Z21.45.

b. Quick Disconnect Couplings: ANSI Z21.41.

c. Semi-Rigid Tubing and Fittings: ANSI Z21.69.

2.5 CASING

Where indicated at railroad or other crossing, provide ASTM A 53, galvanized pipe, Schedule 40 , with extruded polyethylene coating.

2.6 BURIED UTILITY WARNING AND IDENTIFICATION TAPE

Provide detectable aluminum-foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3-inch minimum width, color-coded yellow for natural gas, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be "CAUTION BURIED GAS PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.7 HANGERS AND SUPPORTS

MSS SP-58, as required by MSS SP-69.

2.8 WELDING FILLER METAL

ASME B31.8.

2.9 PIPE-THREAD TAPE

Antiseize and sealant tape of polytetrafluoroethylene (PTFE).

2.10 BOLTING (BOLTS AND NUTS)

Stainless steel bolting; ASTM A 193/A 193M, Grade B8M or B8MA, Type 316, for bolts; and ASTM A 194/A 194M, Grade 8M, Type 316, for nuts. Dimensions of bolts, studs, and nuts shall conform with ANSI B18.2.1 and ASME/ANSI B18.2.2 with coarse threads conforming to ASME B1.1, with Class 2A fit for bolts and studs and Class 2B fit for nuts. Bolts or bolt-studs shall extend through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Bolts shall have American Standard regular square or heavy hexagon heads; nuts shall be American Standard heavy semifinished hexagonal.

2.11 GASKETS

Fluorinated elastomer, compatible with flange faces.

2.12 IDENTIFICATION FOR ABOVEGROUND PIPING

MIL-STD-101 for legends and type and size of characters. For pipes 3/4-inch od and larger, provide printed legends to identify contents of pipes and arrows to show direction of flow. Color code label backgrounds to signify levels of hazard. Make labels of plastic sheet with pressure-sensitive adhesive suitable for the intended application. For pipes smaller than 3/4-inch od, provide brass identification tags 1 1/2 inches in diameter with legends in depressed black-filled characters.

2.13 (LIQUEFIED PETROLEUM GAS) LPG CONTAINERS AND ACCESSORIES

NFPA 58, ASME containers with appurtenances, system working pressure, minimum design pressure, that is LPG vapor pressure at 100 degrees F, and water capacity as indicated. Provide containers with piping and fittings, fuse plugs, hose and flexible hose connectors, strainer, and marking conforming to NFPA 58.

PART 3 EXECUTION

3.1 INSTALLATION

Install gas piping, appliances, and equipment in accordance with NFPA 54. Install distribution piping in accordance with ASME B31.8. Install and store liquefied petroleum gas piping, appliances, and equipment in accordance with NFPA 58.

3.1.1 Excavating and Backfilling

Perform excavating and backfilling of pipe trenches as specified in Section 02220, "General Excavation, Filling, and Backfilling." Place pipe directly in trench bottom and cover with minimum 3 inches of sand to top of pipe. If trench bottom is rocky, place pipe on a 3-inch bed of sand and cover as above. Provide remaining backfilling. Coordinate provision of utility warning and identification tape with backfill operation. Bury utility warning and identification tape with printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.2 Piping

Cut pipe to actual dimensions and assemble to prevent residual stress. Provide supply connections entering the buildings as indicated. Within buildings, run piping parallel to structure lines and conceal in finished spaces. Terminate each vertical supply pipe to burner or appliance with tee, nipple and cap to form a sediment trap. To supply multiple items of gas-burning equipment, provide manifold with inlet connections at both ends.

3.1.2.1 Cleanliness

Clean inside of pipe and fittings before installation. Blow lines clear using 80-to-100 psig clean dry compressed air. Rap steel lines sharply along entire pipe length before blowing clear. Cap or plug pipe ends to maintain cleanliness throughout installation.

3.1.2.2 Aboveground Steel Piping

Determine and establish measurements for piping at the job site and accurately cut pipe lengths accordingly. For 2-inch diameter and smaller, use threaded or socket-welded joints. For 2 1/2-inch diameter and larger, use flanged or butt-welded joints.

a. Threaded Joints: Where possible use pipe with factory-cut threads, otherwise cut pipe ends square, remove fins and burrs, and cut taper pipe threads in accordance with ANSI/ASME B1.20.1. Provide threads smooth, clean, and full-cut. Apply anti-seize paste or tape to male threads portion. Work piping into place without springing or forcing. Backing off to permit alignment of threaded joints shall not be permitted. Engage threads so that not more than three threads remain exposed. Use unions for connections to valves for which a means of disconnection is not otherwise provided.

b. Welded Joints: Weld by the shielded metal-arc process, using covered electrodes and in accordance with procedures established and qualified in accordance with ASME B31.8.

c. Flanged Joints: Use flanged joints for connecting welded joint pipe and fittings to valves to provide for disconnection. Install joints so that flange faces bear uniformly on gaskets. Engage bolts so that there is complete threading through the nuts and tighten so that bolts are uniformly stressed and equally torqued.

d. Pipe Size Changes: Use reducing fittings for changes in pipe size. Size changes made with bushings shall not be accepted.

e. Painting: Paint new ferrous metal piping, including supports. Do not apply paint until piping tests have been completed.

f. Identification of Piping: Identify piping aboveground in accordance with MIL-STD-101, using adhesive-backed or snap-on plastic labels and arrows. In lieu of labels, identification tags may be used. Apply labels or tags to finished paint at intervals

of not more than 50 feet. Provide two copies of the piping identification code framed under glass and install where directed.

3.1.2.3 Buried Plastic Lines

Provide totally PE piping. Prior to installation, obtain printed instructions and technical assistance in proper installation techniques from pipe manufacturer.

a. PE Piping: Prior to installation, Contractor shall have supervising and installing personnel, certified in accordance with paragraph entitled "Welder's Qualifications." Provide fusion-welded joints except where transitions have been specified. Use electrically heated tools, thermostatically controlled and equipped with temperature indication.

b. Laying PE Pipe: Bury pipe 24 inches below finish grade. Lay in accordance with manufacturer's printed instructions.

3.1.2.4 Wrapping

Where connection to existing steel line is made underground, tape wrap new steel transition fittings and exposed existing pipe having damaged coating. Clean pipe to bare metal. Initially stretch first layer of tape to conform to the surface while spirally half-lapping. Apply a second layer, half-lapped and spiralled as the first layer, but with spirals perpendicular to first wrapping. Use 10-mil minimum thick polyethylene tape. In lieu of tape wrap, heat shrinkable 10-mil minimum thick polyethylene sleeve may be used.

3.1.3 Valves

Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally. Provide support for valves to resist operating torque applied to PE pipes.

3.1.3.1 Pressure Regulator

Provide plug cock or ball valve ahead of regulator. Install regulator outside of building and 18 inches aboveground on riser. On outlet side of regulator provide a union and a 3/8-inch gage tap with plug.

3.1.3.2 Stop Valve and Shutoff Valve

Provide stop valve on service branch at connection to main and shut-off valve on riser outside of building.

3.1.4 Pipe Sleeves

Where piping penetrates concrete or masonry wall, floor or firewall, provide pipe sleeve poured or grouted in place. Make sleeve of steel or cast-iron pipe of such size to provide 1/4-inch or more annular clearance around pipe. Extend sleeve through wall or slab and terminate flush with both surfaces. Pack annular space with oakum, and caulk at ends with silicone construction sealant.

3.1.5 Piping Hangers and Supports

Selection, fabrication, and installation of piping hangers and supports shall conform with MSS SP-69 and MSS SP-89, unless otherwise indicated.

3.1.6 Final Connections

Make final connections to equipment and appliances using rigid pipe and fittings.

3.2 FIELD QUALITY CONTROL

3.2.1 Metal Welding Inspection

Inspect for compliance with NFPA 54 and ASME B31.8. Replace, repair, and then re-inspect defective welds.

3.2.2 PE Fusion Welding Inspection

Visually inspect butt joints by comparing with, manufacturer's visual joint appearance chart. Inspect fusion joints for proper fused connection. Replace defective joints by cutting out defective joints or replacing fittings. Inspect 100 percent of all joints and reinspect all corrections. Arrange with the pipe manufacturer's representative in the presence of the Contracting Officer to make first time inspection.

3.2.3 Pressure Tests

Use test pressure of 1 1/2 times maximum working pressure, but in no case less than 50 psig. Do not test until every joint has set and cooled at least 8 hours at temperatures above 50 degrees F. Conduct testing before backfilling; however, place sufficient backfill material between fittings to hold pipe in place during tests. Test system gas tight in accordance with NFPA 54 or ASME B31.8. Use clean dry air or inert gas, such as nitrogen or carbon dioxide, for testing. Systems which may be contaminated by gas shall first be purged as specified. Make tests on entire system or on sections that can be isolated by valves. After pressurization, isolate entire piping system from sources of air during test period. Maintain test pressure for at least 8 hours between times of first and last reading of pressure and temperature. Take first reading at least one hour after test pressure has been applied. Do not take test readings during rapid weather changes. Provide temperature same as actual trench conditions. There shall be no reduction in the applied test pressure other than that due to a change in ambient temperature. Allow for ambient temperature change in accordance with the relationship PF + 14.7 = $(P_1 + 14.7)$ $(T_2 + 460)$ / $T_1 + 460)$, in which "T" and "PF" represent Fahrenheit temperature and gage pressure, respectively, subscripts "1" and "2" denote initial and final readings, and "PF" is the calculated final pressure. If "PF" exceeds the measured final pressure (final gage reading) by 1/2 psi or more, isolate sections of the piping system, retest each section individually, and apply a solution of warm soapy water to joints of each section for which a reduction in pressure occurs after allowing for ambient temperature change. Repair leaking joints and repeat test until no

reduction in pressure occurs. In performing tests, use a test gage calibrated in one-psi increments and readable to 1/2 psi.

3.2.4 System Purging

After completing pressure tests, and before testing a gas contaminated line, purge line with nitrogen at junction with main line to remove all air and gas. Clear completed line by attaching a test pilot fixture at capped stub-in line at building location and let gas flow until test pilot ignites. Procedures shall conform to NFPA 54 and ASME B31.8.

-CAUTION-

Failure to purge may result in explosion within line when air-to-gas is at correct mixture.

-- End of Section --

SECTION 15620

UNIT HEATERS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z83.8	1990 (Addenda 1990) Gas Unit Heaters

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	1989 (Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B 117	1990 Salt Spray (Fog) Testing
ASTM D 1654	1979 (Rev. A) (R 1984) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	1988 Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Controls and Systems
NEMA MG 1	1987 (Rev. 1) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	1988 National Fuel Gas Code
NFPA 70	1990 National Electrical Code
NFPA 90A	1989 Installation of Air Conditioning and Ventilating Systems
NFPA 90B	1989 Installation of Warm Air Heating and Air Conditioning Systems
NFPA 91	1990 Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying
NFPA 211	1988 Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances

UNDERWRITERS LABORATORIES INC. (UL)

UL 441 1991 Gas Vents

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Unit heaters

1.3.2 SD-19, Operation and Maintenance Manuals

a. Unit heaters, Data Package 2

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

PART 2 PRODUCTS

2.1 UNIT HEATERS

Self-contained and factory assembled, propeller fan with capacities expressed as Btu per hour output and cubic foot-per-minute air delivery, operating conditions, and mounting arrangements as indicated. Average fan bearing life shall be minimum 200,000 hours at operating conditions. Provide fan motor with direct drive. Construct fan-guard motor mount of steel wire. Equip each heater with individually adjustable package discharge louver. Louvers may be substituted by discharge cones or diffusers. Provide thermostats as indicated. Furnish circuit breaker disconnect switch.

2.1.1 Gas-Fired Unit Heater

ANSI Z83.8 and AGA label.

2.1.1.1 Casing

Minimum 22 gage steel. Provide removable access panels.

2.1.1.2 Heat Exchanger

Minimum 20 gage all-welded steel construction with corrosion-resistant aluminum finish.

2.1.1.3 Burners

Die-formed, slot ports, and steel construction with aluminum paint.

2.1.1.4 Draft Diverter

All-welded steel construction and an integral part of each heat exchanger section. Allows backdrafts to bypass burner assembly without affecting normal operation.

2.1.1.5 Controls

Consisting of a combination pressure regulator, main shutoff valve, pilot cock, pilot safety switch for 100 percent shutoff, high temperature limit switch, and time-delay fan switch. Include power and control connections in an integral junction box.

2.1.1.6 Efficiency

Minimum steady state efficiencies shall be 78 percent at maximum rated capacity and 75 percent at minimum rated capacity that is provided and allowed by the controls.

2.1.1.7 Accessories

Provide propane-gas conversion kit and automatic electric pilot recognition kit.

2.2 FAN

Provide steel fans with ball or roller bearings for motors over 1/8 horsepower (hp) and sleeve bearings for motors 1/8 hp and under. Provide sleeve bearings with oil reservoir, if not permanently lubricated.

2.3 MOTOR AND STARTER

NEMA MG 1, and NEMA ICS 2, and NEMA ICS 6, respectively.
Provide continuous-duty motor with built-in automatic reset thermal overload protection. For motor 1/2 hp and larger, use three-phase.
Provide single-phase motor of permanent split capacitor or capacitor start.
Limit motor speed at 1800 r/min. Wire motor to heater power supply source.

2.4 GAS PIPING SYSTEM AND FLUE VENT

Comply with Section 15492, "Fuel Gas Piping," for gas valves and piping. Use UL 441 flue vents and gas-vent roof jacks, of galvanized steel.

2.5 SOURCE QUALITY CONTROL

Special protection is not required for equipment that has a zinc coating conforming to ASTM A 123. Otherwise, protect affected equipment items by manufacturers' corrosion-inhibiting coating or paint system that has proved capable of withstanding salt-spray test in accordance with ASTM B 117. Test indoor and outdoor equipment for 125 hours; test outdoor

equipment used in a marine atmosphere for 500 hours. For each specimen, perform a scratch test as defined in ASTM D 1654.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment where indicated and as recommended by manufacturer's recommendations, NFPA 54, NFPA 90A, NFPA 90B, NFPA 91 and NFPA 211.

3.1.1 Suspensions of Equipment

Provide equipment supports including beam clamps, turnbuckles and twist links or weld-wire chains, wire ropes with rope clips and rope thimbles, threaded-eye rod hangers with lock nuts and heat-duct hangers, threaded-eye bolts with expansion screws, brackets, platform and mounting frame, and vibration isolators. Locate equipment in such a manner that working space is available for servicing, such as vacuum pump and burner removal, access to automatic controls, and lubrication. Provide electrical isolation of dissimilar metals. Clean interior of casings or cabinets before and after completion of installation.

3.1.2 Vents

NFPA 54 and NFPA 211. Provide vents with weatherproofing flashings.

3.1.3 Electrical Work

NFPA 70 and Division 16, "Electrical Work." When replacing original control wires, provide No. 16 AWG with minimum 105 degrees C insulation.

3.2 FIELD QUALITY CONTROL

Administer, schedule, and conduct specified tests. Furnish personnel, instruments and equipment for such tests. Correct defects and repeat the respective inspections and tests. Conduct inspections and testing in the presence of the Contracting Officer.

3.2.1 Test Instruments and Apparatus

Provide instruments and apparatus currently certified as being accurate to within one percent of their full scale. Use gages with a maximum scale between 1 1/2 and 2 times test pressure.

3.2.2 Field Inspection

Prior to initial operation, inspect equipment installation to ensure that indicated and specified requirements have been met.

3.2.3 Field Tests

3.2.3.1 Fuel Piping Pressure Tests

Pneumatically test gas piping at 1 1/2 times operating pressure and check for leakage with soap solution.

3.2.3.2 Fire Tests for Nonelectrical Heating Equipment

Test combustion controls and equipment with specified fuel at 100 percent full rated load. During tests, verify proper operation of controls. Adjust burners for maximum efficiency using Orsat or similar apparatus. Maintain firing for at least four hours. For acceptable combustion efficiency, allow maximum 4.5 percent carbon dioxide in flue gases.

3.2.3.3 Insulation-Resistance Tests for Electrical Equipment

At the completion of wiring, test 600 volt wiring to verify that no short circuits exist before or after the attachment of electrical heating equipment to the power source. Make tests with an instrument which applies a voltage of approximately 500 volts for a direct reading of insulation resistance.

3.2.3.4 Operational Tests

After completing fire tests and insulation-resistance tests, operate equipment continuously under varying load conditions to verify functioning of combustion controls, electrical controls, flame safeguard controls, safety interlocks, and specified operating sequence. Run each test for a minimum period of one hour.

-- End of Section --

SECTION 15780

PACKAGED AIR CONDITIONING UNITS

PART 1 GENERAL

1.1 REFERENCES

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

ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)

AHAM RAC-1	1982 Room Air Conditioners
AHAM DCRAC	1992 Directory of Certified Room Air Conditioners

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI DCUAC	Directory of Certified Unitary Air-Conditioning Equipment
ARI 210/240	1989 Unitary Air-Conditioning and Air-Source Heat Pump Equipment
ARI 380	1990 Packaged Terminal Heat Pumps

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE 15	1992 Safety Code for Mechanical Refrigeration
ASHRAE 52	1976 Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.22	1989 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B31.5	1992 Refrigeration Piping

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	1989 (Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B 88	1992 Seamless Copper Water Tube
ASTM B 117	1990 Salt Spray (Fog) Testing
ASTM B 280	1993 Seamless Copper Tube for Air

	Conditioning and Refrigeration Field Service
ASTM C 534	1988 Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM D 1654	1992 Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM F 1040	1987 Filter Units, Air Conditioning: Viscous-Impingement and Dry Types, Replaceable

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS A5.8	1992 Filler Metals for Brazing and Braze Welding

COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-50502	Air Conditioners, (Unitary Heat Pump), Air to Air (3,000 to 300,000 BTU)

FEDERAL SPECIFICATIONS (FS)

FS OO-A-373	(Rev. C) (Int Am. 1) Air Conditioners, Single Package Type

MILITARY SPECIFICATIONS (MIL)

MIL-C-5541	(Rev. E) Chemical Conversion Coatings on Aluminum and Aluminum Alloys

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	1987 (Rev. 1-2) Motors and Generators

UNDERWRITERS LABORATORIES INC. (UL)

UL 109	1993 Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use
UL 484	1993 (Bul. 1993) Room Air Conditioners
UL 900	1987 (R 1988) Air Filter Units

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Room air conditioners

For packaged terminal units, include indoor noise rating.

1.3.2 SD-04, Drawings

a. Control system wiring diagrams

1.3.3 SD-06, Instructions

a. Room air conditioners

1.3.4 SD-11, Factory Test Reports

a. Salt-spray tests

1.3.5 SD-12, Field Test Reports

a. Start-up and initial operational tests

1.3.6 SD-18, Records

a. Posted operating instructions

1.3.7 SD-19, Operation and Maintenance Manuals

a. Room air conditioners, Data Package 3

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

1.4.1 Modification of References

Accomplish work in accordance with the referenced publications, except as modified by this section. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "the Authority having jurisdiction," "the Administrative Authority," "the Owner," or "the Design Engineer" to mean the Contracting Officer.

1.4.2 Safety

Design, manufacture, and installation of unitary air conditioning equipment shall conform to ASHRAE 15.

1.5 REFRIGERANTS

Refrigerants shall have an Ozone Depletion Factor (ODF) of 0.05 or less. The ODF shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, sponsored by the United Nations Environment Programme.

PART 2 PRODUCTS

2.1 ROOM AIR CONDITIONERS

AHAM RAC-1 and UL 484. Minimum energy efficiency ratio (EER) shall be in accordance with ASHRAE 90.1. Provide units removable from inside the building for servicing without removing the outside cabinet. Construct outside cabinets, including metal grilles to protect condenser coils, of zinc-coated steel or aluminum. Steel and zinc-coated surfaces shall receive at least one coat of primer and manufacturer's standard factory-applied finish Insulate cabinets to prevent condensation and run off of moisture. Provide mounting hardware made of corrosion-resistant material or protected by a corrosion-resistant finish. Provide air filters of the throw-away type removable without the use of tools and arranged to filter both room and ventilating air. Remove condensate by means of a drain or by evaporation and diffusion. Provide with metal or plastic mounting flanges on each side, top, and bottom of unit. For thru-the-wall installations provide aluminum or shop painted zinc-coated steel flanged telescopic wall sleeves. Design wall sleeves to restrict driving rain. For window mounted units provide shop-painted metal mounting brackets, braces, and sill plates. Mount compressors on vibration isolators. Minimum cooling capacity shall be not less than that indicated. Provide units listed in the AHAM DCRAC.

2.1.1 Units for Operation on 115 Volts

Provide 3-wire cords of manufacturer's standard length. If not existing, provide a receptacle within reach of the standard length cord. Cords shall have a 15- or 20-amp, 3-pole, 125-volt ground type plug to match receptacle.

2.1.2 Units for Operation on 208 or 230 Volts

Provide 3-wire cords of manufacturer's standard length. If not existing, provide a receptacle within reach of the standard length cord. Cords shall have a 15-, 20-, or 30-amp, 3-pole, 250-volt ground type plug to match receptacle.

2.1.3 Controls

Mount controls in cabinet. Manual controls shall permit operation of either the fan or the fan and refrigerating equipment. Fan control shall provide two fan speed settings. Automatic controls shall include a thermostat for controlling air temperature. Thermostat shall have an adjustable range, including 72 to 80 degrees F and shall automatically turn the refrigeration system on or off to maintain the preselected temperature within plus or minus 4 degrees F.

2.2 PACKAGED TERMINAL UNITS

2.2.1 Heat Pumps

ARI 380, UL 484, air-cooled, thru-wall type, ARI certified, and UL listed. Minimum energy efficiency shall be in accordance with ASHRAE 90.1. Provide units listed in ARI DCAACP. Provide supplemental electric resistance heaters integral with unit.

2.2.2 Indoor Noise Rating

Rate in accordance with ARI 350. Indoor rating shall not exceed 6.0 bels while entire unit is operating at any fan or compressor speed.

2.2.3 Room Cabinets

Fabricate of 18-gage minimum steel (MSS). Provide removeable front panel and access panels for equipment machinery, coils, controls, and filters. In lieu of steel, front panel may be constructed of high impact styrine structural foam conforming to requirements of UL 484. Structural foam shall pass tests specified in UL 484 for classification of 94 HB. Line interior of steel cabinets with insulation having a fire hazard rating not exceeding 25 for flame spread, and 50 for smoke developed, as determined by ASTM E 84. Caulk around floor mounted units at the floor. Locate wall-mounted units 2 1/2 inches minimum above the floor.

2.2.4 Grilles

Provide manufacturer's architectural anodized aluminum outdoor grilles and caulk and seal on all sides when required by manufacturer's instructions. Provide both horizontal and vertical adjustable deflection inside air supply grilles. Provide for air return under the front panel or a return air grille in the lower part of the front panel.

2.2.5 Wall Sleeves and Mounts

Provide manufacturer's standard wall sleeves and mounts. Wall sleeves shall have seals designed to restrict driving rain and wind. Provide unit subbase of the same construction and finish as the sleeve to provide for concealed electrical connection, cord storage, and equipped with unit leveling legs. Provide subbase with 24-volt remote control circuitry and wall mounted thermostat.

2.2.6 Heating Section for Air Conditioners

a. Electric Coils: Electric resistance heating elements with high temperature-limit safety device, factory-mounted, and wired to chassis.

b. Heating unit shall have internal thermal insulation having a fire hazard rating not to exceed 25 for flame spread and 50 for smoke developed as determined by ASTM E 84.

2.2.7 Refrigeration Sections

Completely self-contained, slide-in assembly or removable chassis with welded, hermetically sealed, air-cooled refrigeration system, outdoor fan, indoor fan, control box, and ventilation damper. Provide refrigeration sections capable of installation or removal without the use of tools. Refrigeration sections shall include refrigeration circuit tubing, wiring, and safety controls, and shall operate down to 35 degrees F outdoor temperature and 70 degrees F indoor temperature, without compressor short cycling while delivering not less than 100 percent of rated cooling capacity. Units shall have drains to the building exterior to eliminate excess driving rain. Condensate shall not drain onto building exterior or interior.

a. Compressors: Hermetic type with vibration isolation devices.

b. Coils: Constructed of seamless copper tubing with aluminum fins bonded to tubes. Coat outdoor air coils with factory applied corrosion resistant treatment. Coils to be coated shall be part of manufacturer's standard product for capacities and ratings indicated and specified. Provide plate type fins.

c. Outdoor Fans: Direct connected centrifugal type with aluminum or plastic wheel and forward curved blades or direct connected aluminum propeller type. Design fans so that condensate will evaporate without drip, splash, or spray on building exterior.

d. Indoor Fans: Direct connected centrifugal type with aluminum, galvanized steel, or plastic wheel and forward curved blades. Provide minimum two-speed motor with built-in overload protection.

2.2.8 Ventilation Damper Assembly

Operated by automatic actuator. Dampers shall close on unit shutdown or loss of power and shall open on heating or cooling start-up.

2.2.9 Air Filters

Removable without use of tools, and shall filter both recirculated and ventilating air.

2.2.10 Controls

Provide controls including, an adjustable thermostat, and switches, to regulate room air temperature through control of refrigerant compressors or heating elements. Controls shall at least have positions for off, high or low fan speed for heating and cooling, and fan only operation. Provide remote mounted night set-back thermostat.

2.3 MOTORS AND STARTERS

NEMA MG 1, NEMA ICS 1, and NEMA ICS 2. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Provide motors to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating.

Motor size shall be sufficient for the duty to be performed and shall not exceed its full load nameplate current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide general-purpose type enclosures in accordance with NEMA ICS 6. Provide energy efficient motors per Section 16011, "Electrical General Requirements."

2.4 REFRIGERANT PIPING AND ACCESSORIES

2.4.1 Factory Charged Tubing

Provide extra soft, deoxidized, bright annealed copper tubing conforming to ASTM B 280, factory dehydrated and furnished with a balanced charge of refrigerant recommended by manufacturer of equipment being connected. Factory insulate suction line tubing with 3/8-inch minimum thickness of closed cell, foamed plastic conforming to ASTM C 534 with a permeance rating not to exceed 1.0.

2.5 FINISHES

Provide steel surfaces of equipment including packaged air conditioners, that do not have a zinc coating conforming to ASTM A 123, or a duplex coating of zinc and paint, with a factory applied coating or paint system. Provide a coating or paint system on actual equipment identical to that on salt-spray test specimens with respect to materials, conditions of application, and dry-film thickness.

2.6 SOURCE QUALITY CONTROL

2.6.1 Salt-Spray Tests

Salt-spray test the factory-applied coating or paint system of equipment including packaged air conditioners in accordance with ASTM B 117. Conduct test for 500 hours for equipment installed outdoors, or 125 hours for equipment installed indoors. Test specimens shall have a standard scribe mark as defined in ASTM D 1654. Upon completion of exposure, evaluate and rate the coating or paint system in accordance with procedures A and B of ASTM D 1654. Rating of failure at the scribe mark shall not be less than six, average creepage not greater than 1/8 inch. Rating of the unscribed area shall not be less than 10, no failure.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Install equipment in a manner to ensure proper and sequential operation of equipment and equipment controls. Install equipment not covered in this section, or in manufacturer's instructions, as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, and controls including, but not limited to, supports, clamps and brackets. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated. Set

anchor bolts and sleeves using templates. Locate equipment to allow working space for servicing .

3.1.1 Packaged Terminal Air Conditioners

Wall sleeve installation shall provide a positive weathertight and airtight seal.

3.1.2 Room Air Conditioners

Install units in accordance with manufacturer's instructions. Provide structural mountings, closures, and seals for weathertight assembly. Pitch unit as recommended by manufacturer to ensure condensate drain to drain pan without overflow.

3.2 FIELD QUALITY CONTROL

3.2.1 Start-Up and Initial Operational Tests

Test the air conditioning system components for proper operation. Adjust safety and automatic control instruments as necessary to ensure proper operation and sequence. Conduct operational tests for not less than 8 hours.

--End of Section--

SECTION 15850

AIR HANDLING EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

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

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

ANSI/AMCA 210	1985 Testing Fans for Rating
AMCA 300	1985 (R 1987) Reverberant Room Method for Sound Testing of Fans
AMCA 500	1991 Louvers, Dampers and Shutters

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 410	1991 Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	1989 Central-Station Air-Handling Units

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z83.4	1991 Direct Gas-Fired Make-Up Air Heaters
ANSI Z83.18	1990 Direct Gas-Fired Industrial Air Heaters

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE 52	1976 Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ANSI/ASHRAE 68	1986 In-Duct Sound Power Measurement Procedure for Fans

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	1989 (Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B 117	1990 Salt Spray (Fog) Testing
ASTM D 1654	1992 Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

FEDERAL SPECIFICATIONS (FS)

FS F-F-2790	Filter, Air-Extended Area, Initial Installation

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	1988 Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Control and Systems
NEMA MG 1	1987 (Rev. 1-2) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1993 National Electrical Code
NFPA 90A	1993 Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA DCS	1985 HVAC Duct Construction Standards - Metal and Flexible

UNDERWRITERS LABORATORIES INC. (UL)

UL 507	1991 (R 1992) (Bul. 1992 and 1993) Electric Fans
UL 586	1990 High-Efficiency, Particulate, Air Filter Units
UL 705	1984 (R 1990) Power Ventilators
UL 900	1987 (R 1988) Air Filter Units

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Central station air handlers

b. Fans

c. Roof curbs

d. Filter Sections

e. Manometers

Include sound rating data and sound power level for all octave-band center frequencies or loudness level.

1.3.2 SD-10, Test Reports

a. Corrosion protection

1.3.3 SD-12, Field Test Reports

a. Preliminary tests

b. Air handling and distribution equipment tests

c. Dampers leakage test

Include certification by the equipment manufacturer's representative.

1.3.4 SD-13, Certificates

a. Central station air handlers

b. Fans

1.3.5 SD-19, Operation and Maintenance Manuals

a. Central station air handlers, Data Package 3

b. Fans, Data Package 3

c. Filter sections, Data Package 2

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

1.4 TESTING FOR CORROSION PROTECTION

Comply with ASTM A 123, or protect equipment with a corrosion-inhibiting coating or paint system that has proved capable of satisfactorily withstanding corrosion in accordance with ASTM B 117. Test 125 hours for equipment installed indoors and 500 hours for equipment installed outdoors or subjected to a marine atmosphere. Each specimen shall have a standard scratch as defined in ASTM D 1654.

1.4.1 Corrosion Criteria

Upon completion of exposure, evaluate coating or painting in accordance with ASTM D 1654. Coat or paint shall show no indication of deterioration, loss of adhesion, or indication of rust or corrosion extending further than 1/8-inch on either side of original scratch.

1.4.2 Thickness of Coating

Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry film thickness.

PART 2 PRODUCTS

2.1 FANS

Total sound power level of the fan shall not exceed 90 dBA when tested per AMCA 300 and rated perAMCA 301; statically and dynamically balanced, with air capacities, brake horsepowers, fan types, fan arrangement, sound power levels or loudness level, and static pressure as indicated. Fan bearing life shall have a minimum average life of 200,000 hours at design operating conditions. Provide nominal 2-mesh 0.063-inch wire diameter, aluminum or stainless steel bird screens for outdoor inlets and outlets. Equip with automatic backdraft dampers where indicated. Have thermal overload protection in the operating disconnect switches within the building. Construct housings and impellers of aluminum except as specified otherwise. Provide non-sparking construction where indicated. For wiring terminations, provide terminal lugs to match branch circuit conductor quantities, sizes, and materials. Enclose terminal lugs in terminal box sized to NFPA 70.

2.1.1 Centrifugal Fans

AMCA 210 with AMCA seal, backward-inclined single width type, direct or V-belt drive motors, and manual inlet vanes as indicated. Provide threaded drain connection. Inlet and outlet duct connections shall be flanged. Impeller shall be constructed of steel or aluminum with smooth curved rim, back plate, blades, and cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.

2.1.2 Propeller Fans

AMCA 210 with AMCA seal, direct or V-belt drive motors. Furnish fans with a three-conductor neoprene covered flexible cable, (Type SO), and a three-prong attachment plug. Provide for connection of permanent wiring. Provide shaped steel or steel reinforced aluminum blade impeller with heavy hubs, statically and dynamically balanced, keyed and locked to shaft.

2.1.3 Power Roof and Wall Ventilators

UL 705 with UL label and AMCA 210 with AMCA seal, centrifugal V-belt fans in low-silhouette housings high-impact plastic with glass fiber reinforcement. Equip motors with unfused safety disconnect switches mounted under fan housings and resilient mounts. Mount motors out of air stream. Provide factory-fabricated roof curbs with continuous curb gaskets and aluminum bird screen. Provide gravity actuated, aluminum multiple blade construction backdraft damper and cast iron or steel sheaves, dynamically balanced and bored to fit shafts and keyed.

2.2 CENTRAL STATION AIR HANDLERS

ARI 430 with sound rating in accordance with ANSI/ASHRAE 68, single-zone type, sound power level, and static pressure, as indicated. Include damper section, supply blower section, filter section and coil section. Filters, housing coils, heaters, and drip pans must be completely removable from the unit without having to dismantle the unit or adjacent equipment.

2.2.1 Casings

Construct casings of steel or galvanized steel, on channel base and drain pan coated externally with manufacturers standard paint finish. Provide removable panels and access doors for inspection and access to internal parts. Insulate casings with manufacturer's standard materials.

2.2.2 Supply Blower (Fan) Sections

Centrifugal fan of backward-inclined blades with V-belt drive motor adjustable, with belt guards for external mounted motors. Belt guards are not required for internally mounted motors. Bearings shall be grease-lubricated ball-bearing type, with minimum average life of 200,000 hours at design operating conditions.

2.2.3 Vibration Isolation

For the entire fan, motor, and drive assembly, provide 2-inch nominal deflection spring vibration isolators, internally mounted at the factory together with fan discharge flexible connection and thrust restraint springs. As an alternate, vibration isolation may be provided external to air handlers. When alternate is chosen, provide 2-inch nominal deflection springs, pipe and duct flexible connections, thrust restraint springs, and spring type pipe hangers on pipes directly-connected to such air handlers.

2.2.4 Filter Sections

Provide visible identification on media frames showing model number and air-flow direction. Where filter bank is indicated or required, provide means of sealing to prevent bypass of unfiltered air. Except extended media with self-supporting cartridge and high efficiency particulate filters, performance shall be determined in accordance with ASHRAE 52. Provide inclined-type manometers for filter stations of 2,000 cfm capacity or more, including filters furnished as integral parts of air-handling units. Manometers with 1/10-inch graduations and spirit level shall be of sufficient length to read at least 3-inch w.g. Equip with over-pressure safety traps and three-way vent valves.

2.2.4.1 Extended Media (Pleated Air Filters

MIL-F-29177, permanent holding frame and filter housing with factory-assembled side access:

a. Pre-Filter (Type I): Internally supported cartridge.

Efficiency: 30, 40 percent rated.

	Pre-Filter Track:	Required.
b.	After-Filter (Type II):	Internally supported cartridge.
	Efficiency:	85 (Grade C) percent rated.

2.2.4.2 Filter Housing

Minimum thickness, 14-gage steel with baked finish inside and out. Hardware shall be stainless steel. Joints shall be continuously welded. Interior of cabinet shall have a heavy duty lever action bar or crank-up mechanism to position filter in place against a flange which contains a fixed air sealing gasket. The fixed air sealing gasket shall be hollow cross section, closed cell rubber or resilient neoprene, suitable for repetitive reuse. Cabinets shall have flanged ends for connection to adjacent ducts. Hinged access doors on both cabinet sides. Provide access doors with fixed air sealing gaskets to be airtight at the static pressure expected in service. Provide two 3/8-inch Society of Automotive Engineers (SAE) flare connection test ports complete with seal cap, one on each side of the filter. Weld test ports into each filter cabinet or plenum. Test port shall not penetrate to filter frame or media.

2.2.5 Heating

2.2.5.1 Gas Heaters

Direct gas fired heater per ANSI Z83.18 and ANSI Z83.4 with American Gas Association (AGA) label. Outdoor air velocity across the burner shall be designed for 3,000 fpm through a fixed, factory-set profile. The gas burner shall be designed to burn propane at non-contaminating levels below that as required by OSHA. The burner shall have a 25 to 1 control turndown ration. Provide electronic ignition for burners.

2.3 MOTORS AND MOTOR STARTERS

NEMA MG 1, NEMA ICS 2, and NEMA ICS 6, respectively, with electrical characteristics as indicated. Motors shall be totally-enclosed. Motor starters shall be magnetic-across-the-line type with general-purpose enclosure.

2.4 ROOF CURBS

Factory-fabricated sheet-steel structural members. Provide minimum 4-inch cants for built-up roofing, 2- by 6-inch factory-installed wood nailers, and fully mitered end sections. Provide welded 18-gauge galvanized steel shell, base plate, and counterflashing and provide stiffness required to eliminating deflection.

2.5 CORROSION PROTECTION FOR MARINE ENVIRONMENTS

2.5.1 Corrosion Protection for Marine Environments

Provide a special finish on the interior of the equipment and the exterior, where indicated. Apply coating at the premises of a company specializing in such work.

2.5.1.1 Mild Steel and Factory Primed Surfaces

a. Synthetic Resin Primer: 36 percent, plus or minus 6 percent, solids content by volume; 1 coat, 3 mils minimum dry film thickness.

b. Vinyl Copolymer: 23 percent, plus or minus 4 percent, solids content by volume; 2 coats, 1 1/2-mils minimum dry film thickness per coat.

2.5.1.2 Nonferrous Heat Exchanger Fin Coil Surfaces

Vinyl copolymer, 4 coats, 1 1/2-mils minimum dry film thickness per coat.

2.5.1.3 Galvanized Surfaces

a. Polyamide Epoxy Primer: 48 percent, plus or minus 2 percent, solids content by volume; 1 coat, 2 mils minimum dry film thickness.

b. Vinyl Copolymer: 23 percent, plus or minus 4 percent, solids content by volume; 2 coats, 1 1/2-mils minimum dry film thickness per coat.

2.5.1.4 Aluminum Surfaces Other than Fin Coil Surfaces

a. Polyamide Epoxy Primer: 48 percent, plus or minus 2 percent, solid contact by volume; 1 coat, 2 mils minimum dry film thickness.

b. Vinyl Copolymer: 23 percent, plus or minus 4 percent, solids content by volume; 2 coats, 1 1/2-mils minimum dry film thickness per coat.

PART 3 EXECUTION

3.1 PREPARATION

Provide storage for equipment and materials at the project site. Parts shall be readily accessible for inspection, repair, and renewal. Protect materials and equipment from weather.

3.2 INSTALLATION

Install air distribution equipment as indicated and in accordance with the manufacturer's instructions. Provide clearance for inspection, repair, replacement, and service. Electrical work shall conform with NFPA 70 and Division 16, "Electrical." Provide overload protection in the operating disconnect switches and magnetic starters. Locate air intake of air handling equipment at a minimum of 25 feet from industrial stacks, bathroom vents, and sanitary risers. Prevailing wind direction shall not be used as justification for placing air intake closer than 25 feet of exhaust stacks. Locate annunciator panel in maintenance office or foreman's office.

3.2.1 Fans

Install with resilient mountings, flexible electrical leads, and flexible connections between fan inlet and discharge ductwork. Provide fixed sheaves required for final air balance and safety screen where inlet or outlet is exposed.

3.2.2 Air Handling Units

Install assembled units on vibration isolators and isolate fan section with flexible duct connections. Bolt sections together in high pressure units. Pipe drain pan to the nearest floor drain.

3.2.3 Power Ventilators

Secure roof exhausters with stainless steel lag screws to roof curb structure. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

3.3 FIELD QUALITY CONTROL

Schedule and administer specified tests. Provide personnel, instruments, and equipment for such tests. Correct defects and repeat the respective inspection and tests. Give the NTR ample notice of the dates and times scheduled for tests and trial operations. Conduct inspection and testing in the presence of the NTR.

3.3.1 Inspection

Prior to initial operation, inspect equipment installation for conformance with drawings and specifications.

3.3.2 Preliminary Tests

For each item of air handling and distribution equipment and its components, perform an operational test for a minimum period of 4 hours.

3.3.3 Testing and Balancing

After preliminary tests, perform air handling and distribution equipment tests, adjustment, and balancing in accordance with Section 15996, "Testing/ Adjusting/Balancing: Heating/Ventilating/Cooling Systems".

-- End of Section --

SECTION 15871

INDUSTRIAL VENTILATION AND EXHAUST SYSTEMS (DUCTS AND FANS)

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 2080	1992 Industrial Ventilation

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA 9	1990 Load Ratings and Fatigue Life for Ball Bearings
AFBMA 11	1990 Load Ratings and Fatigue Life for Roller Bearings

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 99	1986 Standards Handbook
AMCA 99-0401-66	Classification for Spark Resistnat Construction
ANSI/AMCA 201	1990 Fan Application Manual - Fans and Systems
ANSI/AMCA 210	1985 Testing Fans for Rating
AMCA 211	1987 Certified Ratings Program for Air Moving Devices
AMCA 261	1992 Directory of Products Licensed to Use the AMCA Seal
AMCA 300	1985 (R 1987) Reverberant Room Method for Sound Testing of Fans
AMCA 500	1991 Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI IP-20	1988 Drives Using Classical V-Belts and Sheaves Cross Sections, A, B, C, and D

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	1989 (Rev. A) Zinc (Hot-Dip Galvanized)

	Coatings on Iron and Steel Products
ASTM A 525	1991 (Rev. B) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 527/A 527M	1990 Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock-Forming Quality
ASTM B 117	1990 Salt Spray (Fog) Testing
ASTM C 582	1987 Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment
ASTM D 1330	1985 (R 1990) Rubber-Sheet Gaskets
ASTM D 1654	1992 Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 4167	1991 Fiber-Reinforced Plastic Fans and Blowers

AMERICAN WELDING SOCIETY, INC. (AWS)

ANSI/AWS Z49.1	1988 Safety in Welding and Cutting

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	1988 (Rev. 1-2) Industrial Control and Systems
NEMA ICS 2	1988 Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Control and Systems
NEMA MG 1	1987 (Rev. 1-2) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1993 National Electrical Code
NFPA 91	1992 Exhaust System for Air Conveying of Materials

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA APIDC	1975 Accepted Industry Practice for Industrial Duct Construction
SMACNA HVACADLTM	1985 HVAC Air Duct Leakage Test Manual

SMACNA RIDCS	1980 Rectangular Industrial Duct Construction Standards
SMACNA RIDCSTD	1977 Round Industrial Duct Construction Standards

UNDERWRITERS LABORATORIES INC. (UL)

UL 181	1990 (R 1990) Factory-Made Air Ducts and Air Connectors
UL 214	1976 (Bul. 1992) Flame-Propagation of Fabrics and Films

1.2 GENERAL REQUIREMENTS

1.2.1 SMACNA Duct Construction Manuals

The recommendations in the Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) duct construction manuals shall be considered mandatory requirements. Substitute the word "shall" for "should" in these manuals.

1.2.2 Related Requirements

Conform to Section 15011, "Mechanical General Requirements" as well as additional requirements specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Fans

b. Dampers

c. Flexible connectors

d. Gaskets

e. Protective coating materials

f. Sealants

g. Access ports

h. Damper regulators

i. Supports and hangers

j. Vibration isolators

k. Steel ducts

l. Fiberglass ductwork

1.3.1.1 Fan Data

For fans include fan curves or rating tables and derating factors. Provide certified performance curves showing total pressure, HP, and mechanical efficiency versus flow rate of the operating density and fan speed. All areas of unstable operation shall be indicated. For fans equipped with adjustable capacity controls such as variable inlet or vaneaxial fans with adjustable blade settings, minimum and maximum performance shall be indicated along with performance for fire intermediate settings.

1.3.2 SD-04, Drawings

a. Industrial ventilation and exhaust systems

1.3.2.1 Industrial Ventilation and Exhaust Systems

Submit drawings including fan installation drawings; duct systems, supports and anchor location and load imposed.

1.3.3 SD-08, Statements

a. Welding procedures

b. Welding test agenda

c. Welding test procedures

d. Welders' identification

e. Work plan

f. Fiberglass fan servicer experience information

1.3.3.1 Welders' Identification

Submit a listing of the names and identification symbols to be used to identify the work performed by the welder or welding operator who after completing a welded joint shall identify it as his work by applying his assigned symbol for a permanent record.

1.3.3.2 Work Plan

Submit a detailed agenda of the proposed work to the NTR prior to starting any work.

1.3.3.3 Fiberglass Fan Servicer Experience Information

Submit text.

1.3.4 SD-10, Test Reports

a. Fan tests, including sound power level tests

1.3.5 SD-12, Field Test Reports

a. Ventilation and exhaust system start-up tests

b. Sound level tests

1.3.5.1 Start-Up Tests

Submit start-up tests reports in accordance with the paragraph entitled "Testing, Adjusting and Balancing." Submit final test report for the systems tested, describing all test apparatus, instrumentation calculations, factors, flow coefficients, sound levels, and equipment data based on ACGIH 2080 recommended forms or reasonable facsimiles thereof to suit project conditions. Adjustment and setting data shall be included in test report. Submit sound level test reports for high noise level equipment.

1.3.6 SD-18, Records

a. Posted operating instructions

Submit text of posted operating instructions for ventilation and exhaust systems.

1.3.7 SD-19, Operation and Maintenance Manuals

a. Fans, Data Package 2

b. Industrial ventilation and exhaust systems, Data Package 2

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

1.4 QUALIFICATIONS

1.4.1 Qualified Personnel

Operations involving joining fiberglass ductwork by laminating shall be performed by personnel certified by the manufacturer as qualified for the work.

1.4.2 Qualification of Welders

Qualify each welder or welding operator by tests using equipment, welding procedures and a base metal and electrode or filler wire from the same compatible group number that will be encountered in the applicable welding test procedures. Welders or welding operators who make acceptable procedure qualification test welds will be considered performance qualified for the welding procedure used. Determine performance qualification in accordance with AWS D1.1. Notify the NTR 24 hours in advance as to the time and place of tests and wherever

practical perform the tests at the work site.

1.5 POSTED OPERATING INSTRUCTIONS

Provide for ventilation and exhaust system. In addition, permanently mark, drill, and pin as an integral part of device, final adjustment and settings pursuant to testing, adjusting, and balancing.

1.6 SAFETY PRECAUTIONS

1.6.1 Guards and Screens

Provide metal personnel safety guards for normally accessible unducted fan inlets and discharges and moving power transmission components in accordance with OSHA 29 CFR 1910.219.

1.6.2 Welding

Conform to ANSI/AWS Z49.1 for safety in welding and cutting.

PART 2 PRODUCTS

2.1 FANS, GENERAL REQUIREMENTS FOR

2.1.1 General Performance, Component, and Other Requirements

Fans shall have certified performance ratings as evidenced by conformance to the requirements of AMCA 211, and shall be listed in AMCA 261, or shall be currently eligible for such listing. Fans shall generally be in accordance with AMCA 99 unless superseded by other requirements stated elsewhere herein. Determine performance data for fans in accordance with ANSI/AMCA 210. Select fans to minimize the exposure of personnel working in or occupying the immediate installation area. The total sound power level of the fan tests shall not exceed 90 dBA when tested per AMCA 300 and rated per AMCA 301, or it shall be provided with an appropriate attenuation device or devices. Scheduled fan performance is the performance required under specified or indicated installation conditions with specified or indicated accessories. The net installed air performance of the fan, with accessories/appurtenances in place, shall be sufficient to meet the scheduled performance within the limits of the fan rating certification tolerance. Affix the manufacturer's product identification nameplate to each unit. Apply additional requirements for specific service or generic type or class of fan. If nonuniform air flow conditions are likely to be encountered, contact the fan manufacturer to ensure that the fan is rated for the additional fan inlet and outlet effect. Install fans to minimize fan system effect in accordance with ANSI/AMCA 201. Fans shall be listed in the Directory of Products licensed to use AMCA seal.

2.1.2 Bearings and Lubrication

Precision anti-friction or sleeve type with provisions for self-alignment and for radial and thrust loads imposed by the service. Provide water-cooled bearings where required for the service or recommended by the manufacturer.

2.1.2.1 Anti-friction Bearings

Constructed of steel alloys with a certified L-10 minimum rated life of 80,000 hours under load conditions imposed by the service. Rated and selected in accordance with AFBMA 9 and AFBMA 11. Provide with dust-tight seals suitable for environment and lubricant pressures encountered; cast ferrous metal housing, bolted-split pillow block type where located within fan casings; grease lubricated with provisions to prevent overheating due to excess lubricant; surface ball check type grease supply fittings. Provide manual or automatic grease pressure relief fittings visible from normal maintenance locations. Include lubrication extension tubes where necessary to facilitate safe maintenance during operation and fill tubes with lubricant prior to equipment operation. Prelubricated, sealed, anti-friction bearings, which conform to above specified materials and L-10 life requirements, may be provided for fans requiring less than 1/2 horsepower.

2.1.2.2 Sleeve Bearings

Premounted, self-aligning, continuous oil supply, single or double ring lubricated, insert type, with suitable provisions for shaft expansion and such thrust as may be imposed by service loads. Provide water cooling for shaft surface speed exceeding 1200 feet per minute. Provide each sleeve bearing with approximately 16-ounce capacity constant level oiler and oil level gage. Include on sleeve bearing submittal data: Bearing manufacturing source, type, lubricant, clearances, "L/D" ratio, antifriction metal, belt angle, shaft speed, shaft critical speed, Brinell hardness at journal, and shaft surface finish at journal in micro-inches.

2.1.3 Motors and Motor Starters

Conform to NEMA MG 1 and NEMA ICS 1 and NEMA ICS 2. Motors shall not exceed 1800 rpm, unless otherwise indicated, and shall be totally enclosed fan cooled type. Provide magnetic-across-the-line type motor starters with general-purpose NEMA 1 enclosure in accordance with NEMA ICS 6. Provide single-phase motors with inherent thermal overload protection with manual reset. Provide three-phase motors with thermal overload protection in the control panel. Provide permanently lubricated or grease-lubricated ball or roller bearings; auxiliary lubrication and relief fittings on outside of fan casing; arrange grease lines to minimize pressure on bearing seals. Motor horsepower shall not be less than brake horsepower required with blades set at maximum pitch angle at any air delivery from the indicated amount down to 50 percent thereof.

2.1.4 Guards and Screens

Construct guards and screens to provide, as applicable: required strength and clearance with minimal reduction in free area at fan inlets and discharges; cooling; access panels for tachometer readings; ease of sectional disassembly for maintenance and inspection functions where guard total weight exceeds 50 pounds; weather protection where components are weather exposed. Installed guards and screens shall not negate noise control and vibration isolation provisions.

2.1.5 Power Transmission Components

2.1.5.1 Fan Drives

Direct or V-belt type as indicated. Drives shall be applied in accordance with the manufacturer's published recommendations, unless specified otherwise. Base horsepower rating of a V-belt drive on maximum pitch diameter of sheaves. Provide classical belt section adjustable sheave type, with a minimum service factor of 1.5 for drives with motors rated up to and including 30 hp. Provide at least two belts for drives with motors rated one hp and above.

2.1.5.2 Sheaves

Statically and dynamically balanced, machined cast ferrous metal or machined carbon steel, bushing type, secured by key and keyway. Pitch diameter or fixed sheaves and adjustable sheaves, when adjusted to specified limits, shall not be less than that recommended by NEMA MG 1. Select adjustable sheaves that provide the required operating speed with the sheave set at midpoint of its adjustment range. The adjustment range for various size and type belts shall be: 16 percent, minimum for Classical section belts; 12 percent, minimum for Narrow section belts. Belt deflection in adjustable sheave drives shall not exceed 1 1/2-degrees. Provide companion sheaves for adjustable sheave drives with wide groove spacing to match driving sheaves, except that standard fixed pitch spacing may be used for all two-through-four groove drives whose center-to-center dimensions exceed the following: "A" and "B" Section 16 inches; "C" Section 25 inches; "D" Section 36 inches. Furnish endless, static dissipating, oil-resistant, synthetic cloth or filament reinforced elastomer construction belts.

2.2 CENTRIFUGAL FANS

2.2.1 General Requirements for Centrifugal Fans

Provide fan of backward inclined blades. Arrange fans for indicated service, and construct for the applicable AMCA 99 Class pressure ratings as indicated for system design pressure and temperature. Fan shaft shall be solid steel, ground and finished as required for the service, with first critical speed a minimum 25 percent higher than cataloged fan speed. Select fan for maximum efficiency, minimum noise, and stability during all modes of system operation. Vibration isolation mountings shall be spring type and limit vibration transmissibility to a maximum 5 percent of the unbalanced force at lowest equipment speed, unless otherwise specified or indicated. Arrangement and drives shall be as indicated.

2.2.2 Fiberglass Centrifugal Fans

ASTM D 4167. Construct of fire retardant fiberglass with a flame spread rating at least equal to or less than that of the duct system. Housing and fan impeller shall be fiberglass. Shaft and fan support stand shall be steel with protective coating. Provide exterior gel coat, coating, or paint with ultraviolet light inhibiting properties for fans exposed to sunlight. Fiberglass fans shall be suitable for the intended service. Provide with flanged outlet and inlet connections, threaded and

plugged scroll drain, bolted access and inspection doors, and epoxy coated steel fan base and motor mount.

2.3 BASIC MATERIALS

2.3.1 Coated and Uncoated Carbon Steel Sheets, Plates, and Shapes

2.3.1.1 Mill Galvanized Steel Sheet

ASTM A 527/A 527M, lock forming quality, Coating G-90

2.3.1.2 Mill Galvanized Steel Shapes

ASTM A 36/A 36M galvanized in accordance with ASTM A 123.

2.3.2 Corrosion Protection

Treat equipment fabricated from ferrous metals that do not have a zinc coating conforming to ASTM A 123 for prevention of corrosion with a factory coating or paint system that will withstand 125 hours in a salt-spray fog test except that equipment located outdoors shall withstand 500 hours. Perform salt-spray fog test in accordance with ASTM B 117. Each specimen shall have a standard scribe mark as defined in ASTM D 1654. Upon completion of exposure, evaluate and rate the coating or paint system in accordance with procedures A and B of ASTM D 1654. The rating of failure at the scribe mark shall be not less than six (average creepage not greater than 1/8 inch). The rating of the unscribed area shall be less than ten (no failure). Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry-film thickness.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Filler Metal, Welding

AWS filler metal specification and grade compatible with base materials to develop full joint strength.

2.4.2 Flashing Materials

Mill galvanized, phosphatized, steel sheet with minimum spangle, conforming to ASTM A 525, Coating G90, 24-gage minimum thickness. Mill No. 1 or 2D finished, stainless steel, fully annealed, soft temper, conforming to ASTM A 167, Type 304, 0.015-inch minimum thickness. Mill finished copper, conforming to ASTM B 152, minimum 16 ounces per square foot.

2.4.3 Flexible Connectors

2.4.3.1 General Service

Airtight, fire-retardant, fume and vapor resistant, chloroprene or chlorosulfonated polyethylene impregnated, woven fibrous glass fabric, rated for continuous service at 250 degrees F, conforming to UL 214, with 20-ounce per square yard weight for service at 2 inches water gage and

under and 30-ounce per square yard weight for service over 2 inches water gage. Provide with or without integral 24-gage mill galvanized sheet metal connectors.

2.4.3.2 Fume Service

1/8 thick, single-ply, synthetic fabric reinforced chloroprene suitable for 225 degrees F.

2.4.4 Gaskets

2.4.4.1 Elastomer Buna N

Sheet, 1/8-inch thick, conforming to ASTM D 2000, Type 2BG410B14.

2.4.4.2 Elastomer Chloroprene

Sheet, 1/8-inch thick, conforming to ASTM D 2000, Type 2BE410B14.

2.4.4.3 Rubber

Sheet, 1/8-inch thick red or black, natural, reclaimed, synthetic rubber or mixture thereof, conforming to ASTM D 1330.

2.4.5 Protective Coating Materials

2.4.5.1 Baked Unmodified Phenolic

MIL-V-12276, Type II.

2.4.5.2 Inorganic Zinc Coating

SSPC Paint 20, Type I-C (Self-cure type).

2.4.5.3 Galvanizing Repair Paint

Conform to MIL-P-21035.

2.4.6 Sealants

2.4.6.1 Elastomeric

Sealant specified in these specifications or referenced standards as elastomeric or without further qualification, shall be silicone, polyurethane, polysulfide, polyisobutylene, or acrylic terpolymer suitable for the service. For sealing of nongasketed duct joints during fabrication or assembly, sealant shall be polyurethane, acrylic terpolymer or polysulfide. Sealants shall conform to the following:

a. Silicone: Conforming to FS TT-S-001543, single component type, not requiring primed substrate, with manufacturer published estimated life of 30 years and a maximum 5 percent shrinkage when cured.

b. Polyurethane: Conforming to FS TT-S-00230, Type 2, Class A,

single component type, not requiring primed substrate, with manufacturer published estimated life of 20 years and a maximum 10 percent shrinkage when cured.

c. Polysulfide: Conforming to FS TT-S-00230, Type 2, Class A, single component type, not requiring primed substrate, with manufacturer published estimated life of 20 years and a maximum 10 percent shrinkage when cured.

d. Polyisobutylene/Butyl: Conforming to FS TT-S-001657, Type 1, single component type, not requiring primed substrate, with manufacturer published estimated life of 10 years and a maximum 15 percent shrinkage when cured.

e. Acrylic Terpolymer: Conforming to FS TT-S-00230, single component type, not requiring primed substrate, with manufacturer's published estimated life of 20 years and a maximum 10 percent shrinkage when cured.

2.4.6.2 Hard Cast Caulking for Exterior Ducts

Mineral and adhesive impregnated woven fiber tape with adhesive activator for exterior round or rectangular duct joints.

2.4.6.3 Caulking of Building Surface Penetration

Foamed silicones, two-component, fire-resistant, low-exotherm, room temperature vulcanizing silicone.

2.5 SPECIALTIES

Steel, nonferrous metal, or plastic to match duct construction, or as indicated.

2.5.1 Access Ports, Test

With gasketed screw cap and flange, to suit exhaust service.

2.5.2 Damper Regulators

Incremental position indicating and locking type, with satin finish chrome plated, flush surface mounting cover and regulator box where concealment is required in finished spaces. For splitter dampers, provide splitter tip mounted trunion brackets with self-locking screw regulator or rods with external swivel joint brackets.

2.6 SUPPORTS AND HANGERS

2.6.1 General Requirements for Supporting Elements

Provide ducting systems and equipment supporting elements including but not limited to building structure attachments; supplementary steel; hanger rods, stanchions and fixtures; vertical duct attachments; horizontal duct attachments; anchors; supports. Design supporting elements for stresses imposed by systems, with a minimum safety factor of 4.0 based on duct being

50 percent full of particulate conveyed. Supporting elements shall conform to SMACNA APIDC, SMACNA RIDCSTD, SMACNA RIDCS, and NFPA 91, as applicable, and modified and supplementary requirements specified herein. Do not use weld studs and powder actuated anchoring devices to support mechanical systems components without prior approval.

2.6.2 Vertical Attachments

Provide in accordance with SMACNA Standards, except mill galvanized iron straps shall be a minimum of one-inch wide, 16-gage thick.

2.6.3 Horizontal Attachments

Provide as indicated in accordance with SMACNA Standards.

2.6.4 Supplementary Steel

Provide where required to frame structural members between existing members or where structural members are used in lieu of commercially rated supports. Such supplementary steel shall be fabricated in accordance with the AISC S335.

2.6.5 Vibration Isolators

Provide vibration isolators with in-series, contained, steel springs, chloroprene elastomer elements, and fasteners for connecting to building structure attachments. Devices shall be loaded by support system in operating condition to produce required static spring deflection without exceeding 75 percent of device maximum load rating.

2.7 FIBERGLASS DUCTWORK

Ductwork, Fiberglass for Nonflammable Fume Exhaust:

2.7.1 Fiberglass Ductwork

Construct ductwork, fittings, accessories, and material of construction in accordance with NFPA 91, and ASTM C 582. Fabricate supplementary steel in accordance with the AISC S335.

2.7.2 Basic Ductwork Materials

Fabricate ducts, accessories and components in sheet form from materials conforming to ASTM C 582. Provide exterior gel coat, coating or paint with ultraviolet light inhibiting properties for ducts exposed to sunlight. Construct metal components, when permitted to be located interior to the duct, of Type 316 corrosion resistant steel.

2.7.3 Fasteners

Where penetration of duct surfaces is approved or specified, provide Type 316 corrosion resistant steel fastener assemblies encapsulated with polyster on duct interior, unless total disassembly is intended. Provide flange fastener bolts and nuts of hex type only, cadmium plated, unless exposed to corrosive fumes; in which case provide Type 316 stainless steel.

Equip bolted assemblies with two oversized washers, except where assembled with metallic reinforcement contact. Plastic bolting is prohibited.

2.7.4 Joint Gaskets

Provide 1/8-inch thick acid resistant chloroprene.

2.7.5 Fabrication

Construct water washable, watertight, self-draining, and airtight ductwork as specified or indicated. Provide required reinforcements, bracing, supports, framing, gasketing, sealing, resilient mounting, drainage provisions, and fastening to guarantee rigid construction and freedom from vibration, airflow induced motion and noise, and excessive deflection at specified maximum system pressure and velocity.

2.7.5.1 Flanges

Provide flanges at all branches on maximum 20-foot centers in ducting sized 16 inches and under, on maximum 8-foot centers in duct sized over 16 inches, where required for ease of access to equipment, at hoods, enclosure connections and where indicated. Furnish one piece, heat, adhesive, or solvent vulcanized or bonded full face gaskets at flange joints. Provide flanges at dissimilar material joints, such as between fiberglass reinforced plastic (FRP) and PVC.

2.7.5.2 Access Plates

Provide access plates upstream and downstream of equipment in ducts at locations to facilitate duct cleaning, and where indicated. Locate access openings at least 2 inches above bottom of duct and externally frame with welded and ground miter joint steel which is isolated from duct interior. Construct access plate with fiberglass on interior side, backed with steel on exterior side. Provide Type 316 stainless steel access plate fasteners. For ductwork cleaning access, provide 8-inch diameter gasketed access plates on not more than 10-foot centers, except where access is available through an air terminal device or other required access provision.

2.8 STACKHEADS

Provide SMACNA APIDC no loss type stackheads for vertical discharge to the atmosphere unless indicated otherwise. Weather caps are prohibited. Provide bracing or guy wires for wind loads on stacks as indicated. Discharge stacks should be vertical and terminate at a point where height or velocity prevents reentry of exhaust air.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Installation Requirements

Install in accordance to NFPA 91, and SMACNA RIDCSTD, and SMACNA RIDCS. Provide mounting and supports for equipment, ductwork, and accessories, including structural supports, hangers, vibration isolators,

stands, clamps and brackets, access doors, and dampers. Install accessories in accordance with the manufacturer's instructions. Construct positive pressure duct inside buildings airtight.

3.1.2 Electrical Ground Continuity

Where electrical ground continuity is required, provide brazed connection insulated, multi-strand, copper wire jumpers across points of discontinuity. Provide connection to ground and continuity testing as part of the work of Division 16.

3.1.3 Special Requirements for Installation of Fiberglass Ductwork

Requirements for Installation of Fiberglass Ductwork for Nonflammable Corrosive Fume and Vapor Exhaust:

3.1.3.1 Slope

Slope horizontal ducts one inch in 40 feet in the direction of airflow or one inch in 10 to the direction of airflow. Where necessary, slope duct to common drainage point.

3.1.3.2 Drains

Provide drains at all low points, at internal drainage restrictions, at base of risers, and where indicated. Provide drain connections of one-inch IPS couplings with polytetrafluoroethylene paste lubricated plug where drainage piping is not indicated, and where piping is indicated, provide PVC Type DWV piping conforming to ASTM D 2665 to points indicated. Provide a trap of one inch greater depth than the positive or negative pressure in the duct but not less than 2 inches.

3.1.3.3 Duct Supports

Isolate duct support contact surfaces from supporting steel by 1/4-inch thick closed-cell foamed cellular elastomer insulation material of a width greater than support. Design duct supporting system to include additional weight due to collection of condensate and washing water in nondrainable, deflected surface and other areas.

3.1.4 Miscellaneous Sheet Metal Work

Provide and fabricate from mill galvanized steel as indicated. Sheet metal thickness, reinforcement and fabrication, where not indicated, shall conform to SMACNA APIDC.

3.1.5 Building Penetrations

3.1.5.1 General Penetration Requirements

Provide properly sized, fabricated, located, and trade coordinated sleeves and prepared openings, for duct mains, branches, and other item penetrations, during the construction of the surface to be penetrated. Provide sleeves for round duct 15 inches and smaller and prepared openings for round duct larger than 15 inches and square or rectangular duct.

Fabricate sleeves, except as otherwise specified or indicated, from 20-gage, 0.0396-inch thick mill galvanized sheet metal. Sleeves penetrating load bearing surfaces shall be standard weight galvanized steel pipe. Provide roof penetrations as shown in SMACNA APIDC.

3.1.5.2 Framed Opening

Provide framed openings in accordance with approved shop drawings.

3.1.5.3 Clearances

Provide a minimum one inch clearance between penetrating and penetrated surfaces. Fill clearance space with bulk fibrous glass or mineral wood or foamed silicone and seal and close.

3.1.5.4 Tightness

Penetration shall be weathertight.

3.1.5.5 Sealants

Provide sealant of elastomeric type or foamed silicone type, as specified under paragraph entitled "Sealants," in this section. Apply to oil free surfaces to a minimum 3/8-inch depth.

3.1.5.6 Closure Collars

Provide a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around penetrating item without contact. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20-gage, 0.0396-inch nominal thickness, mill galvanized steel. Attach collars a minimum of 4 fasteners to where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20-gage, 0.0396 inch nominal thickness, mill galvanized steel. Fabricate collars for round, square, and rectangular ducts with minimum dimension over 15 inches from 18-gage, 0.0516 inch in nominal thickness, mill galvanized steel. Install collars with fasteners a maximum of 6-inches on center.

3.1.6 Installation of Flexible Connectors

Flexibly connect duct connected and vibration isolated fans and specified or indicated components. When fans are started, stopped, or operating, flexible connector surfaces shall be curvilinear, free of stress induced by misalignment or fan reaction forces, and shall not transmit vibration. Leakage shall not be perceptible to the hand when placed within 6 inches of the flexible connector surface or joint. Provide a minimum of 6 inches and a maximum of 2 feet active length with a minimum of one inch of slack, secured at each end by folding in to 24-gage sheet metal or by metal collar frames.

3.1.7 Installation of Supports

3.1.7.1 Selection

Select duct and equipment support system taking into account the best practice recommendations and requirements of SMACNA RIDCSTD, SMACNA RIDCS, and NFPA 91; location and precedence of work under other sections; interferences of various piping and electrical work; facility equipment; building configuration; structural and safety factor requirements; vibration and imposed loads under normal and abnormal service conditions. Indicated support sizes, configurations, and spacings are the minimal type of supporting component required for normal loads. Where installed loads are excessive for the normal support spacings, provide heavier duty components or reduce the element spacing. After system start-up, replace or correct support elements which vibrate and cause noise or possible fatigue failure. Exercise special care to prevent cascading failure.

3.1.7.2 General Requirement for Supports

Securely attach supporting elements to building structural steel or structural slabs. Where supports are required between building structural members provide supplementary structural steel as specified for work under this section. On submittals show location of supports and anchors and loads imposed on each point of support or anchor. Do not hang ductwork or equipment from piping, or other ducts or equipment. Attach supports to structural framing member and concrete slab. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required, between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips. A maximum span of 10 feet shall exist between any two points, with lesser spans as specified or as required by duct assemblies, interferences, and loads imposed or permitted. Provide a minimum one set of two vertical support elements for each point of support and each length of duct, except as otherwise specified. Install supports on both sides of all duct turns, branch fittings, and transitions. Cross-brace hangers sufficiently to eliminate sway. Perforated strap hangers are prohibited. Where ductwork system contains heavy equipment, hang such equipment independently of the ductwork. Duct supports shall be vibration isolated from structure at points indicated. The location of supporting elements shall be limited by the allowable load on the purlin which shall be limited to that no greater than the moment produced by one Kip load at mid-span of purlin. When the hanger load exceeds these limits, provide reinforcing of purlins or additional support beams. When an additional beam is used, the beam shall bear on the top chord of the roof trusses and bearing shall be over gusset plates of top chord. Stabilize beam by connection to roof purlin along bottom flange.

3.1.7.3 Methods of Attachment

Clamp, or weld when approved, attachment to building structural steel in accordance with AWS D1.1. Construct masonry anchors selected for overhead applications of ferrous materials only. Install masonry anchors in rotary, non-percussion, electric drilled holes. Self-drilling anchors

may be used provided masonry drilling is performed with electric hammers selected and applied in such a manner as to prevent concrete spalling or cracking. Pneumatic tools are prohibited.

3.1.8 Welding

Welding test agenda shall be done in accordance with the applicable provisions of AWS D1.1 and AWS D1.3.

3.1.9 Test Ports

Provide test access ports at points required for work under paragraph entitled "Testing, Adjusting, and Balancing," in this section. Locate test ports in straight duct as far as practical downstream of fans, change of direction fittings, takeoffs, interior to duct accessories, and like turbulent flow areas.

3.1.10 Ductwork Cleaning

Protect duct openings from construction debris using temporary caps, flanges, or other approved means. Clean dirty duct interior with high velocity water and oil-free air streams or by vacuum cleaning as required by project conditions. Test watertight duct work for proper support, leakage, and unacceptable drainage provisions by intermittently spraying interior with garden hose nozzle, at a rate of 3 gallons per minute, exercising care to prevent excessive water accumulation. After construction is complete but accessible and prior to acceptance, remove all construction debris from exterior surfaces. Do not close duct inspection ports until inspected by the NTR.

3.1.11 Protective Coating Work

3.1.11.1 General Requirements for Protective Coating Work

Provide protective coating on interior surfaces of system as specified hereafter. Prime coat exterior surfaces of inorganic zinc coating as part of work under this section. Brush primer, or protective coating where no primer is specified, onto corners and into crevices and welds, working the material into irregular surfaces for a holiday free finish.

3.1.11.2 Baked, Unmodified Phenolic System

a. General: The following shall govern for a protective coating system based on unmodified phenol-formaldehyde resin intended for shop application to surfaces in fume exhaust service with possibility of materials concentration by condensation and subsequent evaporation. Shop apply coating by an applicator approved or licensed by the coating manufacturer.

b. Surface Preparation: Clean and blast surfaces with dry abrasive to "White Metal" and critical profile and anchor pattern in accordance with SSPC SP 5, and requirements and recommendations of the coating manufacturer.

c. Application: The complete system shall include the application of

two coats of red pigmented base followed by not less than one coat of the clear finish, to provide a total minimum dry film thickness of 6 mils. Apply coating materials by conventional industrial pressure spray equipment. Use only those thinners and cleaners in amounts recommended by the manufacturer. Heat-cure each coat between coats and bake surfaces after the last coat in accordance with manufacturer's applicable published instructions and specific instructions for the specified application. Baking time between coats shall be a minimum 1 1/2 to 2 hours at 200 to 250 degrees F. Baking after top coat shall be one hour at 200 to 350 degrees F, plus 2 hours final bake at a temperature of 350 degrees F. Other baking schedules to achieve required quality coating may be proposed.

d. Repair: Return damaged surfaces to the applicator's shop for repair, unless otherwise approved by the NTR.

3.1.11.3 Inorganic Zinc Coating System

a. General Requirements, Inorganic Zinc Coating System: The following shall govern for a protective coating system primer based on inorganic zinc coating intended for shop application to black carbon steel surfaces with subsequent field finishing with compatible tie coat and epoxy top coat.

b. Surface Preparation: SSPC SP 5.

c. Application: Apply one coat at 2 to 3 mils dry film thickness by airless or conventional spray equipment. Use only those thinners and cleaners in amounts recommended by the manufacturer.

d. Repair: Field repair damaged surfaces in accordance with manufacturer's instructions.

3.1.11.4 Field Inspection of Protective Coating Work

Visually inspect coated surfaces from a maximum distance of 5 feet with special attention given to corners and crevices. Check coating thickness in accordance with SSPC Paint 2. Perform inspection immediately prior to erection of ductwork and equipment and in the presence of the NTR. Repair coating as required. Apply additional coating if thickness is not sufficient.

3.1.12 Factory and Field Painting and Finishing

3.1.12.1 Factory Work

Factory finish interior ferrous metal and other specified metallic equipment and component surfaces with manufacturer's standard surface preparation, primer, and finish coating. Factory finish exterior to building space ferrous metal surfaces and other exterior to building and interior to building metallic or nonmettallic surfaces with specified protective coating system in accordance with the paragraph entitled "Protective Coating Material," in this section and otherwise with manufacturer's standard surface preparation, primer and finish which meet

the requirements of paragraph entitled "Corrosion Prevention."

3.1.12.2 Field Work

Touch-up or if necessary, repaint factory applied finishes which are marred, damaged, or degraded during shipping, storage, handling, or installation to match the original finish. Clean and prime field or shop fabricated ferrous metals required for the installation specified under this section.

3.2 TESTING, ADJUSTING, AND BALANCING

3.2.1 Ductwork Structural Integrity and Leakage Testing

Inspect and test systems pressure rated higher than 2 inches (51 mm) water gage for structural integrity and leakage as systems or sections during construction but after erection, as work progresses, in system or section lengths not exceeding 100 feet. Test for structural integrity at 50 percent in excess of system fan positive or negative total pressure. Test for leakage at 50 percent in excess of system fan positive or negative total pressure. Leakage test procedure and apparatus shall be in accordance with SMACNA HVACADLTM. Total leakage, prorated to length of duct under test, shall not exceed one percent of system capacity. Do not permit leakage in positive pressure ducts in buildings carrying flammable or toxic materials.

3.2.2 Power Transmission Components Adjustment

Test and adjust V-belts and sheaves for proper alignment and tension preliminary to operation and after 72 hours of operation at final speed, in the presence of the NTR. Belts on drive side shall be uniformly loaded, not bouncing.

3.2.3 Preliminary Tests

Conduct an operational test on the entire exhaust duct systems, components, and equipment for a period of not less than 6 hours after power transmission components are adjusted. Replace filters, if any, after preliminary tests and prior to conducting final acceptance tests.

3.2.4 Testing, Adjusting, and Balancing Work

Perform work in accordance with the applicable and recommended procedures of: ACGIH 2080. Provide apparatus, certified, calibrated, instrumentation including that to measure sound levels, motor current, and power factor. Unless approved otherwise, instruments shall be limited to manometers and approved aneroid type gages (such as a Magnehelic). Velometers may be used for low velocity measurements if approved by the NTR.

3.2.5 Systems Volume Acceptance Criteria

Systems final volume shall be within the following limits:

Fan	Plus 10 percent, minus zero

	percent of design volume at design temperature
Hood or Equipment	Plus or minus 5 percent of design volume at design temperature

Note: Tolerances shall be taken on clean or dirty conditions as indicated on the drawings.

3.2.6 Sound Level Tests

Report to the NTR in writing, sound levels higher than 84 dBA at hoods or at workers' normal operating positions at equipment in addition to being included in the required test reports.

3.3 SYSTEM OPERATION DEMONSTRATION

After systems and equipment testing, adjusting, and balancing has been completed and accepted, demonstrate the complete and correct functioning of systems equipment and controls by operation through normal ranges and sequences, and by simulation of abnormal conditions. Manually and automatically cause every device to function as intended. Readjust, as necessary, any settings and after sufficient operating time, but not less than 6 hours, verify ability of equipment and controls to establish and maintain stable and accurate operation and required system performance. Note any abnormal deviations, such as excessive vibration, noise, and heat, binding damper
mechanisms, and incorrect fan rotation. Make any necessary repairs, replacements or adjustments.

-- End of Section --

SECTION 15895

DUCTWORK AND DUCTWORK ACCESSORIES

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.

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 500	1991 Louvers, Dampers and Shutters
AMCA 501	1985 Application Manual for Air Louvers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 527/A 527M	1990 Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock-Forming Quality
ASTM C 423	1990 (Rev. A) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C 553	1991 Mineral Fiber Blanket and Felt Insulation (Industrial Type)
ASTM E 90	1990 Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
ASTM E 437	1985 (R 1990) Industrial Wire Cloth and Screens (Square Opening Series)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	1989 Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA DCS	1985 HVAC Duct Construction Standards - Metal and Flexible

UNDERWRITERS LABORATORIES INC. (UL)

UL 181	1990 (R 1990) Factory-Made Air Ducts and Air Connectors

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 PRESSURE CLASSIFICATION

SMACNA DCS, Section 1, and as indicated.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Dampers

b. Flexible ducts and connectors

c. Insulation and vapor barrier

d. Louvers

e. Bird screens

f. Diffusers, registers, and grilles

g. Metal ducts

h. Test holes

1.4.2 SD-04, Drawings

a. Locations of test holes

b. Duct hangers and supports details

1.4.3 SD-05, Design Data

a. Duct span versus reinforcement schedule

1.4.3.1 Duct Span Versus Reinforcement Schedule

Submit maximum duct dimension, board stiffness rating, board thickness, type and spacing of reinforcement, and maximum duct static pressure.

1.4.4 SD-06, Instructions

a. Ductwork and ductwork accessories

1.4.4.1 Ductwork and Ductwork Accessories

Including job inspection checklist, methods of on-site storage and handling, and recommended repair methods.

1.4.5 SD-07, Schedules

a. Diffusers, registers, and grilles

Submit a schedule of inlets and outlets indicating location, catalog model number, manufacturer, dimensional information, sound pressure level rating, nominal rated volumetric flow rate (cfm), neck or face velocity at specified cfm, pressure drop at specified cfm, throw and drop for outlets, range for diffusers, and maximum and minimum cfm modulation.

1.4.6 SD-08, Statements

a. Certified personnel list

1.4.7 SD-10, Test Reports

a. Automatic dampers

b. Sound pressure level rating

c. Louvers

1.4.7.1 Automatic Dampers

Submit certification of damper leakage testing and conformance with AMCA 500 and specified maximum leakage or pressure drop requirements.

1.4.7.2 Sound Pressure Level Rating

Submit for inlets and outlets including diffusers, registers and grilles.

1.4.8 SD-12, Field Test Reports

a. Air duct leakage tests

b. Testing and balancing of air systems

c. Sound level tests

PART 2 PRODUCTS

2.1 METAL DUCTS

2.1.1 Steel Ducts

ASTM A 527/A 527M galvanized steel sheet, lock-forming quality; coating designation G90.

2.2 DUCTS OF PRESSURE CLASSES 3-INCH OR LESS WATER GAGE

Construction, metal gage, hangers and supports, and reinforcements shall conform with SMACNA DCS, except that ducts with pressure classifications below 2 inch water gage that are located outside of the conditioned space shall have a seal class C. Ductwork shall be airtight

and shall not vibrate or pulsate when system is in operation. Pressure sensitive tape shall not be used as a primary sealant on ductwork with pressure classifications above one inch water gage. Air leakage shall be less than 5 percent of the system capacity. Construct ductwork of galvanized steel.

2.2.1 Curved Elbows

Make a centerline radius not less than 1 1/2 times the width or diameter of the duct.

2.2.2 Laps

Make laps at joints in the direction of air flow. Space button-punch or bolt-connection in standing seams at fixed centers not greater than 6 inches. Longitudinal locks or seams, known as "button-punch snap-lock," may be used in lieu of Pittsburgh Lock.

2.2.3 Fittings

Elbows, vaned elbows, take-offs, branch connections, transitions, splitters, volume dampers, flexible connections, and access doors shall conform with SMACNA DCS, Section 2. Provide factory fabricated airtight, and noncorrosive test holes with screw cap and gasket.

2.2.4 DIFFUSERS, REGISTERS, AND GRILLES

2.2.5 Material and Finishes

Provide factory-furnished diffusers, registers, and grilles constructed of steel. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Steel parts shall be factory zinc phosphate treated prior to priming and painting or have a baked-on enamel finish. Colors shall be selected or approved by NTR.

2.2.6 Sound Pressure Level

Manufacturer certified sound pressure level rating of inlets and outlets. Conform with the following permissible room sound pressure levels:

NC Range, dB	Typical Application
40 - 45	Treatment Area

2.2.7 Throw

The distance from the diffuser, register, or grille to the point which the air velocity falls below 50 feet per minute shall not exceed 1.5 times the outlet mounting height.

2.2.8 Drop

Maximum drop of air stream shall not be within 6 feet of the floor at the end of the throw.

2.2.9 Registers

Double-deflection supply registers. Provide manufacturer-furnished volume dampers. Volume dampers shall be of the group-operated, opposed-blade type and key adjustable by inserting key through face of register. Operating mechanism shall not project through any part of the register face. Automatic volume control devices will be acceptable. Provide exhaust and return registers as specified for supply registers, except that exhaust and return registers shall have a single set of nondirectional face bars or vanes having the same appearance as the supply registers.

2.2.10 Grilles

Construct and finish as specified above for registers, except that volume dampers shall be omitted.

2.3 DUCT SLEEVES, PREPARED OPENINGS, AND CLOSURE COLLARS

2.3.1 Duct Sleeves

Fabricate from minimum 20-gage galvanized steel. Where sleeves are installed in bearing walls, provide structural steel sleeves as indicated. Size sleeves to provide one-inch clearance between duct and sleeve or between insulation and sleeve for insulated ducts.

2.3.2 Prepared Openings

Provide one-inch clearance between the duct and the sleeve, or one-inch clearance between insulation and sleeve for insulated ducts except at grilles, registers, and diffusers.

2.3.3 Packing

ASTM C 553, Type 1, Class B-2, mineral fiber.

2.3.4 Closure Collars

Four inches wide minimum, fabricated from minimum 20-gage galvanized steel.

2.4 DEFLECTORS

Factory-fabricated and factory- or field-assembled units consisting of curved turning vanes or scoop type extractors for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide curved vanes for square elbows.

2.5 ACCESS DOORS

Door shall be rigid and airtight with neoprene gaskets and two or more chrome-plated nickel base enamel painted galvanized steel hinges and quick fastening locking devices. Provide doors as large as practical. Mount doors, if possible, so that air pressure holds them closed.

2.6 DAMPERS AND LOUVERS

Construct dampers and louvers with galvanized sheet metal two gages heavier than ducts in which installed. Except as modified herein, the construction shall be of galvanized steel with interlocking edges and maximum 10-inch blade width. Conform with SMACNA DCS. Dampers shall be opposed-blade type.

2.6.1 Manual Volume Dampers

Balancing, factory-fabricated type. Equip dampers with accessible mechanism such as quadrant operators or 3/16-inch rods brought through the side of ducts with locking setscrew and bushing. Where quadrant operators are furnished, provide chrome plated or enamel painted type with exposed edges rounded.

2.6.2 Automatic Dampers

Section 15971, "Space Temperature Control Systems." Maximum leakage shall not exceed 25 cfm per square foot of damper face area at 2-inch w.g. pressure difference.

2.6.3 Louvers

Fixed type. Fold or bead the edges of louver blades to exclude driving rain. Louvers blades shall be oriented to minimize the entrainment of rainwater. Make louver frames of 16 gage galvanized steel. Provide bird insect screen constructed of the same type metal as the louvers.

2.6.3.1 Bird Screens

ASTM E 437, general industrial-use wire cloth, Grade C, medium light or heavier, nominal 2-mesh 0.063-inch wire diameter, galvanized steel bird screens. Provide removable insect screens of grooved type, with vinyl or neoprene spline insert for securing screen cloth.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to NFPA 90A, SMACNA DCS. Provide mounting and supporting of ductwork and accessories including, but not limited to, structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors, and dampers. Provide electrical isolation between dissimilar metals. Electrical isolation may be fluorinated elastomers or sponge-rubber gaskets. Install ductwork accessories as indicated and as recommended by manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service. Louvers in accordance with AMCA 501.

3.1.1 Ductwork

Air distribution systems shall operate with no chatter or vibration.

3.1.1.1 Field Changes to Ductwork

Those required to suit the sizes of factory-fabricated equipment actually furnished, shall be designed to minimize expansion and contraction. Use gradual transitions in field changes as well as modifications to connecting ducts.

3.1.1.2 Dampers

When installed on ducts to be thermally insulated, equip each damper operator with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of insulation. Stand-off mounting items shall be integral with the operator or standard accessory of damper manufacturer.

3.1.1.3 Deflectors

Provide in square elbows, duct-mounted supply outlets, take-off or extension collars to supply outlets, and tap-in branch-off connections. Adjust supply outlets to provide air volume and distribution as indicated or specified.

3.1.1.4 Access Doors

Provide for automatic dampers, volume dampers, coils, thermostats, temperature controllers, valves, filters, humidifiers and other concealed apparatus requiring service and inspection in the duct systems.

3.1.1.5 Duct Sleeves, Prepared Openings, and Closure Collars

Provide for ductwork penetrations in walls, and partitions through which metallic ductwork passes.

a. Duct Sleeves: Fill space between duct and sleeve or between insulation and sleeve for insulated ducts with mineral fiber, except at grilles, registers, and diffusers.

b. Prepared Openings: Fill space between duct and opening or between insulation and opening for insulated ducts with mineral fiber, except at grilles, registers, and diffusers.

c. Closure Collars: Fit collars snugly around ducts or insulation. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier. Provide nails with maximum 6-inch centers on collars.

3.1.1.6 Packing

Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber.

3.1.2 Duct Hangers and Supports

SMACNA DCS, Section 4. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless

a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing. Provide retainer clips where C clamps are used.

3.1.2.1 Flexible Connectors

Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For rectangular ducts, lock flexible connectors to metal collars.

3.1.3 Inspection Plates and Test Holes

Provide, where required, in ductwork for all balance measurements. If possible, test holes should be located at least 7.5 times diameters downstream from a disturbance. Extend cap through insulation.

3.1.4 Flashing

Provide waterproof flashing where ducts pass through exterior walls and roofs.

3.1.5 Cleaning of Ducts

Remove all debris and dirt from ducts and wipe clean. Before installing air outlets, force air through entire system at maximum attainable velocity to remove accumulated dust. Provide temporary air filters to protect ductwork which may be harmed by excessive dirt. For large systems, clean duct with high power vacuum machines.

3.2 FIELD QUALITY CONTROL

Administer and direct tests. Furnish instruments, equipment, connecting devices, and personnel for the tests. Notify NTR 7 days before inspection or testing is scheduled. Correct defects in work. Repeat tests until work is in compliance.

3.2.1 Air Duct Leakage Tests

Perform duct air leakage test in accordance with Section 15996, "Testing/Adjusting/Balancing: Heating/Ventilating/Cooling Systems."

-- End of Section --

SECTION 15971

SPACE TEMPERATURE CONTROL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

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

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 500	1991 Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.18	1984 Cast Copper Alloy Solder Joint Pressure Fittings

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE HF	1989 Handbook, Fundamentals
ASME/ANSI B16.22	1989 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B16.26	1988 Cast Copper Alloy Fittings for Flared Copper Tubes
ASME/ANSI B16.34	1988 Valves - Flanged, Threaded, and Welding End
ASME B31.1	1992 Power Piping
ASME/ANSI B31.5	1987 (Addenda 1992) Refrigeration Piping
ANSI/ASME B40.1	1991 (Special Notice 1992) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 32	1992 Solder Metal
ASTM B 75	1992 (Rev. A) Seamless Copper Tube
ASTM B 88	1992 Seamless Copper Water Tube
ASTM D 635	1991 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM D 638	1991 Tensile Properties of Plastics
ASTM D 792	1991 Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 1238	1990 (Rev. B) Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1693	1970 (R 1988) Environmental Stress-Cracking of Ethylene Plastics

FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	1989 Rules and Regulations: Radio Frequency Devices

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	1991 Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ST 1	1988 Specialty Transformers (Except General-Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1993 National Electrical Code
NFPA 90A	1989 Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES INC. (UL)

UL 508	1989 (Bul. 1992) Industrial Control Equipment
UL 555S	1983 Leakage Rated Dampers for Use in Smoke Control Systems
UL 916	1984 (R 1992) Energy Management Equipment

1.2 SYSTEM DESCRIPTION

Provide space temperature control systems complete and ready for operation.

1.3 SYSTEM REQUIREMENTS

Provide control systems composed of any combination of electric, analog electronic or pneumatic devices. Indicated control system devices of a particular type do not intend a requirement for the device unless the requirement is specifically indicated. Requirements apply to field installed control systems.

1.4 PERFORMANCE REQUIREMENTS

Provide control systems to maintain the required heating and ventilating (HVAC) conditions by performing the functions and sequences of operations indicated. Control systems shall be complete, including all equipment and appurtenances, and ready for operation. Control systems shall be furnished, installed, tested, calibrated, and started up by, or under the supervision of trained technicians certified by the Contractor as qualified and regularly employed in such work. Control system equipment, valves, panels and dampers shall bear the manufacturer's nameplate.

1.5 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.5.1 SD-02, Manufacturers Catalog Data

a. Actuators

b. Valves

c. Dampers

d. Fire protection devices

e. Sensors

f. Thermostats

g. Sunshields

h. Pressure switches

i. Indicating devices

j. Controllers

k. Pressure gages

l. Control Panels

m. Air Compressor

n. Compressed air station specialties

1.5.2 SD-04, Drawings

a. Control system diagram for each system

b. Ladder diagram coordinated by line number and device number with the control system diagram

c. Operating parameters

d. Automatic control valve schedules

e. Damper schedules

f. Sequence of operation

g. Arrangement drawing

h. Wiring diagram

i. Compressed air station schematic

j. Control panel schematics for pneumatic control

1.5.2.1 Control System Diagram

Indicate process flow and location of devices relative to flow and to the control panel, the connections of control devices in control loops, references of control device contacts and device operating coils to line numbers of a ladder diagram and sequencing diagrams showing the operation of valves, dampers, and contacts relative to controller output, and process variables.

1.5.2.2 Ladder Diagram

Indicate connections and interlocks to control system devices and other devices such as starters, drives, control system panels, and equipment panels.

1.5.2.3 Operating Parameters

Indicate operating parameters for devices shown on the control system diagram such as setpoints, ranges, limits, differentials, outside air temperature schedules, contact operating points, and equipment operating time schedules.

1.5.2.4 Automatic Control Valve Schedules

Indicate valve size, Cv, flow rate, pressure drop, top size, spring range, positioner range, operating signal characteristics, and power source.

1.5.2.5 Damper Schedules

Indicate damper sizes, quantities and sizes of actuators, spring ranges, positioner ranges, operating signal characteristics, and power source.

1.5.2.6 Wiring Diagram

Indicate terminal blocks, wire marker identification, connections to control system devices, external and internal power sources, and connections to external devices, starters, drives, control panels, jumpers, and ground connections.

1.5.2.7 Compressed Air Station Schematic

Indicate compressors, motors and horsepower rating, voltage, starter, isolators, manual bypasses, tubing sizes, drain piping and drain traps, reducing valves, dryer, manufacturers' names and model numbers, mounting, access, and clearance requirements. Also include control panel schematics for pneumatic control.

1.5.2.8 Sequence of Operation

Sequence of operation for each HVAC control system coordinated with device identifiers on control system diagram and ladder diagram.

1.5.2.9 Arrangement Drawing

Arrangement diagram of each HVAC control system panel coordinated with device identifiers on the control system diagram and the ladder diagram.

1.5.3 SD-12, Field Test Reports

a. Commissioning procedures

b. Calibration adjustment and commissioning reports

c. Site testing procedures identifying each item tested and describing each test

d. Performance verification test plans and procedures

1.5.3.1 Site Testing Procedures

Indicate test equipment to be used including manufacturers' names and model numbers, date of last calibration, and accuracy of calibration.

1.5.3.2 Commissioning Procedures

Define procedures specific to each control system including instructions on how to set control parameters and setpoints, proportional, integral and derivative mode constants, contact output settings, positioner range adjustments, and calibration checks of transmitters

1.5.3.3 Calibration Adjustment and Commissioning Reports

Submit specific to each control system, including settings adjustments and results of calibration checks

1.5.4 SD-13, Certificates

a. Tube and fittings

b. Valves

c. Smoke detectors

d. Compressed air storage tank

1.5.5 SD-18, Records

a. Air compressor

b. Refrigerated air dryer

c. Air filtration system

d. Training course documentation

e. Qualified service organization list

f. Certification of completion

1.5.6 SD-19, Operation and Maintenance Manuals

a. Space temperature control system, Data Package 3

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

1.5.6.1 Space Temperature Control System, Data Package 3

Include items of equipment listed under paragraph entitled "Manufacturer's Catalog Data." Manual shall contain full hardware support documentation, which shall include but not be limited to the following:

a. General description and specifications

b. Installation and initial checkout procedures

c. Detailed electrical and logical description

d. Troubleshooting procedures, diagrams, and guidelines

e. Alignment and calibration procedures for components

f. Preventive maintenance requirements and a maintenance checklist

g. Detailed schematics and assembly drawings

h. Spare parts list data, including required tool kits and suggested method of repairs such as field repair, factory repair, or item replacement

i. Signal identification and timing diagrams

j. Complete as-built control drawings, schedules, and sequence of operation

k. Controller configuration and parameter setting procedures

l. Step-by-step procedures required for each control systems startup, operation, shutdown, recovery, and fault diagnosis

m. Manufacturer supplied operator manuals for equipment

n. Qualified service organization list

1.6 QUALITY ASSURANCE

1.6.1 Standard Products

a. Material and equipment shall be standard products of manufacturers regularly engaged in the manufacturing of such products, using similar materials, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of similarly sized equipment and materials used under similar circumstances. The 2 years experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. 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 manufacturer's factory tests, can be shown.

b. The equipment items shall be supported by a service organization.

1.6.2 Nameplates and Tags

a. Provide nameplates bearing legends as shown and tags bearing device unique identifiers as shown shall have engraved or stamped characters. Nameplates shall be mechanically attached to HVAC control panel doors.

b. A plastic or metal tag shall be mechanically attached directly to each field-mounted device or attached by a metal chain or wire.

c. Each airflow measurement station shall have a tag showing flow rate range for signal output range, duct size, and device identifier where shown.

1.6.3 Verification of Dimensions

Contractor shall become familiar with details of work, shall verify dimensions in the field, and shall advise NTR of any discrepancy before performing work.

1.6.4 Modification of References

Accomplish work in accordance with ASME B31.1, ASME/ANSI B31.5, NFPA 70, and NFPA 90A, except as modified herein or indicated otherwise for equipment, materials, installation, examination, inspection, and testing. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had be substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "authority having jurisdiction" and "owner" to mean the Contracting Officer.

1.7 DELIVERY, STORAGE, AND HANDLING

Protect materials from the weather, humidity, and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer. Store dampers so that seal integrity, blade alignment, and frame alignment are maintained.

PART 2 PRODUCTS

2.1 COMPONENTS

Provide components factory ordered for this project. Rebuilt equipment, warehoused equipment, or earlier generation equipment shall not be acceptable. Electrical, electronic, and electropneumatic devices not located within control panels shall have a NEMA 250 Type 1 enclosure in accordance with NEMA 250 unless otherwise specified. Actuators and positive positioners, and transmitters shall operate within temperature limit ratings of plus 35 to 150 degrees F. Panel mounted instruments shall operate within limit ratings of 35 to 120 degrees F and 10 percent to 95 percent relative humidity, noncondensing. Devices installed outdoors shall operate within limit ratings of minus 35 to 150 degrees F.

2.2 ACTUATORS

Provide pneumatic, electric, or electronic actuators. Actuators shall function as required within 85 to 110 percent of their power supply rating. Actuators shall fail to their spring return positions on signal or power failure unless indicated as timed, power return actuators. Actuators shall have visible position indicators. Where actuators do not have positive spring returns for fail-safe operation, provide capacity tanks, restrictors, check valves, and relays, or reserve power as required to achieve proper timed positioning for up to 4 minutes after primary power failure. Actuators shall open or close the devices to which they are applied within 60 seconds after a full scale signal input change. Pneumatic actuators shall be rated for 25 psig operating pressure except for high pressure cylinder type actuators.

2.2.1 Damper Actuators

Damper actuators shall be rated for at least 125 percent of the motive power necessary to operate the connected damper. The actuator stroke shall be limited by an adjustable stop in the direction of the return stroke. Actuators shall be provided with mounting and connecting hardware.

2.2.2 Valve Actuators

Valve actuators shall be rated for at least 125 percent of the motive power necessary to operate the valves over their full range of operation against the total and differential pressures.

2.2.3 Positive Positioners

Positive positioners shall be pneumatic relays with mechanical feedback mechanisms, adjustable operating ranges, and starting points.

2.3 AUTOMATIC CONTROL VALVES

Provide automatic control valves.

2.3.1 Valve Assembly

Valves shall have stainless steel stems and stuffing boxes with extended necks to clear the piping insulation. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Maximum rated shutoff pressure of the valve shall exceed the rated deadhead pressure of the pump that supplies it. Valve leakage rating shall be 0.01 percent of rated Cv for soft-seated valves and 0.05 percent for metal-to-metal seated valves. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall conform to ASME/ANSI B16.5 as a minimum. Components of cast iron valves shall conform to ASTM A 126 Class B or C as a minimum.

2.3.2 Butterfly Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service, and for modulation to the fully closed position, with carbon steel bodies or cast iron Class 125 and noncorrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from minus 20 degrees to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator.

2.3.3 Two-Way Valves

Two-way modulating valves shall have equal percentage characteristics.

2.3.4 Valves for Compressed Air Service

Valves used for switching compressed air supplied to pneumatic systems shall be brass body, three-way valves which shall conform to ANSI/ASME B16.15 Class 250.

2.4 DAMPERS

Provide dampers in air ducts.

2.4.1 Damper Assembly

Damper shall conform to SMACNA DCS. A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall consist of a combination of sections. Dampers shall be steel or other materials where indicated. Flat blades shall be made rigid by folding the edges. Provide blades with compressible seals at points of contact. Provide channel frames of dampers with jamb seals to minimize air leakage. Dampers shall not leak in excess of 10 cfm per square foot at 4 inches water gage static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 degrees F to 200 degrees F. Dampers shall be rated at not less than 2000 fpm air velocity. Moving parts of the

operating linkage in contact with each other shall consist of dissimilar materials. Damper axles shall be 0.5-inch minimum plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by a non-ferrous dissimilar thrust bearings. Pressure drop through dampers shall not exceed 0.05 inch water gage at 1,000 fpm in the wide-open position. Frames shall not be less than 2 inches wide. Dampers shall be tested in accordance with AMCA 500.

2.4.2 Operating Links

Operating links external to dampers, such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Mating parts shall consist of dissimilar materials. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed position of dampers.

2.5 FIRE PROTECTION DEVICES

Provide smoke detectors in return and supply air ducts on the downstream side of the filters in accordance with NFPA 90A, except as otherwise indicated. Provide UL listed or FM approved detectors for duct installation.

Provide in systems having air-handling capacities over 2000 cfm in accordance with NFPA 90A, except as otherwise indicated. Design for detection of abnormal smoke densities by the ionization principle, responsive to both invisible and visible particles of combustion, and not susceptible to undesired operation by changes in relative humidity. Provide UL listed or FM approved detectors for duct installation. Provide duct detectors with an approved duct housing, mounted exterior to the duct, and with perforated sampling tubes extending across the width of the duct. Obtain power from the source to the air-handling unit or air-handling unit controls Detectors shall have test port or test switch. Provide each detector with a visible indicator lamp that lights when the detector is activated. Activation of duct detector shall cause shutdown of the associated air-handling unit and closing of dampers and shall sound an alarm bell, with minimum 6 inch diameter, in a normally occupied area located, as directed.

2.6 SENSORS

2.6.1 Spans and Ranges

Transmitters shall be calibrated to provide an electric or electronic output signal of 4 to 20 mA electric or electronic and 3 to 15 psi output for pneumatics over the indicated span or range.

a. Conditioned space temperature, from 50 to 100 degrees F.

b. Duct temperature, from 40 to 140 degrees F.

c. Outside air temperature, from minus 30 to 130 degrees F.

2.6.2 Temperature Sensors

2.6.2.1 Resistance Temperature Detectors (RTD's)

RTD shall be platinum with a tolerance of plus or minus 0.25 percent at 32 degrees F, and shall be encapsulated in epoxy, Series 300 stainless steel, anodized aluminum, or copper. RTD shall be furnished with RTD transmitter as specified, integrally-mounted unless otherwise indicated.

2.6.2.2 Continuous Averaging RTD's

Continuous averaging RTD's shall have a tolerance of plus or minus 1.0 degrees F at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross section in which it is installed. Sensing element shall have a bendable copper sheath. Averaging RTD shall be furnished with RTD transmitter as specified, to match the resistance range of the averaging RTD. Element length shall be a minimum of one linear foot per square foot of coil face area.

2.6.2.3 RTD Transmitter

RTD transmitter shall be selected to match the resistance range of the RTD. Transmitter shall be a two-wire, loop-powered device. Transmitter shall produce a linear 4 to 20 mA dc output corresponding to required temperature measurement. Output error shall not exceed 0.1 percent of the calibrated measurement. Transmitter shall include offset and span adjustments.

2.6.2.4 Pneumatic Temperature Transmitter

Transmitting sensing elements shall be bi-metal, averaging element and capillary, rod and tube, or bulb and capillary. Transmitters shall operate within the range of 40 to 240 degrees F. Provide the following spans and allowable deviations for applications listed.

a. Room sensors, 25 degrees F, plus or minus 0.5 degrees

b. Outside air, hot water, coil discharge sensors, 100 degrees F, plus or minus 1.0 degree

2.6.6 Pressure Sensors

Provide electronic pressure sensor and transmitter. Sensor shall be a pressure transmitter with an integral sensing element. Sensor over pressure rating shall be 25 psig above its normal operating range. Sensing element accuracy shall be plus or minus one percent of full scale. Transmitter accuracy shall be plus or minus 0.1 percent of the calibrated measurement. Transmitter shall be a two-wire, loop-powered device. Transmitter shall produce a linear 4 to 20 mA dc output corresponding to required pressure measurement. Transmitter shall have offset and span adjustments.

2.7 THERMOWELLS

Provide brass or Series 300 stainless steel thermowells with threaded brass plug and chain, 2-inch lagging neck and extension type well, and inside diameter and insertion length as required for the application. Provide thermowells for immersion sensors with conducting material inside the well.

2.8 THERMOSTATS

Provide thermostats.

2.8.1 Ranges

Thermostat ranges shall be selected so that the setpoint is adjustable between plus or minus 10 degrees F of the setpoint indicated.

2.8.2 Nonmodulating Electric Room Thermostats

Contacts shall be single-pole double-throw (SPDT), hermetically sealed, and wired to identified terminals. Maximum differential shall be 2 degrees F. Thermostat covers shall consist of locking metal or heavy-duty plastic, and shall be capable of being locked by an Allen wrench or special tool. Thermostats shall have manual switches as required by the application and a minimum range of 55 to 90 degrees F.

2.8.3 Nonmodulating Capillary Thermostats and Aquastats

a. Thermostat shall have a capillary length of at least 5 feet, adjustable direct reading scales for both setpoint and differential, and a differential adjustable from 6 to 16 degrees F.

b. Aquastats shall be strap-on type, with 10 degrees F fixed differential.

2.8.4 Low-Temperature Protection Thermostats (Freezestats)

Low-temperature protection thermostats shall be manually reset low-temperature safety thermostats, with NO and NC contacts or a two-position pneumatic output signal and a 20-foot element which shall respond to the coldest 18-inch segment.

2.8.5 Modulating Capillary Thermostats

Thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Thermostats shall have adjustable throttling ranges of 4 to 8 degrees F for each output.

2.8.6 Modulating Pneumatic Room Thermostats

Single-temperature thermostats shall be adjustable proportioning type with one temperature sensing element: one setpoint and proper controller action. "Dead-band" thermostats shall have one adjustable proportioning type controller with two setpoints, adjustable dead-band, and one controller output or two adjustable proportioning type controllers mounted on a common

backplate with two setpoints, adjustable dead-band, and two controller outputs. Temperature sensing elements shall be selected for proper controller action. Individual temperature-sensing elements shall have a separate adjustable throttling range of 2 to 10 degrees F; thermostat shall have a minimum range of 55 to 90 degrees F and minimum safe air input pressure of 25 psig. Dead-band setting shall have a minimum adjustable range of 4 to 15 degrees F. Room thermostat shall have concealed setpoint dial aspirator type wall box with flush plate and locking screws and plug-in gage ports.

2.8.7 Modulating, Insertion, Immersion, & Averaging Pneumatic Thermostats

Thermostats shall be two-pipe, pilot-operated type with pneumatic feedback, proportional action and shall have an adjustable throttling range of 2 to 100 degrees F with a minimum range of minus 10 to 250 degrees F. Averaging elements shall be 1 foot in length for each 4 square feet of ductwork cross-sectional area with a minimum length of 8 feet.

2.8.8 Nonmodulating Pneumatic Thermostats

Thermostats shall have integral positive acting relays, zero or maximum output pressure. Remote element thermostats shall have standard or averaging bulbs. Averaging bulbs shall be 1 foot in length for each 4 square feet of ductwork cross-sectional area and a minimum length of 8 feet. Differential ranges shall be field adjustable. Remote element thermostat differential range shall be 2 to 25 degrees F with minimum control ranges of minus 10 to 250 degrees F. Room thermostat differential range shall be 2 to 10 degrees F with minimum control ranges of 55 to 90 degrees F.

2.9 SUNSHIELDS

Provide sunshields for outside air temperature sensing elements to prevent the sun from directly striking temperature sensing elements. Provide sunshields with adequate ventilation so that the sensing element responds to the ambient temperature of surroundings. The top of each sunshield shall have galvanized metal or aluminum rainshield projecting over the face of the sunshield. Sunshields shall be painted white or shall be unpainted aluminum.

2.10 PRESSURE SWITCHES AND SOLENOID VALVES

Provide pressure switches and solenoid valves.

2.10.1 Pressure Switches

Switches shall have an adjustable setpoint with visible setpoint scale. Range shall be as indicated. Differential adjustment shall span 20 to 40 percent of the range of the device.

2.10.2 Differential Pressure Switches

Switches shall be an adjustable diaphragm-operated device with one SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. Fittings shall be angled-tip type

with tips pointing into the airstream. Range shall be 0.5 to 6 inches water gage. Differential shall be a maximum of 0.15 inch water gage at the low end of the range and 0.35 inch water gage at the high end of the range.

2.10.3 Pneumatic Electric (PE) Switches

Switches shall have an adjustable setpoint range of 3 to 20 psig, and differential adjustable from 1 to 2 psi.

2.10.4 Solenoid Operated Pneumatic (EP) Valves

Valves shall have three-port operation: common, normally open, and normally closed. Valves shall have an outer cast aluminum body. The air connection shall be a 1/4-inch NPT threaded connection. Valves shall be rated for 50 psig where used in a control system which operates at 25 psig or less, or 150 psig where used in a control system which operates in the range of 25 to 100 psig.

2.11 INDICATING DEVICES

Provide indicating devices.

2.11.1 Thermometers

a. Thermometers for insertion in ductwork shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, and permanently stabilized glass tube with an indicating fluid column, white face, black numbers, and a 9-inch scale.

b. Air duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanisms.

c. Averaging thermometers shall have 3.5-inch (nominal) dial, with black legend on white background, and pointer traveling through a 270-degree arc.

d. Thermometers shall have an accuracy of plus or minus one percent of scale range. Thermometers shall have the following ranges:

(1) Mixed air temperature: 0 to 100 degrees F in 1-degree F graduations.

(2) Return air temperature: 0 to 100 degrees F in 1-degree F graduations.

(3) Heating discharge temperature: 30 to 180 degrees F in 2-degree F graduations.

2.11.2 Pressure Gages

Provide pressure gages with gage cock, snubber, and syphon.

a. ANSI/ASME B40.1. Gages shall be 2 1/2-inch (nominal) size, back-connected, suitable for field or panel mounting as required,

shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Accuracy shall be plus or minus 3 percent of scale range.

b. Gages for indicating signal output to pneumatic actuators and main air gages shall have scale of 0 to 30 psig in 1-psig graduations.

c. Gages for air storage tanks and for use before and after dirt and oil filters or dryers, shall have a scale of 0 to 160 psig with 2-psig graduations.

d. Gages for fuel system applications shall have ranges and graduations as required.

e. Pneumatic transmission receiver gages shall have a range to match the respective transmitters.

2.12 LOW-DIFFERENTIAL PRESSURE GAGES

Gages for low-differential pressure measurements shall be 4 1/2-inch (nominal) size with two seats of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gages shall have ranges and graduations as indicated. Accuracy shall be plus or minus 2 percent of scale range.

2.13 CONTROLLERS

2.13.1 Pneumatic Controllers

Controllers shall be two-pipe devices which use main air supplied to controller and pneumatic relay to produce the controller output signal. Controllers shall have field selectable local and remote adjustable setpoints, and an adjustable proportional band for analog (proportional) control or an adjustable differential for binary (two-position or floating) control. Controllers shall have single- or dual-input ports as required for the application and field selectable direct or reverse action for inputs. Dual input controllers shall have adjustable secondary input authority. Controllers shall have integral gage or test connections for testing or indication of input and output signals.

2.13.2 Analog Electronic Controllers

Controllers shall be solid-state electronic devices which sense the difference between input sensor analog values (resistance or voltage) and setpoint adjustment analog values (resistance or voltage), and shall amplify the difference signal to provide the output signal. Controllers shall include the following:

a. Proportional band: 2.5 to 33 percent of input device span.

b. Authority: minimum of 33 to 200 percent.

c. Inputs: thermistor, resistance, transmitter, or output of other electronic controllers.

d. Outputs: within the range of minus 5 to 20 Vdc or a 4 to 20 mA dc current loop.

e. Remote setpoint adjustment (SPA): plus or minus 10 percent of input device span.

2.13.3 Pneumatic Low-Range Pressure Controllers for Ductwork Applications

Controllers shall provide two-pipe, pilot-operated control with pneumatic feedback and proportional action. Sensing elements shall be differential type with pressure ranges appropriate for intended service. One element shall measure the variable while the other element measures the standard reference. Static pressure controllers shall have slack diaphragms with standard ranges between 0 to 6 inches water gage and an adjustable throttling range of 0.02- to 0.5-inch water gage. Sensing element shall be mountable in ductwork and shall measure static pressure without pulsations.

2.14 CONTROL DEVICES AND ACCESSORIES

Provide control devices and accessories.

2.14.1 Function Modules

Function modules shall accept mA dc analog input signals to produce analog output signals or contact output signals. Modules shall have zero and span adjustments for analog outputs, and setpoint adjustments for contact outputs.

2.14.1.1 Minimum Position Switches and Temperature Setpoint Devices

Minimum position switches and temperature setpoint devices shall accept manual input and shall produce steady analog output. Switches and devices shall be suitable for recessed wall mounting or panel mounting and shall have a graduated dial.

2.14.2 Relays

Relays shall be two-pole, double-throw (DPDT) with a 10-ampere resistive rating at 120 Vac, and shall have an enclosed coil.

2.14.3 Current-to-Pneumatic (IP) Transducers

Transducers shall be two-wire transmitters which convert an input signal to 3 to 15 psig or 15 to 3 psig pneumatic output, with a conversion accuracy of plus or minus 2 percent of full scale, including linearity and hysteresis. Air consumption shall not be greater than 0.25 scfm.

2.14.4 Regulated Power Supplies

Power supplies shall provide a 24-Vdc linear supply at not less than 2 amperes, with regulation to 0.05 percent of output voltage. Power supplies shall have a fused input, and shall be protected from voltage surges and power-line transients. Power supply output shall be protected against overvoltage and short circuits. Power supply loading shall not be greater than 1.2 amperes.

2.14.5 Transformers

UL 508 and NEMA ST 1 as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for available voltage and secondaries wound for correct control circuit voltage. Transformers shall be sized so that connected loads equal 80 percent of rated capacity. Transformers shall be enclosed in rustproof, galvanized steel cabinets with conduit connections. Disconnect switch shall be provided on the primary side, and a fuse cutout on the secondary side.

2.14.6 Pilot Lights and Manual Switches

Device illumination shall be by light-emitting diode (LED) or neon lamp. Switches shall have operating levers and index plates showing switch positions and names of apparatus controlled or other appropriate designations.

2.15 HVAC SYSTEM CONTROL PANELS

Provide HVAC system control panels.

2.15.1 Panel Assembly

Panel shall be fabricated for bottom entry connection for control system electric power, control system main air source, control system wiring, pneumatic tubing, interconnection of control systems, interconnection of starters, and external shutdown devices. Panel shall have an operating temperature rise of not greater than 20 degrees F above an ambient temperature of 100 degrees F.

2.15.2 Panel Electrical Requirements

Control panel shall be powered by nominal 120 Vac terminating at panel on terminal blocks. Instrument cases shall be grounded. Interior and exterior panel enclosures shall be grounded.

2.15.3 Enclosures

Enclosures for each panel shall be a single door, wall-mounted box conforming to NEMA 250 with a continuous hinged and gasketed exterior door with a print pocket, key lock, and interior back panel. Inside finish shall be white enamel, and outside finish shall be gray primer over phosphatized surfaces.

2.15.4 Mounting and Labeling

Provide pilot lights, switches, panel-mounted control devices, and pressure gages shall be mounted on the door. Power conditioners, fuses, and duplex outlets shall be mounted on the interior of the cabinet. Other components housed in the panel shall be mounted on the interior back panel surface of the enclosure and shall be identified by plastic or metal nameplates which are mechanically attached to the panel. Lettering shall be cut or stamped into the nameplate to a depth of not less than 1/64 inch, and shall have contrasting color, produced by filling with enamel or lacquer or by use of

laminated material. Painting of lettering directly on the surface of the door or interior back panel is not permitted.

2.15.5 Wiring and Tubing

a. Pneumatic device inputs and outputs shall be piped to bulkhead fittings in the bottom of the panel with a 2-inch loop to facilitate replacement. Electric, electronic, and electropneumatic device signals entering and leaving the panel shall be wired to identified terminal blocks.

b. Wiring shall be installed in wiring ducts so that devices can be added or replaced without disturbing existing wiring that is not affected by the change. Wiring to single-loop controllers shall have a 4-inch wiring loop in the horizontal wiring duct at each wiring connection. There shall be no wiring splices within the control panel. Interconnections required for power or signals shall be made on device terminals, if available, or panel terminal blocks, with not more than two wires connected to each terminal.

c. Instrument signal grounds at the same reference level shall end at a grounding terminal connected to a common ground point for that level. Wiring shield grounds at the same reference level shall end at a grounding terminal connected to a common ground point for that level. Grounding terminal blocks shall be identified by reference level.

d. Wiring connected to controllers shall be identified by function and polarity, e.g., process variable input and remote setpoint input and output.

2.16 COMPRESSED AIR STATIONS

Provide compressed air stations.

2.16.1 Air Compressor Assembly

a. Compressor shall be a duplex machine. Compressor shall be equipped with an electric motor with a totally enclosed belt guard, operating pressure switch, safety relief valve, cylinder unloader or solenoid unloader, intake filter, and intake silencer. Provide an alternator and two magnetic starters with undervoltage protection and thermal overload protection for each phase. Compressors shall be supported on a steel base mounted on an air storage tank. Compressor shall be sized to the control system compressed air requirement while operating not more than one-half of the time.

b. Compressed air storage tank shall be fabricated for working pressure of not less than 200 psig, and constructed and certified in accordance with ASME BPVC. Tank shall be of sufficient volume so that no more than six compressor starts per hour are required with the starting pressure switch differential set at 20 psi differential. Tank shall be provided with an automatic condensate drain trap with a manual override feature.

2.16.2 Compressed Air Station Specialties

a. Pressure regulator and refrigerated air dryer shall be provided in the air outlet line of the air storage tank. Dryer shall be sized for full air delivery capacity of compressor. Air shall be dried at a pressure of not less than 70 psig to a temperature not greater than 35 degrees F. Dryer shall be provided with an automatic condensate drain trap with a manual override feature.

b. Two parallel combination dirt and coalescing type oil filters with shutoff valves and pressure regulators shall be provided in the dryer discharge. Air filtration system shall be rated for full delivery capacity of compressor. Filter shall be 100 percent efficient for particle diameters down to 0.3 microns. Filter bowl shall be rated for 150 psig maximum working pressure. One of the filters shall serve as a standby. Pressure regulator and safety valve shall be provided downstream of the filter.

c. Flexible pipe connectors shall be designed for 150 psig and 250 degrees F service, and shall be constructed of rubber, tetrafluoroethylene resin, or braided corrosion-resistant steel, bronze, monel, or galvanized steel. Connectors shall be suitable for service intended and may have threaded or soldered ends. Length of connectors shall be as recommended by the manufacturer for service intended.

d. Vibration isolation units shall be standard products with published loading ratings, and shall be single rubber-in-shear, double rubber-in-shear, or spring type.

2.17 CONTROL TUBING AND WIRING

Provide HVAC control tubing and wiring.

2.17.1 Tube and Fittings

2.17.1.1 Copper Tubing

ASTM B 75 or ASTM B 88. Tubing 0.375-inch outside diameter and larger shall have a minimum wall thickness equal to ASTM B 88, Type M. Tubing less than 0.375-inch outside diameter shall have a minimum wall thickness of 0.025 inch. Concealed tubing shall be hard or soft copper; multiple tubing shall be racked or bundled. Exposed tubing shall be hard copper; rack multiple tubing. Fittings shall be solder type ANSI B16.18 or ASME/ANSI B16.22, using ASTM B 32, Plumbing Code approved lead-free solder, or compression type ASME/ANSI B16.26.

2.17.1.2 Polyethylene Tubing

In areas where polyethylene tubing is exposed, tubing shall be flame-resistant in rigid metal, intermediate metal, or electrical metallic tubing conduit. Multiple exposed polyethylene tubing can be in extruded flame-retardant, polyethylene protective sheathing with a mylar barrier. Single, unsheathed, flame-resistant polyethylene tubing may be used where

concealed in walls or ceilings and within control panels. Number each tube. Provide compression or barbed push-on type fittings. Extruded seamless polyethylene tubing shall conform to the following:

a. Minimum burst pressure requirements: 100 psig at 75 degrees F to 25 psig at 150 degrees F.

b. Stress crack resistance: ASTM D 1693, 200 hours minimum.

c. Tensile strength (minimum): ASTM D 638, 1100 psi.

d. Flow rate (average): ASTM D 1238, 0.30 decigram per minute.

e. Density (average): ASTM D 792, 920 kg/m^3.

f. Burn rate: ASTM D 635.

2.17.2 Wiring

a. Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanisms. Terminal blocks shall be rail mounted, and shall have end plates, partition plates or enclosed sides for separation.

b. Control wiring for 24-V circuits shall be 18 AWG minimum and shall be rated for 300-V service.

c. Wiring for circuits operating at more than 100 V shall be 14 AWG minimum and shall be rated for 600-V service.

d. Analog signal wiring circuits within control panels shall not be less than 20 AWG and shall be rated for 300-V service.

e. Instrumentation cable shall be 18 AWG, stranded copper, single or multiple twisted, minimum 2-inch lay of twist, 100 percent shielded pairs, and shall have 300-V insulation. Each pair shall have a 20-AWG tinned copper drain wire, individual pair, and overall insulation. Cables shall have an overall aluminum polyester or tinned overall copper cable shield tape, 20-AWG tinned-copper cable drain wire, and overall cable insulation.

f. Nonconducting wiring ducts in control panels shall have slotted side snap-on covers, fittings for connecting ducts, mounting clips for securing ducts, and wire retaining clips.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation under the supervision of competent technicians regularly employed in the installation of control systems. Provide components for a complete and operational control system. Provide control system complete and ready for operation, as specified and indicated. Provide dielectric isolation where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the

building exterior shall be watertight. Control system installation shall provide adequate clearance for control system maintenance by maintaining access spaces between coils, to mixed-air plenums, and as required to calibrate, remove, repair, or replace control system devices. Control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance. Install devices mounted in or on piping or ductwork, on building surfaces, in mechanical and electrical spaces, or in occupied space ceilings in accordance with manufacturer's recommendations and as indicated on contract documents. Provide control devices to be installed in piping and ductwork with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Certify that installation of control system is complete and technical requirements of this section have been met.

3.1.1 Sensors

Provide sensors in locations to sense the appropriate condition. Install sensor and transmitter where easily accessible and serviceable without special tools. Sensors shall be calibrated to the accuracy specified in the contract, and operate correctly when installed. Do not install sensors designed for one application in the place of another application (e.g., replacing a duct sensor with a room sensor).

3.1.1.1 Room Sensors

Provide on interior walls to sense average room conditions. Avoid locations which may be covered by office furniture. Do not mount room sensors on exterior walls if other locations are available. Mount centerline of sensor 5 feet above finished floor.

3.1.1.2 Duct Temperature Sensors

Provide sensors in ductwork in general locations as indicated. Select specific sensor location within duct to accurately sense appropriate air temperatures. Locate sensor connection boxes in position not obstructed by ducts or equipment. Install gaskets between sensor housing and duct wall. Seal duct and insulation penetrations. Install duct averaging sensors between two rigid supports in serpentine position to sense average conditions. Sensor shall have a total minimum length of 1 linear foot per 4 square feet of duct area. Sensor shall be mounted a minimum of 3 inches from outside wall surface. Thermally isolate temperature sensing elements from supports. Provide duct access doors to averaging sensors.

3.1.1.3 Strap-on Temperature Sensors

Strap-on temperature sensors, using helical screw stainless steel clamps, shall be permitted on new hot water piping for on-off operation, and for existing hot water piping sizes not greater than 3 inches. Clean the pipe to bright metal. Insulate strap-on bulb and pipe after installation. Provide other liquid temperature sensors with thermowells. Provide NEMA 250 Type 4 enclosures for outdoor installations. Provide brushed aluminum or brushed stainless steel enclosures for sensors located in finished spaces.

3.1.1.4 Outside Air Temperature Sensors

Provide outside air temperature sensor on north side of building, away from exhaust hoods, air intakes, and other areas which may affect temperature readings. Install sunshields to protect outside air temperature sensor from direct sunlight.

3.1.1.5 Low-Temperature Protection Thermostats (Freezestats)

Provide thermostat for each 80 square feet of coil-face area to sense the temperature at location indicated. Install thermostat sensing element in serpentine pattern.

3.1.2 Pressure Gages

Provide snubbers for gages in piping systems subject to pulsation. Install pressure gages at locations indicated. Pneumatic output lines shall have pressure gages mounted near the control panel.

3.1.3 Valves

Provide valve with stems upright where possible but with stems not lower than horizontal.

3.1.4 Damper Actuators

Provide damper actuators so that the damper sealing action is smooth and sufficient to maintain leakage at or below specified leakage rate. Multiple actuators operating a common damper shall be connected to a common drive shaft. Provide positioners where indicated and where necessary to prevent overlap of heating and cooling where one controller operates more than one pneumatic device and to maintain the proper dead band between heating and cooling.

3.1.5 Access Doors

Provide access doors in ductwork to service airflow monitoring devices, devices with averaging elements, and low-temperature protection thermostats (freezestats).

3.1.6 Tubing

a. Provide control system so that pneumatic lines are not exposed to air temperatures below 25 degrees F. Install tubes and tube bundles exposed to view neatly in lines parallel to lines of the building. Route tubing between panels and actuators in mechanical and electrical spaces so that lines are easily traceable. Tubes shall be permanently tagged on both ends with an identifier indicated on shop drawings. Install concealed tubing in finished areas, and install exposed tubing in unfinished areas such as mechanical equipment rooms.

b. Pneumatic lines in mechanical and electrical spaces shall be plastic tubing or copper tubing. Install horizontal and vertical runs of plastic tubes or soft copper tubing in raceways dedicated

to tubing. Dedicated raceways shall be supported every 6 feet of horizontal run and every 8 feet for vertical runs. Tubing not installed in raceways shall be hard-drawn copper tubing with sweat fittings and valves, supported every 6 feet of horizontal run and every 8 feet for vertical runs.

c. Tubing for final connection of sensing elements and transmitters to ductwork shall be plastic with a maximum length of 12 inches.

d. Final connections to actuators shall be plastic tubing, a maximum of 12 inches long and unsupported at the actuator.

e. Provide a manual valve at each HVAC control panel to allow shutoff of main air. Pneumatic connections to HVAC control panels shall be made using bulkhead fittings except where bundled tubing is being used.

f. Final connections to HVAC control panel bulkhead fittings shall be exposed tubing approximately 12 inches long.

g. Tubing and two insulated copper phone wires for installation checkout may be run in the same conduit. Tubing and electrical power conductors shall not be run in the same conduit. Control circuit conductors, 24 V or less, may be run in the same conduit as polyethylene tubing.

3.1.7 Wiring

a. Provide wiring external to control panels, including low-voltage wiring, in metallic raceways. Install wiring without splices between sensors, transmitters, control devices, and HVAC control panels. Install instrumentation grounding as necessary to prevent ground loops, noise, and surges adversely affecting operation of the system. Tag cables, conductors, and wires at both ends, with identifiers indicated on shop drawings.

b. Other electrical work shall be specified in Section 16402, "Interior Wiring Systems." Provide step-down transformers where control equipment operates at lower than line circuit voltages. Transformers serving individual heating and ventilating units shall be fed from fan motor leads, or fed from the nearest distribution panelboard or motor control center, using circuits provided for that purpose.

c. Ground control panels and cabinets as specified in Section 16402, "Interior Wiring Systems." Grounding of the green ac ground wire at the breaker panel alone is not adequate. Install ground wire from each control panel to adequate building ground.

3.1.8 Foundations and Housekeeping Pads

Provide 3 inch high concrete foundations and housekeeping pads for the HVAC control system air compressors.

3.1.9 Compressed Air Stations

Mount air compressor assembly on vibration eliminators, in accordance with ASME BPVC for tank clearance. Connect air line to the tank with a flexible pipe connector. Install compressed air station specialties with required tubing, including condensate tubing to a floor drain.

3.1.10 Control Drawings

Post laminated copies of as-built control system drawings.

3.2 ADJUSTMENTS

Calibrate instrumentation and controls, and verify specified accuracy using test equipment traceable to National Institute for Science and Technology (NIST) standards. Adjust controls and equipment to maintain conditions indicated, to perform the functions indicated, and to operate in the sequence specified.

3.3 FIELD QUALITY CONTROL

a. Demonstrate compliance of HVAC control systems. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Calibrate test equipment in accordance with NIST standards. Ensure that tests are performed or supervised by competent employees of the control system installer or the control system manufacturer regularly employed in testing and calibration of control systems.

b. Testing shall include field tests and the performance verification test. Field tests shall demonstrate proper calibration of instrumentation, input and output devices, and operation of specific equipment. The performance verification test shall ensure proper execution of sequence of operation and proper tuning of control loops.

c. The plan for each phase of field acceptance testing shall be approved in writing before beginning that phase of testing. Furnish written notification of planned testing to Contracting Officer at least 21 days prior to testing. Include proposed test procedures with notification. The Contractor will not be allowed to start testing without written Government approval of test procedures. Test procedures shall consist of detailed instructions for complete testing to prove the performance of heating, ventilating, and air-conditioning system and control system. Include the following tests in test procedures.

d. Submit original copies of data produced, including results of each test procedure, to the Government at the conclusion of each phase of testing. Tests are subject to supervision and approval by NTR. Do not perform testing during scheduled seasonal off-periods of heating systems.

3.3.1 Test Reporting

After completion or termination of field tests and again after the performance verification test, identify, determine causes, replace, repair, or calibrate equipment which fails to meet the specification; and deliver a written report to the Government. The report shall document test results, explain in detail the nature of each failure, and corrective action taken. After delivering the performance verification test report, the Contractor shall convene a test review meeting at the job site to present results and recommendations to the Government. As a part of the test review meeting, the Contractor shall demonstrate by performing appropriate portions of field tests or the performance verification test that failures have been corrected. Based on Contractor's report and test review meeting, the Government will determine either the restart point or successful completion of testing. Do not commence required retesting until after receipt of written notification by the Government. At the conclusion of retesting, repeat the assessment.

3.3.2 Contractor's Field Testing

Calibrate field equipment and verify equipment and system operation before system is placed on-line. Include the following tests in field testing.

3.3.2.1 Tubing and Wiring Integrity Tests

Test tubing system pneumatically at 1.5 times the design working pressure for 24 hours. Allowable leakage rate is that which produces a pressure drop 1 psig in 24 hours with compressed air supply turned off. Test wiring for continuity, ground faults, and open and short circuits.

3.3.2.2 System Inspection

Observe HVAC control system in shutdown condition. Check dampers and valves for proper normal positions. Document positions for the performance verification test report.

3.3.2.3 Calibration Accuracy and Operation of Input Test

Check for proper calibration and operation of input instrument. For temperature sensors, record the reading at the sensor using the sensor, and using NIST traceable test equipment, and record the reading in the digital controller. Document readings for the performance verification test report.

3.3.2.4 Operation of Output Test

Check the operation of output to verify correct operation. Operate analog device to minimum range (e.g., 4 mA) and maximum range (e.g., 20 mA), and measure and record actual output values.

3.3.2.5 Actuator Range Adjustment

With the controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position through to the full range of stroke position. Record actual spring ranges and normal

positions for modulating control valves and dampers.

3.3.3 Coordination With HVAC System Balancing

Tune the control system after air systems have been balanced, minimum damper positions have been set, and a report has been issued.

3.3.4 Field Test Documentation

Before scheduling the performance verification test, provide field test documentation and written certification of completion to NTR and the Naval Energy and Environmental Support Activity (NEESA), that the installed system has been calibrated, tested, and is ready to begin the performance verification test. Do not start the performance verification test prior to receiving written permission from the Government.

3.3.5 Performance Verification Test

Conduct the performance verification tests to demonstrate that the control system maintains setpoints and that the control loops are tuned for the correct sequence of operation. Conduct the performance verification test during one week of continuous HVAC and control systems operation and before final acceptance of work. Specifically, the performance verification test shall demonstrate that the HVAC system operates properly through the complete sequence of operation (e.g., seasonal, occupied and unoccupied, warmup, etc.), for specified control sequences. Demonstrate proper control system response for abnormal conditions for which there is a specified system or controls response by simulating these conditions. Demonstrate that hardware interlocks and safety devices work as designed. Demonstrate that the control system performs the correct sequence of control.

3.3.6 Opposite Season Test

Repeat the performance verification test during an opposite season to the first performance verification test.

3.4 TRAINING

Provide a qualified instructor to conduct training courses for designated personnel in maintenance and operation of HVAC and control systems. Orientate training to the specific system being installed under the contract. Furnish audiovisual equipment and other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15-minute breaks and excluding lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, assume that the attendees have a high school education and are familiar with HVAC systems. Submit planned training schedule, agenda, and class materials to the Government at least 45 days prior to training.

3.4.1 Training Course Documentation

Training shall be based on the operation and maintenance manuals and control system training manual. Deliver manuals for each trainee with two

additional sets for archiving at the project site. Include an agenda, defined objectives, and a detailed description of subject matter for each lesson.

3.4.2 System Maintenance Training

Course shall be taught at the project site within one month after completion of endurance test for a period of 2 training days. Maximum of 5 personnel shall attend the course. Course shall include but not be limited to the following:

a. Physical layout for each piece of hardware

b. Troubleshooting and diagnostics procedures

c. Repair instructions

d. Preventive maintenance procedures and schedule

e. Calibration procedures

3.5 QUALIFIED SERVICE ORGANIZATION LIST

The qualified service organization list shall include names and telephone numbers of organizations qualified to service HVAC control systems.

3.6 COMMISSIONING

Commissioning of control systems is specified in the pre-field TAB engineering report described in Section 15996, "Testing/Adjusting/Balancing: Heating/Ventilating/Cooling System."

-- End of Section --

SECTION 15996

TESTING/ADJUSTING/BALANCING: HEATING/VENTILATING/COOLING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

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

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	1989 National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning System

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S1.4 (ASA 47)	1983 Sound Level Meters

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE HA	1991 Handbook, HVAC Applications

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MSV	1977 Measuring Sound and Vibration
NEBB TABES	1991 Testing, Adjusting, Balancing of Environmental Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA HVACADLTM	1988 HVAC Air Duct Leakage Test Manual
SMACNA HVACTAB	1983 HVAC Systems - Testing, Adjusting and Balancing

1.2 DESCRIPTION OF WORK

The work includes testing, adjusting, and balancing (TAB) of heating, ventilating, and cooling (HVAC) air systems including equipment, ducts, and piping which are located within, on, under, between, and adjacent to buildings.

1.2.1 Air Distribution Systems

Systems shall be tested, adjusted, and balanced (TAB'd) in compliance with this section. Obtain NTR's written approval before applying insulation to exterior of air distribution systems under Section 15250, "Insulation for Mechanical Systems."

1.3 DEFINITIONS

a. DALT: Duct air leakage testing

b. DALT'd: Duct air leakage tested

c. Sound measurements terminology: Defined in AABC MN-1 or NEBB MSV.

d. TAB team supervisor: TAB team engineer.

e. TAB team technician: TAB team assistant.

f. Field check group: One or more systems of the same basic type; the subgroup of a "field check group" is a "system."

g. Out-of-tolerance data: Pertains only to field checking of certified DALT or TAB report. The term is defined as a measurement taken during field checking which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the certified DALT or TAB report for a specific parameter.

h. Season of maximum heating load: Time of year when outdoor ambient temperature at equipment installation site remains within following range throughout the period of data recording for TAB work. Indicated winter outdoor design dry bulb temperature plus 30 to minus 30 degrees Fahrenheit.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.4.1 SD-08, Statements

a. Independent TAB agency personnel qualifications

b. Design review report

c. Pre-field DALT preliminary notification

d. Advanced notice for DALT field work

e. Advanced notice for Season 1 TAB field work

f. Check out list for Season 1

g. Pre-final DALT report

h. Final certified DALT report

1.4.1.1 Independent TAB Agency Personnel Qualifications

Submit following for one of the two types of agencies to Contracting Officer for approval in compliance with Appendix B, "TAB Personnel Qualification Requirements."

a. Independent AABC or NEBB certified TAB agency:

(1) TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification.

(2) TAB team supervisor: Name and copy of AABC or NEBB TAB supervisor certificate and expiration date of current certification.

(3) TAB team field leader: Name and documented evidence that the team field leader meets the qualification requirements.

(4) TAB team field technicians: Names and documented evidence that each field technician meets the qualification requirements.

(5) Current certificates: Registrations and certifications shall be current, and valid for the duration of this contract. Certifications which expire prior to completion of the TAB work, shall be renewed in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification shall not perform TAB work on this contract.

1.4.1.2 Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

1.4.1.3 Pre-Field DALT Preliminary Notification

a. Notification: On completion of the duct installation for each system, the Contractor shall notify the NTR in writing within 5 days after completion.

b. Duct testing: The NTR shall randomly select sections of the completed duct system for testing by the Contractor. The sections selected shall not exceed more that 20 percent of the total measured linear footage of supply, return, exhaust or plenum duct length. Sections of main ducts, branch main ducts, branch ducts and plenums are subject to testing. From time of receipt of the Contractor's notification of system completion, the Contracting Officer shall provide the Contractor within 7 working days selected locations of duct sections which are to be tested.

c. DALT testing: All DALT testing shall be in accordance with SMACNA HVACADLTM.

1.4.1.4 Advanced Notices

a. Submit "Advanced Notice for DALT Field Work" in writing.

b. Submit "Advanced Notice for Season 1 TAB Field Work" in writing.

c. Pre-field DALT preliminary notification.

1.4.1.5 Completed Check Out Lists

a. Check out list for Season 1

Submit "Prerequisite HVAC Work Checkout List" and certify in writing that each item has been checked and is operating as designed.

1.4.2 SD-12, Field Test Reports

a. Certified DALT report

b. Certified TAB report for Season 1

Submit certified reports in the specified format including the above data.

1.4.2.1 Certified DALT Report

a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA HVACADLTM. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Node numbers shall be included in the completed report forms to identify each duct section. The report shall be reviewed and certified by the TAB supervisor.

b. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

c. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.4.2.2 Certified TAB Reports

Submit Certified TAB Report for Season 1 in the following manner:

a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report.

Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.

b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded.

c. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.5 QUALITY ASSURANCE

1.5.1 Modifications of References

Accomplish work in accordance with referenced publications of AABC or NEBB except as modified by this section. In the references referred to herein, consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may" wherever they appear. Interpret reference to the "authority having jurisdiction," the "Administrative Authority," the "Owner," or the "Design Engineer" to mean the "NTR."

1.5.2 Responsibilities

The Contractor shall be responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in Appendix A.

1.5.2.1 Contractor

a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by either of the following groups provided they meet the applicable requirements specified in Appendix B.

(1) Independent AABC or NEBB certified TAB agency

b. Pre-DALT/TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor, mechanical contractor, electrical contractor, and automatic temperature controls contractor.

c. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB Agency:

(1) Contract drawings and specifications

(2) Approved submittal data for equipment

(3) Construction work schedule

(4) Up-to-date revisions and change orders for the previously listed items

d. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in Appendix A, is met.

e. Coordination of supporting personnel: Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the DALT and TAB field measurement work. Provide equipment mechanics to operate HVAC equipment to enable TAB field team to accomplish the DALT and TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the DALT and TAB field work. Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.

f. Deficiencies: Ensure that equipment defects, installation deficiencies, and design deficiencies reported by the TAB team field leader are brought to the attention of the Contracting Officer. Ensure that design deficiencies reported by the TAB field leader, or the TAB team supervisor, are transmitted to the NTR within 4 calendar days from date of receipt from the TAB agency.

g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. List as prerequisite work items, the deficiencies, pointed out by the TAB team supervisor in the design review report. Ensure that the TAB Agency gets a copy of the prerequisite HVAC work checklist specified in the paragraph entitled, "Submittals." Do not allow the TAB team to commence TAB field work until all of the following are completed.

(1) HVAC system installations are fully complete.

(2) HVAC prerequisite checkout work lists have been completed, submitted, and approved.

(3) DALT field checks for all systems are completed.

(4) HVAC system filters are clean for Season 1 TAB field work.

h. Advance notice: Furnish to the NTR with advance written notice for each event, the commencement of the DALT field work and for the commencement of the TAB field work.

i. Insulation work: If DALT work is required, ensure that no insulation is installed on ducts to be DALT'd until all DALT work on the subject ducts is complete. Later, ensure that openings for TAB test ports in insulation covering HVAC ducts and machinery are closed and sealed.

1.5.2.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of Appendix B.

1.5.2.3 TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Pre-DALT/TAB meeting: Attend meeting with Contractor.

c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, the pre-field DALT plan or during the DALT or TAB field work.

e. Pre-field DALT preliminary notification: Monitor the completion of the duct installation of each system and provide the necessary written notification to the NTR.

f. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.

g. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report is submitted.

h. Technical assistance for DALT work

(1) Technical assistance: Provide immediate technical assistance to TAB field team.

(2) DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being implemented and to confirm the accuracy of the pre-final DALT Report data which has been reported. Also, sufficient evaluation shall be made to allow the TAB supervisor to issue certification of the final report.

i. Certified DALT report: Certify the DALT report. This certification includes the following work:

(1) Review: Review the DALT Pre-final report data. From these field reports, prepare the certified DALT report.

(2) Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.

j. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.

TAB field visit: At the midpoint of the Season 1 and Season 2 TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of two 8-hour workdays duration.

k. Certified TAB report: Certify the TAB report. This certification includes the following work:

(1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.

(2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.

l. Design deficiencies: Submit in writing as soon as possible, to the Contractor and the NTR, each design deficiency reported by the TAB field team. Provide, in this submittal, a complete explanation including supporting documentation detailing the deficiency.

m. TAB Field Check: The TAB team supervisor shall attend and supervise Season 1 TAB field check.

1.5.2.4 TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution".

b. Full time: Be present at the contract site when DALT field work or

TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

1.6 PRE-DALT/TAB MEETING

Meet with the NTR's TAB representative to develop a mutual understanding relative to the details of the DALT work and TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 DALT PROCEDURES

3.1.1 DALT Field Work

Leak test the HVAC air ducts and sections of each system as selected by the NTR. Accomplish leak tests in accordance with SMACNA HVACADLTM, except as modified by this section. Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA HVACADLTM. Provide instruments and consumables required to accomplish the DALT field work. Follow the same basic, procedure specified below in paragraph "TAB Field Work," which include maintenance of and calibration of instruments, accuracy of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies.

3.1.2 Data From DALT Field Work

After completion of the DALT work, prepare a pre-final DALT report using the reporting forms specified. Data required by those data report forms shall be furnished by the TAB team. Prepare the report neatly and legibly; the pre-final DALT report shall be the final DALT report minus the TAB supervisor's review and certification. Verbally notify the Contracting Officer's TAB representative that the field check of the pre-final DALT report data can commence; give this verbal notice 48 hours in advance of when the field checking shall commence.

3.1.3 Quality Assurance for DALT Field Work

a. Field Check

(1) Pre-final DALT report data: Field check for accuracy, in the presence of the NTR's TAB representative, the pre-final DALT

report data for each system. The TAB team field leader shall be present full-time when the field check of 50 percent of the duct sections for each duct system reported shall be conducted. Pre-final report field checks may be conducted separately for each system to allow phased testing.

(2) Additional system field check: If any data on the DALT report form for a given duct section is out-of-tolerance, then data for one more duct section will be checked. The additional duct section to be checked shall be in addition to the original 50 percent of duct sections to be checked.

(3) Out-of-tolerance: If any of the duct sections checked for a given system are determined to be out-of-tolerance, testing shall be terminated and the pre-final DALT report data for the given system shall be disapproved.

b. Additional field checks: If during the random field checks of the pre-final DALT report data is determined to be out-of-tolerance, the Contractor shall make the necessary corrections and prepare a revised pre-final DALTS report. A field check of the revised report data shall then be rescheduled with the Contracting Officer's TAB representative.

c. Final certified DALT report: On successful completion of all field checks of the pre-final DALT report data for all systems, the TABS Supervisor shall assemble, review, certify and submit the final certified DALT Report.

d. Prerequisite to TAB Field Work: Upon completion of DALT work, field check and correction of outstanding items, including additional field checks, submit the final certified DALT report for NTR approval. No TAB field work shall commence prior to the completion and approval, for all systems, of the pre-final DALT report field check.

3.2 TAB PROCEDURES

3.2.1 TAB Field Work

Test, adjust, and balance the listed HVAC systems to the state of operation indicated on and specified in the contract design documents. Air systems shall be proportionately balanced and reported in the Season 1 certified TAB report. Provide instruments and consumables required to accomplish the TAB work. Conduct TAB work, including sound measurement work, on the listed HVAC systems in conformance with the AABC MN-1, or NEBB TABES, and NEBB MSV, except as modified by this section:

a. Maintenance and calibration of instruments.

b. Accuracy of measurements.

c. Preliminary procedures: Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field

work. Test ports required for testing by the TAB engineer shall be located in the field by the TAB engineer during TAB field work. It shall be the responsibility of the sheetmetal contractor to provide and install test ports as required by the TAB engineer.

d. Air distribution systems TAB work:

(1) Heating and ventilating unit systems including fans, coils, ducts, registers, grilles, and louvers for supply air and outside air.

(2) Exhaust fan system including fans, ducts and grilles, for exhaust air.

(3) Unit heaters.

e. Sound measurement work:

(1) All areas to be sound measured: Measure and record the sound power level for each octave band listed in ASHRAE HA.

(2) Procedure: At the time the sound level is measured, each room shall be unoccupied, except for TAB team, and all HVAC systems that would cause noise in the room shall be operating in their noisiest mode. Record the sound level (dB) in each octave band. Attempt to mitigate the sound level and bring the level to within the specified ASHRAE HA goals, if such mitigation is within the TAB team's control. If sound level cannot be brought into compliance, provide written notice of the deficiency to the Contractor for resolution or correction.

(3) Timing: Sound levels shall be measured at times prescribed by AABC or NEBB.

(4) Meters: Measure sound levels with a sound meter complying with ANSI S1.4 (ASA 47), Type 1 or 2. Measurement methods for overall sound levels and for octave band sound levels shall be as prescribed by NEBB.

(5) Calibration: Sound levels shall be calibrated as prescribed by AABC or NEBB except that calibrators emitting a sound pressure level tone of 94 dB at 1000 hertz (Hz) are also acceptable.

(6) Background noise correction: Determine background noise component of room sound (noise) levels for each (of eight) octave bands as prescribed by AABC or NEBB.

g. TAB work within seasonal limitations:

(1) Performance tests: Accomplish proportionate balancing TAB work on the air distribution systems and water distribution systems, in other words, accomplish adjusting and balancing of

the air flows and water flows, any time during the duration of this contract, subject to the limitations specified elsewhere in this section. However, accomplish, within the following seasonal limitations, TAB work on HVAC systems which directly transfer thermal energy.

(2) Season of maximum load: Visit the contract site for at least one TAB work sessions for TAB field measurements. Visit the contract site during the season of maximum heating load the goal being to TAB the operational performance of the heating systems under their respective maximum outdoor environment-caused loading. During the seasonal limitations, TAB the operational performance of the heating systems.

(3) Sound measurements within seasonal limitations: Comply with paragraph titled, "Sound Measurement Work," specifically, the requirement that a room must be operating in its noisiest mode at the time of sound measurements in the room. The maximum noise level measurements could depend on seasonally related heat or cooling transfer equipment.

(4) Ambient temperatures: On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. That is, record these temperatures at beginning and at the end of data taking.

h. Workmanship: Conduct TAB work on specified HVAC systems until measured parameters are within plus or minus 10 percent of the design values, that is, the values specified or indicated on the contract documents.

i. Deficiencies: Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled, "Workmanship," provide written notice as soon as possible to the Contractor and the NTR describing the deficiency and recommended correction. Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.2.2 Data From TAB Field Work

After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms shall be furnished by the TAB team. Except as approved otherwise in writing by the NTR, the TAB work and thereby the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph titled, "Workmanship".

3.2.3 Quality Assurance For TAB Field Work

a. Field check: Test shall be made to demonstrate that capacities and general performance of air and water systems comply with the contract requirements.

(1) Recheck: During field check, the Contractor shall recheck, in the presence of the NTR, random selections of data (air quantities, air motion, sound level readings) recorded in the certified report.

(2) Areas of recheck: Points and areas of recheck shall be selected by the NTR.

(3) Procedures: Measurement and test procedures shall be the same as approved for work for forming basis of the certified report.

(4) Recheck selections: Selections for recheck will not exceed 25 percent of the total number of reported data entries tabulated in the report.

b. Retests: If random tests reveals a measured quantity which is out-of-tolerance, the report is subject to disapproval at the NTR's discretion. In the event the report is disapproved, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and a new field check conducted at no additional cost to the Government.

c. Approval prerequisite: Compliance with the field checking requirements of this section is a prerequisite to the final approval of the certified TAB report submitted.

3.3 MARKING OF SETTINGS

Permanently mark the settings of HVAC adjustment devices including valves, splitters, and dampers so that adjustment can be restored if disturbed at any time. The permanent markings shall indicate the settings on the adjustment devices which result in the data reported on the submitted certified TAB report.

3.4 MARKING OF TEST PORTS

The TAB team shall permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, these markings shall be made on the exterior side of the duct insulation. The location of test ports shall be shown on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

-- End of Section --

APPENDIX A

TAB SUBMITTAL AND WORK SCHEDULE

NOTE: Compliance with the following schedule is the Contractor's responsibility.

1. Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.

2. Pre-DALT/TAB Meeting: Within 30 calendar days after the date of approval of the TAB agency and personnel, meet with the Contracting Officer's TAB representative.

3. Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

4. Pre-Field DALT Preliminary Notification: On completion of the duct installation for each system, the Contractor shall notify the Contracting Officer in writing within 5 days after completion.

5. Notice of DALT Field Work: At a minimum of 14 calendar days prior to commencement of the DALT work, submit the written advanced notice of DALT field work.

6. DALT Field Work: Accomplish DALT field work.

7. Submit Pre-final DALT Report: Within one working day after completion of DALT field work, submit pre-final DALT report. Separate pre-final DALT reports may be submitted to allow phased testing from system to system.

8. DALT Work Field Check: 48 hours after verbal notification of DALT work completion, the field check shall commence.

9. Season 1 Checklist and Notice of TAB Work: At a minimum of 90 calendar days prior to CCD, submit Season 1 prerequisite HVAC work checklist certified as complete, and submit advance notice of commencement of Season 1 TAB field work.

10. Season 1 TAB Field Work: At a minimum of 30 calendar days prior to CCD, and when the ambient temperature is within Season 1 limits, accomplish Season 1 TAB field work.

11. Submit Season 1 TAB Report: Within 15 calendar days after completion of Season 1 TAB field work, submit certified Season 1 TAB report.

12. Season 1 TAB Field Check: 30 calendar days after certified Season 1 TAB report is approved by the NTR, conduct Season 1 field data check.

APPENDIX B

TAB PERSONNEL QUALIFICATION REQUIREMENTS

1. Independent AABC or NEBB Certified TAB Agency: Provide services of a TAB agency certified by AABC or NEBB to perform and manage TAB work on HVAC

air and water systems. This TAB agency shall not be affiliated with any company participating in any other phase of this contract, including design, furnishing equipment, or construction.

1.1 TAB Team Personnel: The TAB team approved to accomplish work on this contract shall be full-time employees of the TAB agency. No other personnel shall do TAB work on this contract.

a. TAB Team Supervisor: Supervisor shall be qualified by AABC or NEBB as a TAB supervisor or a TAB engineer.

b. TAB Team Field Leader: Leader shall have satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

c. TAB Team Field Technician: Technician shall have satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

SECTION 15997

TESTING INDUSTRIAL VENTILATION SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

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

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	1989 National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning System

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 2080	1992 Industrial Ventilation

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 201	1990 Fan Application Manual - Fans and Systems

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB PSTABES	1983 Testing, Adjusting, Balancing of Environmental Systems

1.2 DEFINITIONS

a. Capture velocity: Air velocity at a point in front of the hood or at the hood opening necessary to overcome opposing air currents and to capture contaminated air at that point to cause it to flow into the hood.

b. Capture zone: Controlled space around an industrial process that ensures a safe and healthy workspace for the worker.

c. Equilibrium performance point: The condition where an air pollution control device operates for sufficient start-up time and reaches optimum efficiency. The manufacturer recommends the minimum start-up time for each device.

d. Facility: A building or portion of a building in which contaminated air is controlled by the industrial ventilation system. This includes the shop space, equipment room, offices, restrooms and locker rooms which are affected by the industrial process being controlled.

e. Full load condition: Condition in the shop or facility where exhaust and replacement air systems operate simultaneously, as

installed by the Contractor in accordance with the design plans and specifications.

f. Heating equipment: Equipment used to condition air in the facility. Equipment includes but is not limited to: heat exchangers and heating and cooling coils.

g. Hood static pressure: Static pressure, in inches of water (gauge), taken at 3 duct diameters from the hood for flanged or plain hoods and 1 duct diameter from a tapered hood.

h. Manometer: An instrument for measuring pressure. Electronic or U-tube manometers with water or light oil are acceptable. Mercury manometers are acceptable for measuring vacuum or low volume, high velocity ventilation systems.

i. Replacement air system: The mechanical system supplying air to a building to replace air being exhausted.

j. Test agency: Subcontractor who is independent from the Contractor and the mechanical subcontractor except by the affiliation established by this contract.

k. Transport velocity: Minimum air velocity, in feet per minute, necessary, to prevent the contaminant from settling or condensing in the ductwork.

l. Velocity pressure: The kinetic pressure in the direction of flow necessary to cause a fluid at rest to flow at a given velocity. It is usually expressed in inches of water, gauge.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.3.1 SD-08, Statements

a. Work plan

b. Qualifications of installer

c. List of test instruments

1.3.1.1 Work Plan

Submit 60 calendar days prior to beginning the test, steps to be taken by the lead engineer to accomplish the required testing. Submit the following:

a. Prerequisite work checklist.

b. Memorandum of test procedure.

(1) Proposed dates for the preliminary review, proposed test

dates.

(2) Plan view showing proposed test locations.

(3) Pitot traverse reading locations.

c. Test equipment to be used.

d. Other equipment required, such as, scaffolding.

e. Personnel support, such as, factory representatives.

1.3.1.2 Qualifications of Installer

Use the sample form, "Test Agency Qualifications Sheet," to submit the following information:

a. Verification of 5 years of experience as an agency in testing industrial ventilation systems.

b. References from five facility managers of facilities with industrial ventilation systems that the agency has tested. A minimum of three facilities shall have processes and contaminants similar to those generated by the facility in this project.

c. Registration for Professional Engineer (PE) license or Certification for an Industrial Hygienist (CIH) for the lead test engineer. Submit PE license or CIH registration number, discipline, date of issue, and expiration date. Engineers shall include the state of issue.

d. Confirmation of 5 years of industrial ventilation test experience for the lead test engineer. References from five facility managers for facilities where the lead engineer has supervised industrial ventilation systems tests in the last 5 years.

e. Verification of length of time lead engineer has been employed by a test and balance agency.

1.3.1.3 List of Test Instruments

Submit a signed and dated list of test instruments, their application, manufacturer, model, serial number, range of operation, accuracy and date of calibration.

1.3.2 SD-12, Field Test Reports

a. Preliminary review report

b. Smoke tests report

c. Fan operating points report

d. Static pressure report

e. Volume and velocity flow rates report

f. Pitot traverse report

Submit 6 copies of an organized report which is bound in a durable, water-resistant binder. Report shall contain a table of contents, an executive summary, an introduction, a results section and a discussion of the results. Document unmet design requirements which were identified during testing. Submit field data and report forms in appendices separated according to the fan system tested. Include the preliminary review report as an Appendix. Report daily temperature, humidity and barometric pressure readings. Note weather and barometric pressure changes during the day, for example, "clear in the morning and thunderstorm in the afternoon." Forms other than those listed may be used; however, information required by these forms shall be submitted. Include completed forms in the report appendix. Use the sample forms, "Replacement Air System Test Data" and "Exhaust Air System Test Data," to summarize the tests for the appropriate fan.

1.3.2.1 Preliminary Review Report

Submit a preliminary review report 15 calendar days prior to beginning the test.

1.3.2.2 Smoke Tests Report

Describe turbulent air flow and dead air spaces in the hood capture zone. Describe smoke flowing from the capture zone. Report leaks in the ductwork, access door, and fan to duct connectors. Report smoke behavior as it exits from the exhaust stack and describe entrainment around the tested facility, nearby structures and geographical features.

1.3.2.3 Fan Operating Points Report

From test data and manufacturer's performance data for the duct system and fans, determine the difference between measured and design volume flow rate and fan static pressure at the point of operation. Show the design and measured operating point for each fan on the corresponding fan curve. Report fans that can not operate at speeds 25 percent greater than the measured speed while remaining within the boundaries of the fan curve and fan class.

1.3.2.4 Static Pressure Report

Report static pressures using tables to summarize test results by system, fan static pressure for replacement and exhaust air systems, and the static pressure, as compared to atmosphere, of each room in the facility. Note static pressures that are inconsistent and report the reason. Inconsistencies include:

a. Inconsistent static pressure drop or increase in one or a series of hoods on the same branch;

b. Different static pressures for similar systems in the facility;

c. Decreasing static pressures as the hoods get closer to the exhaust

fan inlet; and

d. Increasing static pressures as the replacement air branches get closer to the fan outlet.

1.3.2.5 Volume and Velocity Flow Rates Report

Report volume flow rates and velocities in standard cubic feet per minute and feet per minute, respectively. Compare measured volume flow rate with design value for each hood, the total exhaust air system, each replacement air distribution point and the total replacement air system. Report the transport velocity for each branch and main duct in the exhaust air system. In tabular form, list the measured and design values and indicate if the test value is adequate or inadequate. Adequate hood volume flow rates and transport velocities are those with measured values within plus or minus 5 percent of design values. Adequate total system volume flow rates are those with measured values within plus 10 percent of the design values.

1.3.2.6 Pitot Traverse Report

Use the "Pitot Traverse Data" sample form to record pitot traverse readings. As a minimum the following data is required for each pitot traverse:

a. Velocity pressure readings and converted velocities;

b. Average velocity;

c. Duct area; and

d. Total measured volume flow rate.

1.3.2.7 Deadline

All work and the report shall be completed at least 60 calendar days before the contract completion date.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

a. Test agency experience data;

b. Test agency personnel experience data; and

c. Professional engineer license or industrial hygienist certification data.

1.4.2 Modification of References

Comply with the referenced standards of ACGIH, NEBB, AMCA, and AABC when testing the industrial ventilation system except as modified by this section. Advisory or recommended provisions shall be considered mandatory.

1.4.3 Test Requirements

The Contractor shall adjust and balance the industrial ventilation system in accordance with NEBB PSTABES or AABC MN-1.

1.4.4 Test Engineer

1.4.4.1 Field Work

The lead test engineer shall be present at the project site while testing is performed and shall be responsible for conducting, supervising, and managing of test work. Management includes health and safety of test agency employees.

1.4.4.2 Reporting Work

The test agenda, equipment list and certified report shall be prepared, signed and dated by the lead test engineer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 TEST PROCEDURE

Test the industrial ventilation system and report results for the following rooms: Office and toilet room.

3.1.1 Preliminary Review

Conduct a preliminary review of the facility 45 calendar days prior to beginning the test. Perform the following tasks and report the results of each task in the preliminary review report.

a. Locate industrial ventilation system components including hoods, hood transitions, ductwork, branch to main duct entries, elbows, expansions and contractions, fans, exhaust stacks, weather protection, and distribution devices. Show each component on single line drawings which are segregated according to the fan servicing the component.

b. Review design drawings, specifications, and shop drawings to verify that testing can be performed on the system. Record locations of planned pitot traverses of mains and branches, and calculated velocities. Report potential test problems, such as inadequate space, to the NTR.

c. Use AMCA 201 to report systems effects that occur at the inlet and outlet of each replacement and exhaust air fan.

d. Verify that ductwork sizes, elbows and fittings, exhaust stacks and weather protection meet the design plans and specifications for both replacement and exhaust air systems.

e. Verify that fans are rotating in the proper direction.

f. Identify equipment such as fans, heating coils, and controls, that do not meet the design plans and specifications.

g. Obtain fan performance data from the manufacturer.

h. Verify that replacement air terminals including louvers, grills are installed in accordance with the design plans and specifications.

i. Obtain manufacturer's differential pressure data and maximum operating pressures for air filtration devices including dirty and clean replacement air filters.

j. Obtain the temperature and pressure control diagram.

k. Identify on each system single-line drawing the location of pressure differential sensors and static pressure sensors.

l. Record the nameplate data from each fan, motor, and other applicable components installed per this design.

m. Record motor starter sizes and thermal overload protection devices installed per this design.

n. Perform all calculations that can be performed prior to the start of actual field testing.

o. Verify the following requirements unless otherwise specified in the individual section:

(1) The fan bearings have a minimum rated life of 200,000 hours.

(2) Sound and vibration isolation equipment has been installed to prevent sound and vibration transmission to the ductwork and floor or fan mounting structure.

(3) Fan bases are level.

(4) Fan wheels are balanced and clear the housing.

(5) Fan shafts are of uniform diameter.

(6) Access to fan grease fittings and other routine maintenance equipment.

(7) Safety equipment, such as fan belt guards, are in place.

(8) Drive alignment and belt tension are correct for each fan.

3.2 FIELD TESTS

3.2.1 Preliminary Procedures

Provide instruments and consumable equipment required to test the industrial ventilation system. Test the facility under full load conditions. Close windows and doors in the facility. Ensure that exhaust and replacement air ductwork and air intake sources are free from debris and dirt. Conduct the testing with the replacement air prefilters loaded to the manufacturer's recommended maximum-load condition.

3.2.2 Test Method

Test in accordance with ACGIH 2080, Chapter 9 and this section. The test engineer is authorized to readjust and rebalance the system if minor adjustments will bring the system into compliance with the design. Minor adjustments include adjusting the fan sheave, correcting fan rotation and resetting dampers. Balance the system without blast gates. Record quantitative readings on sample forms, "Pitot Traverse Data," Rectangular or Round Duct," "Exhaust Air System Test Data," and "Replacement Air System Test Data."

3.2.2.1 Smoke Test

Prior to performing quantitative tests on the industrial ventilation system, test each hood with smoke generators or titanium tetrachloride to verify contaminant control in the capture zone. Smoke simulates the contaminant. Comply with restrictions on the use of incendiary devices. When large quantities of smoke are expected, inform the fire department or other responsible parties.

3.2.2.2 Air Quantity Readings

Using a pitot tube and manometer, test the exhaust and replacement air systems for velocity pressure. Use pitot traverse measurements. Determine the number of velocity pressure readings and access holes required at traverses for round and rectangular ducts in accordance with ACGIH 2080. Traverse access holes shall be drilled. Round ducts require two traverse access holes positioned 90 degrees apart. Rectangular ducts may require several traverse access holes. Make pitot traverses at a point which is at least 7.5 duct diameters of straight duct after the fan outlet, or 5 duct diameters of straight duct prior to the fan inlet, away from air disturbing devices including elbows, branch entries, duct expansions, and hood transitions. When these distances of straight duct are not available, use a schematic drawing to note the disturbance producing device, and distance between the pitot traverse and the device. Number of velocity pressure readings in a pitot traverse shall depend on the duct configuration and dimensions. After completing a traverse, confirm one velocity pressure reading for each access hole. Accept traverse data when the difference between the original and confirmation measurement is less than 5 percent; otherwise repeat the traverse. Convert velocity pressure readings to velocity values before averaging the duct velocity. Plug holes with cap plugs immediately after each traverse. Velocity and volume flow rates calculated from velocity pressure readings are required at the following locations:

a. Replacement air fan outlet;

b. Replacement air duct branch;

c. Exhaust air duct branch, including hoods and submains;

d. Exhaust fan inlet or outlet;

e. Outside air ducts in recirculating replacement air system.

3.2.2.3 Velometer Readings

A flow hood may be used for measuring office and restroom replacement air quantities. Velometer readings shall not be substituted for manometer and pitot tube readings. Use velometers to estimate the following:

a. Velocity exiting from replacement air systems without ductwork;

b. Crossdrafts in a room;

c. Hood capture velocity; and

d. Duct velocities less than 600 feet per minute.

3.2.2.4 Static Pressure Readings

Take static pressure readings using a pitot tube and manometer. Take hood static pressure readings in the direction of the air flow away from the hoods. Take readings at a distance of one duct diameter from tapered hoods, and 3 diameters from plain or flanged hoods. Take other static pressure readings where velocity pressure readings are taken. The following readings are required:

a. Hood static pressure;

b. Replacement and exhaust fan inlet and outlet static pressure;

c. Room static pressure as compared to outdoors

d. Branch static pressure in the replacement and exhaust air system submain ductwork.

3.2.2.5 Control System Check-Out

Test warning system controls for the industrial ventilation system including above and below range alarms for room static pressure, fan motor operating lights, set screws tightened allowing dampers to be operated by the control motor.

3.2.2.6 Other Readings

Take the following readings on each day testing is performed:

a. Take the following temperature readings after the system has

stabilized and has been running for at least 4 hours:

(1) Wet bulb and dry bulb temperature of ancillary rooms, workspaces, replacement air and outside air.

(2) Temperature for fan and motor bearings on ventilation equipment.

b. Record barometric pressure and altitude. Base weather station data is acceptable when the test engineer does not have barometric pressure test equipment.

3.2.3 System Markings

To re-evaluate the industrial ventilation system during follow-up tests, mark the settings and test ports. Before submitting the report, label test points. Use spray paint or another accepted practice to mark the airflow adjusting devices so they can be returned to their original position if an adjustment is changed.

3.2.4 Test Verification

In the presence of the NTR, the test engineer shall repeat at least 10 percent of the test for each replacement and exhaust air system to verify the results. As a minimum, re-test the following readings: total volume flow for each fan, inlet and outlet static pressure for each fan, and volume flow and hood static pressure for the hood with the longest duct run from the exhaust fan. Retest hood volume flow rates and total system volume flow rates which disagree with the design value.

3.2.4.1 Test Result Disagreements

The difference between test and verification readings for static and velocity pressure shall be within plus or minus 5 percent. When the difference between test and verification readings are greater than these acceptable values, the test engineer shall:

a. Recalibrate test equipment

b. Retest the entire system

c. Reverify the results

3.2.5 Test Engineers Out-Brief

Verbally summarize for the NTR the condition of the industrial ventilation system. Report test data that does not meet the design criteria as defined in paragraph entitled "Field Test Reports."

-- End of Section --

TEST AGENCY QUALIFICATION SHEET

DATE _____
COMPLETED BY_____

A. Agency Qualifications

Agency Name _____
Address _____
Telephone Number _____
Years of experience testing industrial ventilation systems_____

Industrial facilities tested (5 required - use additional pages)
Facility _____
Address _____
Point of contact _____
Telephone number _____
Dates of test _____
Type of operation _____
Contaminants _____
Number of fans _____
Type of exhaust hoods _____
Air cleaning devices _____
Personnel performing the test _____

Attach letters of recommendation for tests performed at these facilities. Three facilities shall be of the type of operation to be tested.

B. Lead Test Engineer Qualifications

Name _____

Length of time lead engineer has worked with Agency _____

Years of experience testing industrial ventilation systems _____

Professional Engineering Information
discipline _____
license number _____
issue date _____
recertification date _____
state of registration _____

Industrial facilities tested (5 required - use additional pages)
Facility _____
Address _____
Point of Contact _____
Telephone number _____
Dates of Test _____
Type of Operation _____
Contaminants _____
Number of Fans _____
Type of Exhaust Hoods _____
Air Cleaning Devices _____

PITOT TRAVERSE DATA - Rectangular Duct

Test Date _____
Readings By _____
Traverse By _____
Static Pressure _____
Room _____
System/Unit _____
Traverse Location _____
Distance to Resistance Causing Component

Component	Distance
before _____	_____
after _____	_____

Air Temperature _____
Barometric Pressure _____
Inside/Outside Duct Width _____
Inside/Outside Duct Height _____
Inside Duct Area _____
Required Velocity _____
Required Actual Volume Flow Rate ____
Velocity Pressure Reported as _ Units

Pitot Traverse Matrix

Velocity Point Position	Pressure Readings (minimum center distance is 6 inches) 1	2	3	4	5	6	7	8	9	10	Confirm
A	___	___	___	___	___	___	___	___	___	___	_____
B	___	___	___	___	___	___	___	___	___	___	_____
C	___	___	___	___	___	___	___	___	___	___	_____
D	___	___	___	___	___	___	___	___	___	___	_____
E	___	___	___	___	___	___	___	___	___	___	_____
F	___	___	___	___	___	___	___	___	___	___	_____
G	___	___	___	___	___	___	___	___	___	___	_____
H	___	___	___	___	___	___	___	___	___	___	_____
I	___	___	___	___	___	___	___	___	___	___	_____
J	___	___	___	___	___	___	___	___	___	___	_____

Velocity Point Position	Pressure Readings Converted to Velocity (FPM) 1	2	3	4	5	6	7	8	9	10
A	___	___	___	___	___	___	___	___	___	___
B	___	___	___	___	___	___	___	___	___	___
C	___	___	___	___	___	___	___	___	___	___
D	___	___	___	___	___	___	___	___	___	___
E	___	___	___	___	___	___	___	___	___	___
F	___	___	___	___	___	___	___	___	___	___
G	___	___	___	___	___	___	___	___	___	___
H	___	___	___	___	___	___	___	___	___	___
I	___	___	___	___	___	___	___	___	___	___
J	___	___	___	___	___	___	___	___	___	___

_____
Subtotal

_____
Total Velocity/# Readings = Avg. Velocity x Duct Area = Actual Volume Flow Rate

_____FPM / _____ = _____ FPM x ____ SQ. FEET = _____ ACFM

REMARKS

PITOT TRAVERSE DATA - Round Duct

Test Date _____
Readings By _____
Traverse By _____
Static Pressure _____
Room Number _____
System/Unit _____
Traverse Location _____

Distance to Resistance Causing Component

	Component	Distance
before	_____	_____
after	_____	_____

Air Temperature _____
Barometric Pressure _____
Inside/Outside Duct DIA. _____
Inside Duct Area _____
Required Velocity _____
Required Actual Volume Flow Rate ____
Velocity Pressure Reported as _ Units

Pitot Traverse Matrix

Duct Diameter	0-6 in. 12 readings (6/traverse)	6-48 in. 20 readings (10/traverse)	More than 48 in. or unstable velocities 40 readings (20/traverse)		
TEST POINT	Velocity Pressure	Velocity	#	Velocity Pressure	Velocity
1	_____	_____	21	_____	_____
2	_____	_____	22	_____	_____
3	_____	_____	23	_____	_____
4	_____	_____	24	_____	_____
5	_____	_____	25	_____	_____
6	_____	_____	26	_____	_____
7	_____	_____	27	_____	_____
8	_____	_____	28	_____	_____
9	_____	_____	29	_____	_____
10	_____	_____	30	_____	_____
11	_____	_____	31	_____	_____
12	_____	_____	32	_____	_____
13	_____	_____	33	_____	_____
14	_____	_____	34	_____	_____
15	_____	_____	35	_____	_____
16	_____	_____	36	_____	_____
17	_____	_____	37	_____	_____
18	_____	_____	38	_____	_____
19	_____	_____	39	_____	_____
20	_____	_____	40	_____	_____
Confirm 1	_____		Confirm 1	_____	
Confirm 2	_____		Confirm 2	_____	

Velocity Sum (Without Confirm Value) _____

Velocity Sum/# Readings = Average Velocity x Duct Area = Actual Volume Flow

Rate _____ FPM / _____ = _____ FPM x _____ SQ. FEET = _____ ACFM

REMARKS

EXHAUST AIR SYSTEM TEST DATA

Test Dates _____
Readings By _____

Unit Number _____
Unit Location _____
Make Model _____
Model _____
Serial Number _____

Damper Positions
Hoods _____
Submains _____

Total Volume Test Location
Duct dia. before fan _____
Duct dia. after fan _____

Pressures (in. w.c.)
Fan Inlet Static _____
Fan Outlet Static _____
Fan Inlet Velocity _____
Fan Static _____
Fan Total _____

Differential Pressure
across air cleaning device

Device	Delta P (in. w.g.)

Fan Speed (RPM) _____
Motor Speed (RPM) _____

Resistance Causing Elements

Type	Relationship to Fan before/after	# Duct dia.
elbow		
damper		
expansion		
contraction		
plenum		

Pulley - Center to Center Distance
_____

Amperage - T1, T2, T3 _____
Voltage - T1-2, T2-3,T3-1 _____

Temperature (W.B./D.B.)
Outside Air _____
Replacement Air _____

VOLUME FLOW RATES (Standard Cubic Feet per Minute)

SYSTEM	ACTUAL	DESIGN	ADEQUATE	INADEQUATE
Total Volume				
SUBMAIN				
Submain name				
Submain name				
Submain name				
HOODS				
Hood name				
Hood name				
Hood name				
Hood name				
Hood name				
Hood name				
Hood name				
Hood name				
Hood name				
Hood name				
Hood name				

REPLACEMENT AIR SYSTEM TEST DATA

Test Dates _____
Readings By _____

Unit Number _____
Unit Location _____
Make _____
Model _____
Serial Number _____

Damper Positions
Terminals _____
Submains _____
across Cooling Coil _____
across Preheat Coil _____

Total Volume Test Location
Duct dia. before fan _____
Duct dia. after fan _____

Resistance Causing Elements

Type	Relationship to Fan before/after	# Duct dia.
elbow		
damper		
expansion		
contraction		
plenum		

Pressures (in. w.c.)
Fan Inlet Static _____
Fan Outlet Static _____
Fan Inlet Velocity _____
Fan Static _____
Fan Total _____

Differential Pressure
across Filters _____
across Reheat Coil _____

Fan Speed (RPM) _____
Motor Speed (RPM) _____

Pulley - Center to Center Distance
_____

Amperage - T1, T2, T3 _____
Voltage - T1-2, T2-3,T3-1 _____

Temperature (W.B./D.B.)
Outside Air _____
Replacement Air _____
Mixed Air _____

VOLUME FLOW RATES (Standard Cubic Feet per Minute)

SYSTEM	ACTUAL	DESIGN	ADEQUATE	INADEQUATE
Total Volume				
Outside Air Volume				
Return Air				
Ratio: Outside/Return				
BRANCH				
Branch name _____				
Branch name _____				
Branch name _____				
Branch name _____				
Branch name _____				
Branch name _____				
Branch name _____				

SECTION 16011

ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

a. General:

1. Provide all labor, materials, tools, equipment, design services, supervision and coordination to perform all electrical work required, in accord with provisions of the contract documents.

2. Completely coordinate with the work and requirements of all other trades.

3. Although such work is not specifically indicated, furnish and install all supplementary items or appurtenances and devices necessary for a sound, secure and complete installation.

b. Drawings Use and Interpretation:

1. Drawings are diagrammatic and indicate general arrangement of systems and equipment, except when specifically dimensioned or detailed.

2. Intention is to show approximate sizes, capacities, locations, direction and general relationship of one work phase to another. But not exact detail or arrangement.

3. Field verify locations, arrangements and capacities of all existing systems and equipment to be utilized at this site.

c. Installation of all systems and equipment is subject to clarification as indicated in reviewed shop drawings, design-build drawings and field coordination drawings.

d. Description of Systems: Furnish and Install all materials to provide functioning systems in compliance with performance requirements specified, and any modifications resulting from reviewed shop drawing, design-build drawings or field coordination drawings.

e. Scope of Work: Without limiting or restricting the volume of work and solely for the convenience of the contractor, the work to be performed, in general, comprises of the following:

1. Provide a complete and operating electrical installation in accordance with these specifications, performance requirements and accompanying contract drawings. This shall include all required labor, materials, apparatus, design and construction supervision.

2. Apparatus, appliance or work not shown on the plans, but mentioned in the specifications or vice versa, or any accessories necessary

to make the work complete and ready for operation, even though not specified or shown on the plans, shall be furnished and installed without additional expense to the owner.

3. Furnish and install temporary power and lighting in construction areas in accordance with Governmental requirements.

4. Furnish and install all primary and secondary power distribution from the existing 12.47 KV overhead power pole line located approximately 1,300 feet south of te site on Piney Green Road to the ground water treatment plant building. Including all metering, overhead cable, power poles, transformers, fuses, cutouts, etc.. per the requirements of the Government.

5. Furnish and install all underground and overhead conduits, cables and handholes for power and control of remote site pump locations as shown on plan.

6. Furnish and install 480Y/277 volt, 3 phase, 4 wire power distribution system.

7. Furnish and install 48o volt-208Y/120 volt transformers.

8. Furnish and install 208Y/120 volt, 3 phase, 4 wire power distribution system.

9. Furnish and install emergency lighting system.

10. Furnish and install lighting system and controls.

11. Furnish and install branch circuit wiring.

12. Furnish and install 120 volt convenience receptacles and all special receptacles.

13. Furnish and install starters and disconnects.

14. Furnish and install all power and control wiring to all motors, valve drives, process control equipment starters and disconnects that are furnished by this contractor or as part of equipment supplied by others.

15. Furnish and install a grounding system.

16. Furnish and install telephone raceway system, terminal board, and outlet boxes.

1.2 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	1993 National Electrical Safety Code

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

FEDERAL SPECIFICATIONS (FS)

FS L-P-387	(Rev. A) (Int Am. 2) Plastic Sheet, Laminated, Thermosetting (for Design Plates)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 100	1992 Dictionary of Electrical and Electronics Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Control and Systems
NEMA MG 1	1987 (Rev. 1-2) Motors and Generators
NEMA MG 10	1983 (R 1988) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA MG 11	1977 (R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1993 National Electrical Code

1.3 RELATED REQUIREMENTS

This section applies to certain sections of Division 2, "Site Work," Division 11, "Equipment," Division 13, "Special Systems," and Division 15, "Mechanical". This section applies to all sections of Division 16, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.4 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections

that describe products, systems, installation procedures, equipment, and test methods.

1.5 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 11.5 kV primary, three phase, three wire, 60 Hz, and 480 volts secondary, three phase, four wire. Final connections to the power distribution system at the existing pole line shall be made by the Contractor as directed by the NTR.

1.6 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of Section C, Part 7.0, of the Basic Contract 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.

1.6.1 Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

1.6.2 Drawings

Submit drawings a minimum of 14 inches 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.

1.6.3 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for

rejection of the equipment or material.

1.6.4 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

1.6.4.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.6.4.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the NTR. 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.

1.6.5 Operation and Maintenance Manuals

Comply with the requirements of Section 01730 and the technical sections.

1.6.5.1 Operating Instructions

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

1.7 QUALITY ASSURANCE

1.7.1 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.

1.7.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.7.3 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.

1.7.4 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.

1.7.5 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.

1.7.6 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 NTR.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 NAMEPLATES

FS L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches. Lettering shall be a minimum of 0.25-inch high normal block style.

1.10 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each cable or wire located in manholes, handholes, and vaults. Tag only new wire and cable provided by this contract. The first position on the tag shall denote the voltage. The second through sixth positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek "phi" symbol. The last position shall denote the cable size. Tag legend shall be as indicated. The tags shall be polyethylene. Do not provide handwritten letters. As an example, a tag could have the following designation: "11.5 NAS 1-80A500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, Phase A, sized at 500 MCM.

1.10.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 4500 pounds per square inch; and that are 0.035-inch thick, non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 300 degrees F. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have block letters, numbers, and symbols one-inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to ANSI C2, NFPA 70, and requirements specified herein.

1.11.1 Motors and Equipment

Provide motors, controllers, integral disconnects, and contactors with their respective pieces of equipment , except controllers indicated as part of the motor control centers shall be provided under Section 16402, "Interior Wiring Systems". Motors, controllers, integral disconnects, and contactors shall conform to Section 16402, "Interior Wiring Systems" Extended voltage range motors shall not be permitted. Control voltage for controllers and contactors shall not exceed 120 volts nominal. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment.

1.11.2 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment under Section 16402, "Interior Wiring Systems." Power wiring and conduit shall conform to Section 16402, "Interior Wiring Systems." Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.11.3 High Efficiency Motors

1.11.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.11.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately

half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

1.13 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 15, "Mechanical."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test.

3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.4 CABLE TAG INSTALLATION

Install cable tags in each manhole, handhole, and vault as specified, including each splice. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

-- End of Section --

SECTION 16370

OVERHEAD ELECTRICAL WORK

PART 1 GENERAL

1.1 REFERENCES

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

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	1987 Thermoplastic and Cross-Linked Polyethylene Insulated Shielded Power Cable Rated 5 Through 35 kV
AEIC CS6	1987 (R 1989) Ethylene Propylene Rubber Insulated Shielded Power Cable Rated 5 Through 69 kV

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	1993 National Electrical Safety Code
ANSI C12.4	1984 (R 1990) Mechanical Demand Registers
ANSI C12.10	1987 Electromechanical Watthour Meters
ANSI C12.11	1987 Instrument Transformers for Revenue Metering, 10 kV BIL Through 350 kV (0.6 kV NSV Through 69 kV NSV)
ANSI C29.2	1983 Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type
ANSI C29.3	1986 Wet Process Porcelain Insulators - Spool Type
ANSI C29.4	1989 Wet-Process Porcelain Insulators - Strain Type
ANSI C29.5	1984 (R 1991) Wet-Process Porcelain Insulators - Low- and Medium-Voltage Types
ANSI C29.7	1983 (Supp. 1986) Wet-Process Porcelain Insulators - High-Voltage Line-Post Type
ANSI C37.42	1989 Switchgear - Distribution Cutouts and Fuse Links
ANSI C57.12.20	1988 Transformers - Overhead-Type Distribution Transformers, 500 kVA and Smaller: High-Voltage, 34 500 Volts and

	Below; Low-Voltage, 7970/13 800Y Volts and Below
ANSI O5.1	1992 Wood Poles

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.11	1991 Forged Fittings, Socket-Welding and Threaded

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 153	1982 (R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 475	1989 Zinc-Coated Steel Wire Strand
ASTM B 1	1990 Hard-Drawn Copper Wire
ASTM B 2	1988 Medium-Hard-Drawn Copper Wire
ASTM B 3	1990 Soft or Annealed Copper Wire
ASTM B 8	1990 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 228	1988 Concentric-Lay- Stranded Copper-Clad Steel Conductors
ASTM B 231	1990 Concentric-Lay- Stranded Aluminum 1350 Conductors
ASTM B 232	1992 Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)
ASTM B 397	1985 (R 1992) Concentric-Lay- Stranded Aluminum-Alloy 5005-H19 Conductors
ASTM B 399	1992 Concentric-Lay- Stranded Aluminum-Alloy 6201-T81 Conductors
ASTM D 117	1989 Electrical Insulating Oils of Petroleum Origin
ASTM D 3487	1988 Mineral Insulating Oil Used in Electrical Apparatus

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	1992 All Timber Products - Preservative Treatment by Pressure Processes

AWPA C4	1992 Poles - Preservative Treatment by Pressure Processes
AWPA C25	1992 Sawn Crossarms - Preservative Treatment by Pressure Processes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 48	1990 High-Voltage Alternating-Current Cable Terminations
ANSI/IEEE C37.30	1992 High-Voltage Air Switches
ANSI/IEEE C37.60	1981 (R 1992) Overhead, Pad Mounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems
ANSI/IEEE C37.63	1984 (R 1990) Overhead, Pad Mounted, Dry Vault, and Submersible Automatic Line Sectionalizers for AC Systems
ANSI/IEEE C57.12.00	1987 Liquid-Immersed Distribution, Power, and Regulating Transformers
ANSI/IEEE C57.12.80	1987 (R 1992) Power and Distribution Transformers
ANSI/IEEE C57.12.90	1987 Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
ANSI/IEEE C57.13	1978 (R 1987) Instruments Transformers
ANSI/IEEE C57.98	1986 (R 1992) Transformer Impulse Test
IEEE C62.1	1989 Gapped Silicon-Carbide Surge Arresters for AC Power Circuits
ANSI/IEEE C62.11	1987 Metal-Oxide Surge Arresters for AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 5	1992 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 7	1988 (Rev. 1) Cross-Linked-Thermosetting-Polyethylene- Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	1988 (Rev. 1) Ethylene-Propylene-

	Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	1991 Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1993 National Electrical Code

RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA 43-5	1989 List of Materials Acceptable for Use on Systems of REA Electrification Borrowers
REA 50-17	1987 Wood Crossarms (Solid and Laminated), Transmission Timber and Pole Keys (DT-5B:PE-16)
REA 50-18	1987 Wood Poles, Stubs, and Anchor Logs

UNDERWRITERS LABORATORIES INC. (UL)

UL 6	1993 Rigid Metal Conduit
UL 83	1991 (R 1992) (Bul. 1991, 1992, and 1993) Thermoplastic-Insulated Wires and Cables
UL 414	1986 (R 1991) Meter Sockets
UL 510	1986 (R 1986) Insulating Tape
UL 854	1991 (Bul. 1992 and 1993) (R 1993) Service-Entrance Cables

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section with additions and modifications specified herein.

1.3 OVERHEAD SERVICE

Terminate overhead service conductors into buildings at service entrance fittings or weatherhead outside building. Installation and connection of service entrance equipment to overhead service conductor is included in Section 16402, "Interior Wiring Systems." Nearby support bracket for overhead wires shall be not less than 15 feet above finished grade at building.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.4.1 SD-01, Data

a. Calculations

1.4.1.1 Transformer Loss Calculations

Submit transformer loss calculations as required by paragraph titled "Transformer Losses."

1.4.2 SD-02, Manufacturer's Catalog Data

a. Conductors

b. Insulators

c. Pole top switch

d. Recloser

e. Sectionalizer

f. Cutouts

g. Transformer

h. Metering equipment

i. Meters

j. Surge arresters

k. Guy strand

l. Anchors

1.4.3 SD-08, Statements

a. Qualifications of cable splicer

For cable splicer and terminator personnel, submit documentation specified in paragraph entitled "Qualifications of Cable Splicer."

1.4.4 SD-10, Test Reports

a. Wood poles

b. Wood crossarms

Furnish an inspection report from an independent inspection agency, approved by the NTR, stating that offered products comply with applicable

AWPA and REA standards. The REA approved Quality Mark "WQC" on each pole and crossarm will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.4.5 SD-09, Reports

a. Routine and other transformer tests

b. Design tests

1.4.5.1 Routine and Other Transformer Tests

a. Resistance measurements

b. Ratio

c. Polarity and phase relation

d. No-load losses (NLL) and excitation current

e. Impedance voltage and load loss (LL)

f. Low frequency dielectric

g. Leak

h. Pressure

i. Lightning impulse test

1.4.5.2 Design Tests

a. Temperature rise

b. Lightning impulse tests

c. Lifting and moving devices

1.4.6 SD-12, Field Test Reports

a. Ground rod tests

b. High voltage cable test

c. Transformer field tests

d. Large overhead systems test

b. Design tests

1.4.7 SD-18, Records

a. Transformer test schedule

1.5 QUALITY ASSURANCE

1.5.1 Qualifications of Cable Splicer

a. In order to establish the cable workman's competency, the Contractor shall be required to submit the following within 30 days prior to commencement of the splice/termination:

(1) Documentation to verify that the individual has completed a splice/termination of the type to be installed under this contract. The test splice/termination shall be performed at the job site for this contract under the supervision of the cable accessory manufacturer or his representative and witnessed by the Government.

(2) Documentation that said splice/termination has undergone and passed the following tests by the splice/termination manufacturer or an independent testing laboratory.

	Minimum Value		
TEST	5 kV	15 kV	35 kV
Discharge Ext. Value with 3 pc or less	13 kV	20 kV	35 kV
AC withstand, 1 minute	35 kV	50 kV	75 kV
DC withstand, 15 minutes	65 kV	70 kV	100 kV

These results shall be attached for review

(3) A statement of the number of years in which the individual has been splicing/terminating medium voltage cable.

b. Criteria for waiver: Items a(1) and a(2) above may be waived on subsequent jobs provided the following criteria is satisfied:

(1) Documentation of prior completion of items a(1) and a(2) be submitted.

(2) A list of the last three jobs where the specific splices/terminations were installed within the past 12 consecutive months. The tabulation shall include splice/terminations installed.

c. Requalification: Requalification to items a(1) and a(2) in above paragraph may be required by LANTNAVFACENGCOM if the splice installer cannot demonstrate a prior history of splice/termination installation during the previous 12 consecutive months. The contractor shall furnish the material for splices and terminations.

1.6 DELIVERY, STORAGE, AND HANDLING

Store and handle poles held in storage more than 2 weeks in accordance with ANSI O5.1. Exception, do not use pointed tools capable of producing indentations of more than one inch in depth. Nails and holes are not permitted in top of poles.

1.7 SCHEDULING

Notify the NTR in writing at least 15 days prior to date connections are required. Obtain approval before interrupting service.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Consider materials specified herein or shown on contract drawings which are identical to materials listed in REA 43-5 as conforming to requirements.

2.2 WOOD POLES

Wood poles machine trimmed by turning, Southern Yellow Pine conforming to ANSI O5.1 and REA 50-18. Gain, bore and roof poles before treatment. Pressure treat poles with pentachlorophenol, in accordance with AWPA C1 and AWPA C4 as referenced in REA 50-18. The quality of each pole shall be ensured with "WQC" (wood quality control) brand on each piece, or by an approved inspection agency report.

2.3 WOOD CROSSARMS

Conform to REA 50-17. Pressure treat crossarms with pentachlorophenol, chromated copper arsenate (CCA), or ammoniacal copper arsenite (ACA). Treatment shall conform to AWPA C25.

2.3.1 Crossarm Braces

Provide as indicated steel angle for 38-inch span with 8-foot crossarm.

2.4 HARDWARE

Hot dip galvanized conforming to ASTM A 153.

2.5 INSULATORS

Provide wet-process porcelain insulators which are radio interference free.

a. Line Post Type Insulators: ANSI C29.7, Class 15 kV.

c. Spool Insulators: ANSI C29.3, Class 15 kV.

d. Guy Strain Insulators: ANSI C29.4, Class 15 kV.

2.6 OVERHEAD CONDUCTORS

Conductors of bare copper of sizes and types indicated.

2.6.1 Solid Copper

ASTM B 1, ASTM B 2, and ASTM B 3, hard-drawn, medium-hard-drawn, and soft-drawn, respectively. ASTM B 8, stranded.

2.6.2 Copper-Clad Steel

ASTM B 228.

2.6.3 Aluminum

ASTM B 231.

2.6.3.1 Aluminum Alloy

ASTM B 397 or ASTM B 399.

2.6.3.2 Steel Reinforced

ASTM B 232, aluminum.

2.7 SECONDARY-SERVICE CONDUCTORS

Aerial Service Secondary conductors shall be copper, triplex with 600-volt cross-linked polyethylene insulation on the phase wires. Neutral shall be bare hard drawn copper messenger. Minimum size shall be No. 2 AWG stranded unless otherwise indicated. Aerial service conductors shall be copper cross-linked polyethylene covered weatherproof. Minimum size shall be No. 4 AWG. Conductors shall conform to NEMA WC 7 for cross-linked polyethylene insulation.

2.8 GUY STRAND

ASTM A 475, extra-high strength, Class A or B, galvanized strand steel cable. Provide guy terminations designed for use with the particular strand and developing at least the ultimate breaking strength of the strand.

2.9 ROUND GUY GUARDS

Vinyl or PVC material, yellow colored, 8 feet long and shatter resistant at sub-zero temperatures.

2.9.1 Guy Attachment

Thimble eye guy attachment.

2.10 ANCHORS AND ANCHOR RODS

Anchors shall be screw anchors Anchor rods shall be thimble-eye, one inch diameter by 8 feet long. Anchors and anchor rods shall be hot dip

galvanized.

2.10.1 Screw Anchors

Screw type anchors having a manufacturer's rating at least equal to rating indicated and extra heavy pipe rods conforming to ASTM A 53, Schedule 80, and couplings conforming to ASME B16.11.

2.11 GROUND RODS

Copper clad steel ground rods at least 3/4 inch in diameter and 10 feet long. Die-stamp each near top with name or trademark of manufacturer and length of rod in feet. Rods shall have a hard, clean, smooth, continuous, surface throughout length of rod.

2.11.1 Ground Wire

Provide soft drawn copper wire ground conductors a minimum No. 4 AWG. Ground wire protectors may be either PVC or half round wood molding. Wood molding shall be fir, pressure treated in accordance with AWPA C25, or shall be cypress or cedar.

2.12 SURGE ARRESTERS

ANSI/IEEE C62.11, metal oxide) surge arresters arranged for crossarm mounting. Rms rating shall be 15 kV. Front of wave sparkover shall be 15 kV or less. Discharge voltage of 10 ka shall be 14 kV or less.

2.13 FUSED CUTOUTS

Open type fused cutouts rated 100 amperes and 10,000 amperes symmetrical interrupting current at 8.3/15 kV gnd Y conforming to ANSI C37.42. Type K fuses conforming to ANSI C37.42 with ampere ratings equal to 150 percent of the transformer full load rating. Open link type and fuse cutouts are not acceptable.

2.14 CONDUIT RISERS AND CONDUCTORS

Rigid galvanized steel conduit conforming to UL 6.

2.14.1 Secondary Riser

600-volt secondary riser conductors shall be copper, THWN conforming to UL 83 RHW-USE conforming to UL 854.

2.14.2 Primary Riser

2.15 CABLE TERMINATIONS

2.15.1 Terminator, Porcelain Insulator Type

Provide terminators for solid insulation nonmetallic jacketed cables of porcelain insulator type. Apply terminators to single conductor cables or to each conductor of multiple conductor cables. Provide terminator and components from one manufacturer and furnished in a package or kit form

compatible with insulation and conductor material. The kit shall include complete assembly and installation instructions. The terminator shall comply with requirements of IEEE 48 Class 1 except that requirements of design tightness test need not be met. The terminator shall not extrude filler compound under either test or service. Terminator shall consist of a porcelain insulator, cable connector-hoodnut assembly and aerial lug as required, metal body and support bracket, sealed cable entrance, and internal stress relief device for shielded cable, and insulating filler compound or material.

2.15.2 Terminator, Modular, Molded Rubber Type

The terminator as specified herein shall be provided for terminating single conductor, or the single conductor of multiconductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 35 kV outdoor. The terminator shall be the product of one manufacturer who shall furnish components in the form of a kit, including complete instructions which shall be followed for assembly and installation, suitable for the type and materials of the cable terminated. The terminator shall conform to IEEE 48 for Class 1 terminations. The terminator shall include stress relief, ground clamp, nontracking rubber skirts, crimp-on connector, rubber cap, and aerial lug. Separate parts of copper or copper alloy shall not be used in contact with aluminum or aluminum alloy parts in the construction and installation of the terminator.

2.16 TRANSFORMER (POLE TYPE)

a. ANSI C57.12.20.

b. Single phase, self-cooled, 65 degrees C. continuous temperature rise, two winding, 60 Hertz.

c. Insulating liquid:

(1) ASTM D 3487, Type II, tested in accordance with ASTM D 117.

(2) Provide identification of transformer as "non-PCB" on the nameplate.

d. Ratings:

(1) kVA: 100.

(2) BIL: 95 kV.

(3) Primary voltage: 11.5 kV.

(4) Secondary voltage: 480 volts.

(5) Impedance: 4 percent (minimum).

f. Three-phase connections:

(1) Connect primary: Delta.

(2) Connect secondary: Grounded wye for 480/277 volt, three phase, 4 wire service.

g. Taps:

(1) Provide four 2 1/2 percent full capacity taps, 2 taps above and 2 below rated primary voltage.

h. Tank finish coat:

(1) Light grey, ANSI color No. 70.

i. Show transformer kVA capacity using 2 1/2-inch Arabic numerals placed near the low-voltage bushings.

2.16.1 Transformer Losses

a. "A" and "B" are given loss factors. A = [_____] B = [_____]

b. "C" is the cost of losses. C = $ [_____]

c. "NLL" and "LL" are the transformer no load losses and load-losses, respectively. See paragraph entitled "Routine Transformer Tests" hereinafter.

2.16.2 Deduct Clause

After factory test results are available, Contractor shall calculate actual transformer losses (D) using test result values for NLL and LL, and values specified above for A and B. Calculate using equation D = A(NLL) + B(LL).

a. If $D \leq C$:

No adjustment will be made to contract price.

b. If $D > C$:

A unilateral contract modification will be issued in the amount of difference between C and D.

c. If $D > 1.25(C)$:

The transformer is unacceptable.

2.17 POLE TOP SWITCH

Pole top switch shall be vertical type switches, three-pole gang operated, with a padlock arrangement for locking in both open and closed positions. Steel parts shall be hot-dip galvanized. Operating rods shall be isolated from the switch by an insulating link or section located as close to the switch as possible. Switch shall be designed for double crossarm mounting and for breaking a 3/4-inch coating of ice before contacts are opened or closed. Switch shall comply with ANSI/IEEE C37.30 for voltage and current requirements indicated.

2.18 METERING EQUIPMENT

Pole mounted metering equipment shall include current transformers, potential transformers, kwh meter, meter test switch block, metering enclosure, wire, conduit and fittings.

2.18.1 Potential Transformers

Potential transformers shall be rated for outdoor service fitted for crossarm mounting and secondary connection box for conduit connection. Voltage rating shall be 12.0 kV to 120 volts ac 60 Hz. Transformers shall conform to the requirements of ANSI C12.11 and ANSI/IEEE C57.13 BIL 95 kV and accuracy Class 0.3 (min.) of 75 VA burden Y.

2.18.2 Current Transformers

Current transformers shall be rated for outdoor service with crossarm mounting and secondary connection box for conduit connection. Voltage rating shall be 12.0 kV. Current rating shall be 600 to 5 amperes. Transformers shall conform to requirements of ANSI C12.11 and ANSI/IEEE C57.13, BIL 95 kV and accuracy Class 0.3 at 50 VA.

2.18.3 Watthour Meter

UL 414 "A base" type, three element, 120 volts, 2 1/2 amperes, 60 Hz with a five dial kWh register. Register ratio shall be selected to provide a meter reading multiplier of even hundreds after applying the product of indicated current transformer ratio and indicated potential transformer ratio. Indicate meter reading multiplier on the meter face. Meters shall comply with ANSI C12.10 form 6A. Provide block interval demand element type for 15 minute interval with dial and sweephand pointer operated by a pusher. Demand register: ANSI C12.4. Provide matching meter socket with automatic current short-circuiting device. Meter shall have provisions for future pulse initiation.

2.18.4 Self-Contained Watthour Meter

2.18.5 Meter Test Block

Provide meter test block with T pole group of open knife type switches designed for the isolation of metering devices at meter location by opening each circuit individually. Current switches shall short circuit current supply before opening meter circuit. Switch handles of potential switches shall be black. Switch handles of current switches shall be red.

2.18.6 Metering Enclosure

Metering enclosure shall be of galvanized steel, weatherproof construction with pole mounting bracket, and 3/4-inch exterior plywood, full size backboard and hinged door arranged for padlocking in closed position. Internal space shall be adequate to house equipment and wiring but not smaller than 20 by 30 by 11 inches deep. Paint metal manufacturer's standard finish.

2.19 ELECTRICAL TAPES

Tapes shall be UL listed for electrical insulation and other purposes in wire and cable splices. Terminations, repairs and miscellaneous purposes, electrical tapes shall comply with UL 510.

2.20 CALKING COMPOUND

Compound for sealing of conduit risers shall be of a puttylike consistency workable with hands at temperatures as low as 35 degrees F, shall not slump at a temperature of 300 degrees F, and shall not harden materially when exposed to air. Compound shall readily calk or adhere to clean surfaces of the materials with which it is designed to be used. Compound shall have no injurious effects upon the workmen or upon the materials.

2.21 SOURCE QUALITY CONTROL

2.21.1 Transformer Test Schedule

a. The Government will witness tests.

b. Provide transformer test schedule for tests to be performed and submit required reports.

c. Notify NTR 15 calendar days in advance of changes to scheduled dates and location for testing.

2.21.2 Routine and Other Transformer Tests

a. Perform ANSI/IEEE C57.12.00 and ANSI/IEEE C57.12.90 tests on the actual transformer prepared for this project.

b. Submit certified copies of test reports, by serial number, and receive approval before delivery of equipment to the project site.

c. Lightning impulse test:

(1) ANSI/IEEE C57.98 and ANSI/IEEE C57.12.90.

(2) State test voltage levels.

(3) Provide oscillograms with test report.

(4) Test 20 percent of transformers provided by this contract as selected by a representative of the Government.

2.21.3 Design Tests

ANSI/IEEE C57.12.80, Section 5.1.2 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports with catalog data and drawings for each of the specified transformers. Design tests must have been conducted within five years of the date of award of this contract.

a. Tests shall be certified and signed by a registered professional

engineer.

b. ANSI/IEEE C57.12.00 and ANSI/IEEE C57.12.90 tests performed on a prototype transformer will be acceptable.

c. Temperature rise: "Basically the same design" for the temperature rise test means a pole type transformer with the same coil construction (strip, layer, or disk), the same kVA, the same cooling type (OA), the same insulation class, and the same insulating liquid as the transformer specified.

d, Lightning impulse test report: "Basically the same design" for the lightning impulse dielectric test means a pole type transformer with the same BIL, the same coil construction (strip, layer, or disk), and a tap changer (if specified).

(1) ANSI/IEEE C57.98 and ANSI/IEEE C57.12.90.

(2) State test voltage levels.

(3) Provide oscillograms with test report.

e. Lifting and moving devices: "Basically the same design" for the lifting and moving devices test means a pole type transformer in the same weight range as the transformer specified.

PART 3 EXECUTION

3.1 INSTALLATION

Provide overhead pole line installation conforming to requirements of ANSI C2 CALPUC G.O. 95 for Grade B construction of overhead lines in light loading districts and NFPA 70 for overhead services. Provide material required to make connections into existing system and perform excavating, backfilling, and other incidental labor. Consider street, alleys, roads and drives "public." Pole configuration shall be as indicated.

3.1.1 Pole Setting

Provide pole holes at least as large at the top as at the bottom and large enough to provide 4-inch clearance between the pole and side of the hole.

3.1.1.1 Setting Depth of Pole

Pole setting depths shall be as follows:

Length of Pole (feet)	Setting in Soil (feet)	Setting in Solid Rock (feet)
20	5.0	3.0
25	5.5	3.5
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0

Length of Pole (feet)	Setting in Soil (feet)	Setting in Solid Rock (feet)
45	6.5	4.5
50	7.0	4.5
55	7.5	5.0
60	8.0	5.0

3.1.1.2 Setting in Soil, Sand, and Gravel

"Setting in Soil" depths, as specified in paragraph entitled "Setting Depth of Pole," apply where the following occurs:

a. Where pole holes are in soil, sand, or gravel or any combination of these;

b. Where soil layer over solid rock is more than 2 feet deep;

c. Where hole in solid rock is not substantially vertical; or

d. Where diameter of hole at surface of rock exceeds twice the diameter of pole at same level.

3.1.1.3 Setting in Solid Rock

"Setting in Solid Rock," as specified in paragraph entitled "Setting Depth of Pole," applies where poles are to be set in solid rock and where hole is substantially vertical, approximately uniform in diameter and large enough to permit use of tamping bars the full depth of hole.

3.1.1.4 Setting With Soil Over Solid Rock

Where a layer of soil 2 feet or less in depth over solid rock exists, depth of hole shall be depth of soil in addition to depth specified under "Setting in Solid Rock" in paragraph entitled "Setting Depth of Pole," provided, however, that such depth shall not exceed depth specified under paragraph entitled "Setting in Soil."

3.1.1.5 Setting on Sloping Ground

On sloping ground, always measure hole depth from low side of hole.

3.1.1.6 Backfill

Thoroughly tamp pole backfill for full depth of the hole and mound excess fill around the pole.

3.1.1.7 Setting Poles

Set poles so that alternate crossarm gains face in opposite directions, except at terminals and dead ends where gains of last two poles shall be on side facing terminal or dead end. On unusually long spans, set poles so that crossarm comes on side of pole away from long span. Where pole top pins are used, they shall be on opposite side of pole from gain, with flat side against pole.

3.1.1.8 Alignment of Poles

Set poles in alignment and plumb except at corners, terminals, angles, junctions, or other points of strain, where they shall be set and raked against the strain. Set not less than 2 inches for each 10 feet of pole length above grade, nor more than 4 inches for each 10 feet of pole length after conductors are installed at required tension. When average ground run is level, consecutive poles shall not vary more than 5 feet in height. When ground is uneven, poles differing in length shall be kept to a minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, a piece shall be sawed off the top. Holes shall be dug large enough to permit the proper use of tampers to full depth of hole.

3.1.1.9 Pole Caps

Provide plastic pole caps with 1/4-inch sealing rings and four nailing tabs. Fill sealing area with either a bituminous, elastigum roof cement or an acceptable preservative paste to level of sealing ring to eliminate possibility of condensation. Place on pole top and nail each tab down with a 1 1/4-inch nail.

3.1.2 Anchors and Guys

Place anchors in line with strain. The length of the guy lead (distance from base of pole to the top of the anchor rod) shall be as indicated.

3.1.2.1 Setting Anchors

Set anchors in place with anchor rod aligned with, and pointing directly at, guy attachment on the pole with the anchor rod projecting 6 to 9 inches out of ground to prevent burial of rod eye.

3.1.2.2 Backfilling Near Anchors

Backfill patent, plate, expanding, concrete, or cone type anchors with tightly tamped coarse rock 2 feet immediately above anchor and then with tightly tamped earth filling remainder of hole.

3.1.2.3 Screw Anchors

Install screw anchors by torquing with boring machine. Anchor rod eye shall extend 6 to 9 inches above grade.

3.1.2.4 Swamp Anchors

Install swamp anchors by torquing with boring machine or wrenches, adding sections of pipe as required until anchor helix is fully engaged in firm soil.

3.1.2.5 Setting Guy Strands

Complete anchor and guy installation, dead end to dead end, and tighten guy before wire stringing and sagging is begun on that line section. Provide

strain insulators at a point on guy strand 8 feet minimum from the ground and 6 feet minimum from the surface of pole. Effectively ground and bond guys to system neutral.

3.1.3 Hardware

Provide hardware with washer against wood and with nuts and lock nuts applied wrench tight. Provide locknuts on threaded hardware connections. Locknuts shall be M-F style and not palnut style.

3.1.4 Grounding

Grounding shall conform to ANSI C2 except that each separate ground electrode shall have a resistance to solid earth not exceeding 5 ohms. When work in addition to that indicated or specified is directed in order to obtain specified ground resistance, provisions of the contract covering changes shall apply.

3.1.4.1 Ground Rod Connections

Make ground rod connections on pole lines by exothermic weld or by using a compression connector for ground wire or wire to rod connections. Make exothermic welds strictly in accordance with manufacturer's written recommendations. Welds which have puffed up or which show convex surfaces indicating improper cleaning, are not acceptable. No mechanical connectors are required at exothermic weldments. Compression connectors shall be type that uses a hydraulic compression tool to provide correct pressure. Provide tools and dies recommended by compression connector manufacturer. An embossing die code or similar method shall provide visible indication that a connector has been fully compressed on ground wire.

3.1.4.2 Other Metal Parts

Ground noncurrent carrying metal parts of equipment or enclosures.

3.1.4.3 Surge Arresters

Connect grounding terminal of each arrester to ground. Surge arrester grounding conductor shall be separate from the other grounding conductors.

3.1.4.4 Transformer Tank and Neutrals

Secondary neutrals and tank of each transformer shall be interconnected and connected to ground.

3.1.4.5 Protective Molding

Protect grounding conductors which are run on surface of wood poles by wood molding or plastic molding of equal mechanical strength extending from ground line throughout communication and transformer spaces.

3.1.5 Conductors

Conductors shall be handled with care necessary to prevent nicking, kinking, gouging, flattening, or otherwise deforming or weakening conductor or impairing its conductivity. Remove damaged sections of conductor and splice conductor.

3.1.5.1 Splices

Conductor splices, as installed, shall exceed ultimate rated strength of conductor and shall be of type recommended by conductor manufacturer. No splice shall be permitted within 10 feet of a support.

3.1.5.2 Ties

Provide ties on pin insulators tight against conductor and insulator and ends turned down flat against conductor so that no wire ends project.

3.1.5.3 Reinstalling Conductors

Existing conductors to be reinstalled or resagged shall be strung to "final" sag table values for the particular conductor type and size involved.

3.1.5.4 New Conductor Installation

String new conductors to "initial" sag table values recommended by the manufacturer for conductor type and size of conductor and ruling span indicated.

3.1.5.5 Fittings

Dead end fittings, clamp or compression type, shall conform to written recommendations of conductor manufacturer and shall develop full ultimate strength of conductor.

3.1.5.6 Aluminum Connections

Make aluminum connections to copper or other material using only splices, connectors, lugs, or fittings designed for that specific purpose. Keep a copy of manufacturer's instructions for applying these fittings at job site for use of the inspector.

3.1.6 Pole Mounted Metering Equipment

3.1.6.1 Primary Meters

Install primary metering transformers according to manufacturer's drawings. Make connections to metering circuits within each transformer conduit connection box.

3.1.6.2 Installing Meter System

Metering enclosure shall house kWh meter and meter test block. Secure the enclosure to pole at a height of 6 feet above grade to center of the

enclosure. Ground enclosure.

a. Connect meter as indicated.

b. Connect meter test block between meter and metering transformers to isolate meter for removal, test or adjustment.

c. Phase sequence and color code of potential and current leads shall be identical. Mark wires which are connected to transformer terminals identified with polarity marks (dots) by a colored plastic tape around the wire at each end.

d. No splices are permissible in metering circuits. Wire shall be trained at sides and bottom of enclosure back board and secured by plastic wraps.

3.1.7 Pole Top Switch Installation

Install pole top switch strictly according to manufacturer's erection drawings and information.

3.1.7.1 Operating Handle

Locate approximately 5 feet above ground on field side of pole.

3.1.8 Risers

Secure conduits on poles by two hole galvanized steel pipe straps spaced no more than 10 feet apart and within 3 feet of any outlet or termination. Ground metallic conduits.

3.2 FIELD QUALITY CONTROL

As an exception to requirements that may be stated elsewhere in contract, the NTR shall be given 5 working days' notice prior to each test.

3.2.1 Ground Rod Tests

Prior to connecting, test ground rods for ground resistance value. Use a portable ground testing megger to test each ground or group of grounds. Make ground resistance measurements in normally dry weather, not less than 48 hours after a rainfall. Follow the directions provided by the equipment manufacturer for proper use of the equipment.

3.2.2 Transformer Field Tests

Perform visual and mechanical inspection and electrical test in accordance with NETA ATS and check transformer secondary voltages. Adjust voltage at the transformer to provide a secondary voltage of 277/480.

3.2.3 Meter

Check disc rotation to ensure that it turns in correct direction for each current-potential phase circuit individually.

3.2.4 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least three times, demonstrating satisfactory operation each time.

3.2.5 High Voltage Cable Test

After installation of cable, splices, and terminators and before terminating to equipment, perform a field acceptance test on cable systems in accordance with NETA ATS. Field acceptance test voltage for 15 kV cable shall be 55 kV dc for 15 minutes. If cable system fails to pass initial test, correct defects and perform subsequent acceptance tests until the work is in compliance with contract requirements.

3.2.6 Large Overhead Systems Test

Perform field acceptance test after installation but before placing system in service. Prior to testing, disconnect transformers, switches, and other such items from overhead system. With service voltage applied, take thermographic or infrared readings of overhead system in accordance with test equipment manufacturer's procedures.

-- End of Section --

SECTION 16375

UNDERGROUND ELECTRICAL WORK

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 315	1980 (R 1986) Details and Detailing of Concrete Reinforcement
ACI 318	1989 (R 1992) Building Code Requirements for Reinforced Concrete

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	1993 National Electrical Safety Code
ANSI C119.1	1986 Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	1990 Hard-Drawn Copper Wire
ASTM B 8	1990 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C 478	1990 (Rev. B) Precast Reinforced Concrete Manhole Sections
ASTM C 260	1986 Air-Entraining Admixtures for Concrete
ASTM F 512	1989 (Rev. A) Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621	(Rev. E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA RN 1	1989 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and
NEMA TC 2	1990 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 3	1990 PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TC 8	1990 Extra-Strength PVC Plastic Utilities Duct for Underground Installation
NEMA TC 9	1990 Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1993 National Electrical Code

RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA 345-6	1978 Splicing Plastic-Insulated Cables (PC-2)

UNDERWRITERS LABORATORIES INC. (UL)

UL 6	1993 Rigid Metal Conduit
UL 83	1991 (R 1992) (Bul. 1991, 1992, and 1993) Thermoplastic-Insulated Wires and Cables
UL 467	1984 (R 1986) Grounding and Bonding Equipment
UL 486A	1991 (Errata 1991 and 1992) (R 1992) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 510	1986 (R 1986) Insulating Tape
UL 514A	1991 (R 1993) (Bul. 1993) Metallic Outlet Boxes
UL 514B	1989 (Errata 1991) (Bul. 1993) (R 1993) Fittings for Conduit and Outlet Boxes
UL 651	1989 (R 1989) (Bul. 1993) Schedule 40 and 80 Rigid PVC Conduit

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements" applies to this section with additions and modifications specified herein.

1.2.1 Overhead Service

Terminate overhead service conductors into building at the service entrance fittings or weatherhead outside the building. Installation and connection of service entrance equipment to the overhead service conductor is included in Section 16402, "Interior Wiring Systems." Locate nearby support bracket for overhead wires not less than 18 feet above the finished grade at the building.

1.3 DEFINITIONS

a. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Conduit

b. Fittings

c. Insulating tape

d. 600 volt wires and cables

e. Cable lubricants

f. Ground rods

g. Precast concrete structures G

h. Manhole and Handhole Frames and covers G

i Sealing material for precast manhole and handhole joints G

j. Proposed precast sectional underground duct bank G

k. Cable Tags

1.4.2 SD-04, Drawings

a. Precast handhole G

b. Pulling-in irons G

1.4.2.1 Precast handhole G

Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

a. Material description (i.e., f'c and Fy)

b. Manufacturer's printed assembly and installation instructions

c. Design calculations

d. Reinforcing shop drawings prepared in accordance with ACI 315.

e. Plans and elevations showing opening and pulling-in iron locations and details.

1.4.3 *SD-12, Field Test Reports

a. Insulation resistance test

b. Continuity test G

c. High potential (hi-pot) test G

d. 600 volt cable tests G

e. Medium voltage cable tests G

f. Ground resistance tests G

Identify each cable for 600-volt, cable tests. When testing grounding electrodes and systems, identify each electrode and system for each test, as well as the resistance and soil conditions at the time the measurement were made.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Conduit

2.1.1.1 Rigid Metal Conduit

UL 6, galvanized steel, threaded type.

2.1.1.2 Rigid Metal Conduit, PVC Coated

UL 6, galvanized steel, threaded type, coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours.

2.1.1.3 Plastic Conduit and Tubing

NEMA TC 2, EPC-40-PVC.

2.1.1.4 Plastic Utilities Duct for Concrete Encasement

NEMA TC 8, ASTM F 512, Type EB-35.

2.1.2 Fittings

2.1.2.1 Metal Fittings

UL 514B, threaded type.

2.1.2.2 PVC Conduit Fittings

NEMA TC 3

2.1.2.3 PVC Duct Fittings

NEMA TC 9.

2.1.2.4 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit shall be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and shall conform to UL 514A.

2.1.3 Tape

2.1.3.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.1.3.2 Buried Warning and Identification Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried cable and conduit. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 2 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be CAUTION BURIED ELECTRIC CABLE BELOW or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.1.4 Power Wire and Cable

2.1.5 600 Volt Wires and Cables

UL 83 THWN UL 44 XHHW. Only use wires with "W" type designation in wet or damp locations. Use No. 12 minimum sized conductors, unless otherwise noted.

2.1.6 600 Volt Wire Connector and Terminals

Shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on stranded conductors.

a. For use with Copper Conductors: UL 486A.

2.1.7 Pull Wire

No. 14 hot-dip galvanized steel or plastic rope having a minimum tensile strength of 200 pounds in each empty duct. Leave a minimum of 24 inches of slack at each end of the pull wires.

2.1.8 Grounding and Bonding Equipment

UL 467. Ground rods shall be copper clad steel with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch in diameter and 10 feet long unless otherwise indicated.

2.1.9 Underground Structures

2.1.9.1 Handholes

Provide type indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Cast the words "ELECTRIC" and "TELEPHONE" in the top face of power and telephone manhole covers, respectively.

2.1.9.2 Metal Frames and Covers

Provide steel frames and covers of rolled steel floor plate for handholes.

2.1.9.3 Drainage Pipe and Fittings

Cast-iron, extra strength. Drains shall be cast-iron, coated or uncoated, plain pattern, bottom outlet with perforated or slotted hinged cover.

PART 3 EXECUTION

3.1 INSTALLATION

NFPA 70 and ANSI C2 and CALPUC G.O.128.

3.1.1 Contractor Damage

The Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the General Provisions of the contract. If the Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the NTR of any such

damage.

3.1.2 Concrete

Concrete work for electrical requirements shall be 3000 psi minimum ultimate 28-day compressive strength with 1-inch minimum aggregate conforming to the requirements of Section 03300 03302 "Cast-In-Place Concrete."

3.1.3 Underground Conduit/Duct Without Concrete Encasement

Type of conduit shall be EPC-40-PVC, EPC-80-PVC, or/and PVC-coated rigid galvanized steel.

3.1.3.1 Conduit Installation

Top of the conduit shall be not less than 24 inches below grade, and shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points. Run conduit in straight lines except where a change of direction is necessary. As each conduit run is completed for conduit sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. Provide not less than 3 inches clearance from the conduit to each side of the trench. A minimum clearance of 2 inches shall be provided between adjacent conduits. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4-inch sieve. Provide color, type and depth of warning tape as specified in paragraphs "BURIED WARNING AND IDENTIFICATION TAPE" in Section 02220, "General Excavation, Filling, Backfilling".

3.1.3.2 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3-inch concrete cover around ducts. The concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks. Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, shall be zinc-coated, rigid steel, jacked place. Hydraulic jet method shall not be used.

3.1.3.3 Multiple Conduits

Separate multiple conduits by a minimum distance of 2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 3 inches. Stagger the joints of the conduits by rows and layers to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally.

Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.1.4 Conduit Protection at Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations shall be protected by a PVC sheath at the penetration; PVC sheath be 40-mils thick conforming to NEMA RN 1, and shall extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.1.5 Cable Pulling

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Accumulate cable slack at each manhole or junction box where space permits by training cable around the interior to form one complete loop. Maintain minimum allowable bending radii in forming such loops. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.1.5.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables. Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic jacketed cables. Lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.

3.1.5.2 Cable Pulling Tensions

Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer. Monitor pulling tension during cable installation to ensure maximum pulling tension is not exceeded.

3.1.5.3 Secondary Cable Runs, 600 Volts and Less

Provide insulated copper equipment grounding conductor, sized as required by the rating of the overcurrent device supplying the phase conductors.

3.1.5.4 Cable Tags in Handholes

Provide cable markers (or tags) as specified in Section 16011, "Electrical General Requirements."

3.1.6 Cable Terminating

Provide splicing and terminating devises and materials to protect 600 volts insulated power and lighting cables from accidental contact, deterioration of coverings and moisture. Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer.

3.1.6.1 Splices for 600 Volt Class Cables

Splices in underground distribution systems shall made only in accessible locations such as handholes, with a compression connector on the conductor and by insulating and waterproofing by one of the following methods suitable for continuous submersion in water and comply with ANSI C119.1.

a. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package. Do not allow the cables to be moved until after the splicing material has completely set.

b. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold. Do not allow cables to be moved until after the splicing materials have completely set.

c. Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which should be applied by a clean burning propane gas torch. Cables may be moved when joint is cool to the touch.

3.1.7 Optional Precast Concrete Construction

3.1.7.1 Optional Precast Concrete Construction

In lieu of cast-in-place, the Contractor may, at his option, provide precast concrete handholes, subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and handholes.

a. General: Precast concrete structures shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. concrete for precast work shall have an ultimate 28-day compressive strength of not less than 4000 psi.

Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

b. Design for Precast Structures: ACI 318. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

Angle of Internal Friction (phi) - 30 degrees

Unit Weight of Soil (Dry) - 110 pcf, (Saturated) = 130 pcf

Coefficient of Lateral Earth Pressure (K_a) = 0.33

Ground Water Level - 3 feet below ground elevation

Vertical design loads shall include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads shall consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. The minimum design vertical load shall be for H20 highway loading per AASHTO HB14.

Horizontal design loads shall include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, shall be considered along with a pulling-in iron design load of 6000 pounds.

Each structural component shall be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.

Design shall also consider the live loads induced in the handling, installation, and backfilling of the handholes. Provide lifting devices to ensure structural integrity during handling and installation.

c. Construction: Structure top, bottom, and wall shall be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide

a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings.

d. Joints: Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

3.1.7.2 Metal Frames and Covers for Handholes

Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled-steel floor plate having an approved antislip surface. Hinges shall be of galvanized steel with bronze hinge pin 5 by 5 inches by approximately 3/16-inch thick, without screw holes, and shall be for full surface application by fillet welding. Hinges shall have nonremovable pins and five knuckles. The surfaces of plates under hinges shall be true after the removal of raised antislip surface, by grinding or other approved method.

3.1.7.3 Precast Handholes Installation

Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to 1 inch size, extending 12 inches beyond the handhole on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator.

3.1.7.4 Field Painting

Cast-iron frames and covers not buried in masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint. Steel frames not buried in masonry and steel covers shall be cleaned of mortar, dirt and grease by an approved blasting process. Surfaces that cannot be cleaned satisfactorily by blasting shall be cleaned to bare metal by wire brushing or other mechanical means. Surfaces contaminated with rust, dirt, oil, grease, or other contaminants shall be washed with solvents until thoroughly cleaned. Immediately after cleaning, surfaces shall be coated with a pretreatment coating or be given a crystalline phosphate coating. As soon as practicable after the pretreatment coating has dried, treated surfaces shall be primed with a coat of primer and one coat of synthetic exterior gloss enamel.

3.1.8 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated.

Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.1.9 Buried Warning and Identification Tape

Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.10 Grounding Systems

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

Grounding secondary distribution system neutral and noncurrent-carrying metal parts associated with distribution systems and grounds not otherwise covered	5 ohms

When work in addition to that indicated or specified is directed in order to obtain the specified ground resistance, the provisions of the contract covering "Changes" shall apply.

Shall be as indicated, and as required by NFPA 70 and ANSI C2.

3.1.10.1 Grounding Electrodes

Provide cone pointed ground rods driven full depth plus 6 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.

3.1.10.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.10.3 Grounding Conductors

Grounding conductors shall be stranded-bare copper conforming to ASTM B 8, Class B, for sizes No. 6 AWG and larger, and shall be solid-bare copper conforming to ASTM B 1 for sizes No. 8 and smaller. Cable

sheaths, cable shields, conduit, and equipment shall be grounded with No. 6 AWG. Surge arresters shall be grounded to ground rods with No. 4 AWG.

3.1.11 Special Conditions

During the construction of duct banks and underground structures located in streets, the streets shall remain open to traffic. Plan and execute the work to meet this condition. At locations where duct banks cross railroad tracks and the work requires closing of the tracks, secure permission from the NTR for each track closure.

3.1.12 Earthwork for Utilities

Section 02220, "General Excavation, Filling and Backfilling."

3.1.12.1 Backfilling

Section 02220, "General Excavation, Filling and Backfilling."

3.1.13 Reconditioning of Surfaces

3.1.13.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct. Preserve and replace sod or topsoil after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.1.13.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.2 FIELD QUALITY CONTROL

As an exception to requirements that may be stated elsewhere in the contract, notify the NTR 5 working days prior to each test. Furnish labor, equipment. and incidentals required for testing, except that the Government will provide electric power required for the tests. Correct defects in the work provided by the Contractor and repeat tests until the work is in compliance with contract requirements. Show by demonstration in service that circuits and devices are in good operating condition. Tests shall be such that each item of control equipment will function not less than five times.

3.2.1 600 Volt Cable Tests

After wiring is completed, connected, and ready for operation, but prior to placing systems in service and before any branch circuit breakers are closed, perform insulation resistance tests in all circuits. Measure the

insulation resistance between conductors and between each conductor and ground. Use an instruments capable of making measurements at an applied potential of 1000 volts dc. Take readings after the voltage has been applied for a minimum of one minute. Minimum insulation resistance values shall be not less than 2 megohms.

3.2.2 Ground Rods

Perform ground resistance tests for ground rods before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Ground resistance shall also be measured for each piece of equipment spliced to the ground electrode. Use a portable ground testing megger to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground electrode under test. Provide one copy of the ground megger manufacturer's directions, indicating the method to be used.

-- End of Section --

SECTION 16402

INTERIOR WIRING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	1990 Rigid Steel Conduit - Zinc Coated

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	1990 Hard-Drawn Copper Wire
ASTM B 8	1990 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

FEDERAL SPECIFICATIONS (FS)

FS L-P-387	(Rev. A) (Int Am. 2) Plastic Sheet, Laminated, Thermosetting (for Design Plates)
FS W-S-896	(Rev. E) Switches, Toggle (Toggle and Lock), Flush Mounted

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	1986 (Rev. 1) Molded Case Circuit Breakers and Molded Case Switches
NEMA FU 1	1986 Low Voltage Cartridge Fuses
NEMA ICS 1	1988 (Rev. 1-2) Industrial Control and Systems
NEMA ICS 2	1988 Industrial Control Devices, Controllers and Assemblies
NEMA ICS 4	1983 (R 1988) (Rev. 1) Terminal Blocks for Industrial Use
NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Control and Systems
NEMA KS 1	1990 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA MG 1	1987 (Rev. 1-2) Motors and Generators

NEMA MG 10	1983 (R 1988) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA MG 11	1977 (R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors
NEMA RN 1	1989 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit
NEMA ST 20	1992 Dry-Type Transformers for General Applications
NEMA TC 3	1990 PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA WD 1	1983 (R 1989) Wiring Devices
NEMA WD 6	1988 Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1993 National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 1	1985 (R 1992) Flexible Metal Conduit
UL 6	1993 Rigid Metal Conduit
UL 50	1992 (Bul. 1993) Safety Enclosures for Electrical Equipment
UL 67	1988 (R 1993) Panelboards
UL 83	1991 (R 1992) (Bul. 1991, 1992, and 1993) Thermoplastic-Insulated Wires and Cables
UL 198C	1986 (Bul. 1991, 1992, and 1993) (R 1992) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198E	1988 (R 1988) (Bul. 1991 and 1992) Class R Fuses
UL 360	1986 (Bul. 1991) (R 1993) Liquid-Tight Flexible Steel Conduit
UL 467	1984 (R 1986) Grounding and Bonding Equipment
UL 486A	1991 (Errata 1991 and 1992) (R 1992) Wire Connector for Use with Copper Conductors

UL 486C	1991 (R 1992) Splicing Wire Connectors
UL 489	1991 (R 1992) (Bul. 1992 and 1993) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 498	1991 (R 1992) (Bul. 1993) Attachment Plugs and Receptacles
UL 506	1989 Specialty Transformers
UL 508	1993 (Bul. 1993) Industrial Control Equipment
UL 510	1986 (R 1986) Insulating Tape
UL 514A	1991 (R 1993) (Bul. 1993) Metallic Outlet Boxes
UL 514B	1989 (Errata 1991) (R 1993) (Bul. 1993) Fittings for Conduit and Outlet Boxes
UL 651	1989 (R 1989) (Bul. 1993) Schedule 40 and 80 Rigid PVC Conduit
UL 845	1988 (R 1989) Motor Control Centers
UL 854	1991 (Bul. 1992 and 1993) (R 1993) Service-Entrance Cables
UL 869	1989 (R 1991) (Bul. 1992 and 1993) Service Equipment
UL 870	1991 Wireways, Auxiliary Gutters, and Associated Fittings
UL 943	1985 (Bul. 1991) (R 1993) Ground-Fault Circuit Interrupters
UL 984	1991 (Bul. 1993) Hermetic Refrigerant Motor-Compressors

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7, of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Receptacles G

b. Circuit breakers G

c. Switches G

d. Conduit and fittings (each type)

g. Ground rods

h. Device plates

i. Wires and cables

j. Outlet boxes and covers

k. Transformers G

l. Junction boxes

m. Splices and termination components

n. Enclosed circuit breakers G

o. Motor controllers G

p. Combination motor controllers G

1.3.2 SD-04, Drawings

a. Panelboards G

b. Transformers G

c. Busway G

d. Cable trays G

e. Motor control centers G

f. Wireways G

1.3.3 SD-08, Statements

a. Fuses G

Submit coordination data as specified in article entitled, "FUSES" of this section.

1.3.3.1 SD-09, Reports

a. Transformer design and prototype tests G

1.3.3.2 Transformer Design and Prototype Tests

Submittal shall contain the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

1.3.4 SD-12, Field Test Reports

a. 600-volt wiring test G

b. Grounding system test G

c. Transformer tests G

d. GFCI receptacle test G

1.3.5 SD-19, Operation and Maintenance Manuals

a. Electrical Systems Data Package 5

1.3.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall be rigid steel (zinc-coated) conduit, rigid nonmetallic conduit, plastic coated rigid steel and liquid tight flexible conduit, conforming to the following:

2.2.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, accordance with NEMA TC 2, or fiberglass conduit, in accordance with NEMA TC 14.

2.2.3 Plastic-Coated Rigid Steel

NEMA RN 1, Type 40 (40 mils thick).

2.2.3.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.4 Fittings for Metal Conduit, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.4.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.5 Fittings for Rigid Nonmetallic Conduit

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, cast-metal.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.5 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.5.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, 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. Conductors indicated to be No. 6 AWG or smaller diameter shall be copper.

2.5.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.5.1.2 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.5.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, 3-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, 3-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

c. 120/240 volt, single phase: Red and black

2.5.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN remote-control and signal circuits shall be Type TW, THW, or TF. Conductors shall conform to UL 83 except that XHHW shall conform to UL 44. Where lighting fixtures require 90 degrees C conductors, provide only conductors with 90 degree C insulation or better.

2.5.4 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.

2.5.5 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A and UL 486B, as applicable, for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, other suitable plates may be provided. Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.03-inch thick. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.8 SWITCHES

2.8.1 Toggle Switches

NEMA WD 1, No. 1121 for single pole, No. 1122 for double pole, No. 1123 for three-way, and No. 1124 for four-way, totally enclosed with bodies of thermosetting plastic and mounting strap with grounding screw. Handles shall be brown. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.8.2 Pilot Lights

Provide yoke-mounted, candelabra-base sockets rated 125 volts and fitted with glass or plastic jewels. Provide clear, 6-watt lamp in each pilot switch. Jewels for use with switches controlling motors shall be green, jewels for other purposes shall be white.

2.8.3 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 12 enclosure per NEMA ICS 6.

2.8.4 Breakers Used as Switches

For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.9 RECEPTACLES

UL 498 and NEMA WD 1, heavy-duty, grounding type. Ratings and configurations shall be as indicated. Bodies shall be of brown thermosetting plastic supported on a metal mounting strap. Wiring terminals shall be screw-type, side-wired. Connect grounding pole to mounting strap.

2.9.1 Duplex Receptacles

Duplex receptacles shall be 15 amperes, 125 volts, No. 5242.

2.9.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations."

2.9.3 Ground-Fault Circuit Interrupter (GFCI) Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFCI devices.

2.10 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as indicated. Panelboards for use as service disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted "above" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served form Panel MDP). Type directories and mount in holder behind transparent protective covering.

2.10.1 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.10.1.1 Panelboard Neutrals for Non-Linear Loads

UL listed, and panelboard type shall have been specifically UL heat rise tested for use on non-linear loads. Panelboard shall be heat rise tested in accordance with UL 67, except with the neutral assembly installed and carrying 200 percent of the phase bus current during testing. Verification of the testing procedure shall be provided upon request. Two neutral assemblies paralleled together with cable is not acceptable. Nameplates for panelboard rated for use on non-linear loads shall be marked "SUITABLE FOR NON-LINEAR LOADS". Provide a neutral label with instructions for wiring the neutral of panelboards rated for use on non-linear loads.

2.10.2 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Plug-in circuit breakers and series rated circuit breakers are unacceptable.

2.10.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.10.2.2 Circuit Breaker With GFCI

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A GFCI devices.

2.11 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated. Provide solid neutral.

2.12 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch and control center. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.12.1 Cartridge Fuses, Current Limiting Type (Class R)

UL 198E, Class RK-1 Associated fuseholders shall be Class R only.

2.13 TRANSFORMERS

NEMA ST 20, general purpose, dry-type, self-cooled, unventilated. Provide transformers in NEMA 3R enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 115 degrees C temperature rise shall be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

2.14 MOTORS

Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.

2.14.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

2.14.2 High Efficiency Polyphase Motors

Polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

2.14.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.15 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch.

Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. Selector switch shall have means for locking in any position. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position. Minimum short circuit withstand rating of combination motor controller shall be 25,000 rms symmetrical amperes.

2.15.1 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. Provide fuses in each ungrounded primary feeder. One secondary lead shall be fused; other shall be grounded.

2.15.2 Enclosures for Starters and Controllers

NEMA ICS 6.

2.15.3 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.15.4 Pilot and Indicating Lights

Provide transformer, resistor, or diode type.

2.15.5 Terminal Blocks

NEMA ICS 4.

2.16 MANUAL MOTOR STARTERS

Single or Three pole designed for surface mounting with overload protection and pilot lights.

2.17 TELEPHONE SYSTEM

Provide system of telephone wire-supporting structures, including: conduits with pull wires, terminal boxes, outlet and junction boxes, other accessories for telephone outlets, and backboards.

2.17.1 Cover Plates

Modular telephone type with same finish specified for receptacle and switch cover plates.

2.17.2 Conduit Sizing

Conduit for single outlets shall be minimum of 3/4 inch and for multiple outlets minimum of one inch. Size conduits for telephone risers to telephone cabinets, junction boxes, and telephone service.

2.17.3 Backboards

Interior grade plywood, 3/4-inch thick, 4 by 8 feet minimum.

2.17.4 Receptacles for Telephone Service

Provide receptacle 125 volts, 20 amps, single phase, 60 Hz adjacent to telephone backboards served from panelboard circuit.

2.18 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.19 NAMEPLATES

FS L-P-387. Provide as specified in Section 16011, "Electrical General Requirements."

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Overhead Service

Overhead service conductors into buildings shall terminate at service entrance fittings or weatherhead outside building. Overhead service conductors and support bracket for overhead conductors are included in the Section 16370, "Overhead Electrical Work."

3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, or enclosures shall be labeled or identified as such.

3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph entitled "Nameplates." Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, or rigid nonmetallic conduit, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Provide insulated, green equipment grounding conductor in feeder and branch circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated, green equipment grounding conductor for circuit installed in conduit or raceways. Minimum conduit size shall be 3/4 inch in diameter for low voltage lighting and power circuits. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be metallic on both sides of fire-rated walls, fire-rated partitions, or fire-rated floors for minimum distance of 6 inches.

a. Restrictions applicable to PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in penetrating fire-rated walls or partitions, fire-rated floors, etc.

3.1.3.1 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph entitled "Flexible Connections."

3.1.3.2 Service Entrance Conduit, Overhead

PVC, Type EPC-40, rigid steel from service entrance to service entrance fitting or weatherhead outside building.

3.1.3.3 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to rigid steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 inches above floor.

3.1.3.4 Conduit in Floor Slabs

Rigid steel; or PVC, Type EPC-40.

3.1.4 Conduit Installation

Conceal conduit under floor slabs and exposed on walls and ceilings. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.4.1 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.4.2 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finish slab.

3.1.4.3 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems must be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations.

3.1.4.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.5 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-pound tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.4.6 Telephone and Signal System Conduits

Install in accordance with specified requirements for conduit and with additional requirement that no length of run shall exceed 150 feet for trade sizes 2 inches and smaller and shall not contain more than two 90-degree bends or equivalent. Provide pull or junction boxes where necessary to comply with these requirements. Inside radii of bends in conduits one-inch trade size and larger shall be minimum five times nominal diameter. Terminate conduit at bottom edge of backboard with plastic bushing.

3.1.4.7 Conduit Installed in Concrete Floor Slabs

Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum one-inch cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horinzontal and vertical movement of raceway. Conduit larger than one-inch trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab. Where nonmetallic conduit is used, raceway must be converted to rigid steel before rising above floor, unless specifically indicated.

3.1.4.8 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.9 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.4.10 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 inch diameter. Provide liquid-tight flexible conduit throughout locations. Provide separate ground conductor across flexible connections.

3.1.5 Boxes, Outlets, and Supports

Provide boxes in wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type throughout when surface mounted on outside of exterior surfaces. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports, or make adequate provisions for distributing load over ceiling support members in an approved manner. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.5.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4

inches square, except that 4- by 2-inch boxes may be used where only one raceway enters outlet and for wall-mounted telephones. Telephone outlets shall be minimum of 4 inches square by 1 1/2 inches deep except for wall-mounted telephones.

3.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 compatible with nonmetallic raceway systems, except where cast-metal boxes are required. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controllers and disconnecting switches so height of operating mechanism at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor, receptacles 36 inches above finished floor, and other devices as indicated. Outlet boxes for wall-mounted telephones shall be 2 inches by 4 inches; mounted at height 60 inches above finished floor. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.7 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves.

3.1.8 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.10 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, and ceilings utilizing proper firestopping materials to maintain fire resistive integrity.

3.1.11 Grounding and Bonding

In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.11.1 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.11.2 Telephone Service

Provide main telephone service equipment ground consisting of separate No. 6 AWG ground wire in conduit between equipment backboard and readily accessible grounding connection. Equipment end of ground wire shall consist of coiled length at least twice as long as terminal cabinet or backboard height.

3.1.12 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.12.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 600-Volt Wiring Test

Test 600-volt wiring and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 Transformer Tests

Perform test classified as routine in accordance with NEMA ST 20 on each transformer.

3.2.4 GFCI Receptacle Test

Test GFCI receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.2.5 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground does not exceed 5 ohms. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --

SECTION 16510

INTERIOR LIGHTING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1353	1990 Electric Lamps - 70-Watt, 52-Volt, S62 Single-Ended High-Pressure Sodium Lamps
ANSI C82.1	1985 (Supp. 1991) Ballasts for Fluorescent Lamps
ANSI C82.2	1984 (R 1989) Fluorescent Lamp Ballasts - Methods of Measurement
ANSI C82.4	1985 (Supp. 1988) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	1991 Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 526/A 526M	1990 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 580	1991 (Rev. B) Stainless and Heat-Resisting Steel Wire
ASTM A 853	1991 Steel Wire, Carbon, for General Use

FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC RR	1976 Rules and Regulations, Vol. II, Transmittals 1 through 6

FEDERAL SPECIFICATIONS (FS)

FS QQ-N-281	(Rev. D) (Am. 2) Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE C62.41	1991 Surge Voltages in Low-Voltage AC Power Circuits

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES LHBK	Lighting Handbook, References and Application Volumes

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	1988 (Rev. 1-2) Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Control and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1993 National Electrical Code
NFPA 101	1991 Code for Safety to Life from Fire in Buildings and Structures

UNDERWRITERS LABORATORIES INC. (UL)

UL 20	1986 (Errata 1988) (R 1991) General-Use Snap Switches
UL 773	1987 (Bul. 1992) Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 773A	1989 Nonindustrial Photoelectric Switches for Lighting Control
UL 924	1990 (R 1991) Emergency Lighting and Power Equipment
UL 935	1984 (R 1992) Fluorescent-Lamp Ballasts
UL 1029	1986 (R 1991) High-Intensity-Discharge Lamp Ballasts
UL 1570	1988 (Bul. 1991) (R 1993) Fluorescent Lighting Fixtures
UL 1571	1984 (Bul. 1992) (R 1992) Incandescent Lighting Fixtures
UL 1572	1991 (R 1992) High Intensity Discharge Lighting Fixtures

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16402, "Interior Wiring Systems." Lighting fixtures and accessories mounted on exterior surfaces of building are specified in this section.

1.3 DEFINITIONS

1.3.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the Basic Contract. Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES LHBK, as applicable, for the lighting system specified.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Fluorescent lighting fixtures

b. Fluorescent lamps

c. Fluorescent core and coil ballasts

d. High-Intensity-Discharge (HID) lighting fixtures

e. HID Ballasts

f. HPS lamps

g. Incandescent lighting fixtures

h. Incandescent lamps

i. Lighting contactor

j. Photocell switch

k. Emergency lighting equipment

l. Support hangers for lighting fixtures in suspended ceilings

m. Exit signs

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1570.

2.1.1 Fluorescent Lamps

Provide energy-efficient 48-inch and 96-inch lamps except where standard lamps are specifically indicated. Energy-saving, rapid-start lamps shall be rated 35 watts (maximum), 2900 initial lumens (minimum), 20,000 hours average rated life. Average rated life is based on 3 hours operating per start.

2.1.2 Fluorescent Core and Coil Ballasts

UL 935, ANSI C82.1, and shall be labeled Certified Ballast Manufacturers (CBM) certified by Electrical Testing Laboratories (ETL). Ballasts shall be high power factor type and shall be designed to operate on the voltage system to which they are connected. Ballasts shall be Class P and shall have sound rating "A" Fixtures and ballasts shall be designed and constructed to limit the ballast case temperature to 90 degrees Celsius (C) when installed in an ambient temperature of 40 degrees C. Provide three lamp fixtures with two ballasts per fixture.

2.1.2.1 Energy-Saving Ballasts

Provide energy-saving fluorescent ballasts of the CBM certified full light output type. Ballasts shall have an average input wattage of 79 or less when operating two 35-watt F40T12 lamps 48 or less when operating one 35-watt F40T12 lamp tested in accordance with ANSI C82.2 methods.

2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

UL 1572.

2.2.1 HID Ballasts

UL 1029 and ANSI C82.4 and shall be regulator, high power factor type. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on the voltage system to which they are connected.

b. Designed for installation in a normal ambient temperature of 40 degrees C.

c. Constructed so that open circuit operation will not reduce the average life.

High-pressure sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode.

2.2.2 HPS Lamps

2.3 INCANDESCENT LIGHTING FIXTURES

UL 1571.

2.3.1 Incandescent Lamps

Provide the number, type, and wattage indicated.

2.4 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom. Access to ballast shall be from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as indicated.

2.5 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of the fixtures supported by the hangers. Hangers shall allow fixtures to swing within an angle of 20 degrees. Brace pendants 4 feet or longer to limit swinging. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous row fluorescent fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Rods shall be a minimum 3/16-inch diameter.

2.6 LIGHTING CONTACTOR

2.7 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide cell rated 277 volts ac, 60 Hz with single-throw contacts rated 1000 watts and 277 volts. Provide switch integral to the fixture in a high-impact-resistant noncorroding and nonconductive molded plastic housing with a locking-type receptacle conforming to ANSI C136.10. Switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition.

2.8 EXIT SIGNS

UL 924, NFPA 70, and NFPA 101. Exit signs shall be self-powered.

2.8.1 Self-Powered Exit Signs (Battery Type)

Provide with automatic power failure device, test switch, pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years.

2.9 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101. Provide lamps in wattage indicated. Provide accessories required for remote-mounted lamps where indicated. Remote-mounted lamps shall be as indicated.

2.9.1 Emergency Lighting Unit

Provide as indicated. Emergency lighting units shall be rated for 12 volts, except units having no remote-mounted lamps and having no more than two unit-mounted lamps may be rated 6 volts.

2.10 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

2.10.1 Wires

ASTM A 853, grade 1010, annealed, light zinc-coated finish, 0.1055 inches in diameter 12 gage).

2.10.2 Wires, for Humid Spaces

ASTM A 580, composition 302 or 304, condition annealed stainless steel or FS QQ-N-281, Class A nickel-copper alloy, 0.1055 inches in diameter (12 gage).

PART 3 EXECUTION

3.1 INSTALLATION

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semirecessed fixtures may be supported from suspended ceiling support system ceiling tees when the ceiling system support wires are provided at a minimum of four wires per fixture and located not more than 6 inches from each corner of each fixture. For recessed fixtures, provide support clips securely fastened to ceiling grid members, a minimum of one at or near each corner of each fixture. For round fixtures or fixtures smaller in size than the ceiling grid, provide a minimum of four wires per fixture and locate at each corner of the ceiling grid in which the fixture is located. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently or with at least two 3/4-inch metal channels spanning, and secured to, the ceiling tees. Provide wires or rods for lighting fixture support in this section.

3.1.1 Exit Signs and Emergency Lighting Units

Wire exit signs and emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

3.1.1.1 Emergency Lights and Exit Lights

Wire emergency lights ahead of the switch to the normal lighting circuit located in the same room or area.

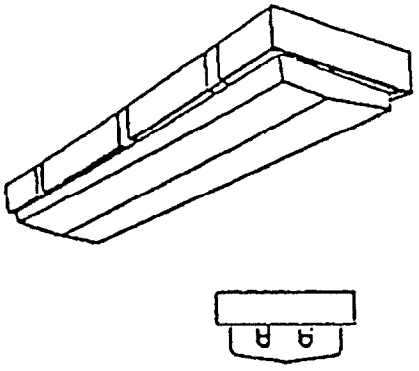
3.1.2 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations. Mount switch on or beside each luminaire when switch is provided in cast weather proof aluminum housing with swivel arm.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this Section.

-- End of Section --



LUMINAIRE REQUIREMENTS

1. MOLDED 100% ACRYLIC DIFFUSE LENS (NOT CLEAR) FULLY GASKETED WITH FIBERGLASS OR PLASTIC HOUSING.
2. PROVIDE A MINIMUM OF 6 PLASTIC LATCHES TO SECURE LENS.
3. BALLAST SHALL BE HIGH POWER FACTOR (≥ .9) ETL CBM APPROVED RAPID START CLASS P ENERGY SAVING BALLAST WITH A SOUND RATING OF B. SECURE BALLAST TO HOUSING WITH AT LEAST ONE SCREW AND SLIP-ON BRACKET OR 2 SCREWS - ONE AT EACH END.
4. UL LISTED FOR DAMP OR "WET" LABEL AS INDICATED.
5. OVERALL LUMINAIRE LENGTH SHALL BE 48" NOMINAL.
6. MINIMUM COEFFICIENT OF UTILIZATION (CU) WITH CAVITY REFLECTANCES OF 80% CEILING, 50% WALLS AND 20% FLOOR SHALL BE:

RCR	C.U. TYPE A	TYPE B
1	76	70
2	65	60
3	57	52
4	50	46

7. SPACING TO MOUNTING HEIGHT RATIO = 1.5
8. HOUSING SHALL HAVE INTERNAL GREEN GROUNDING SCREW.

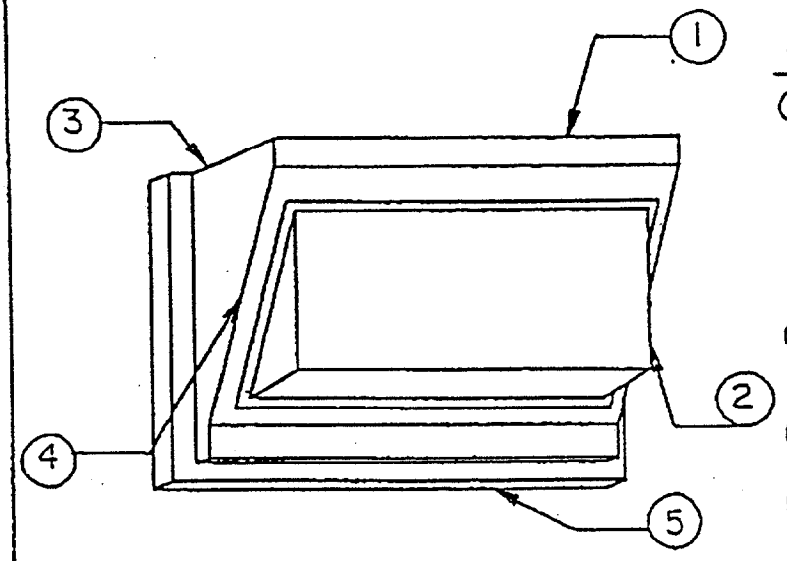
TYPE A- 1-F40T12CW.
TYPE B- 2-F40T12CW.

HOUSING OPTIONS

1. UL LISTED FOR DAMP LOCATIONS.
2. UL LISTED FOR WET LOCATIONS.

WET/DAMP LOCATION LUMINAIRES

SKETCH DATE SEPTEMBER 1988	STYLE NL-8



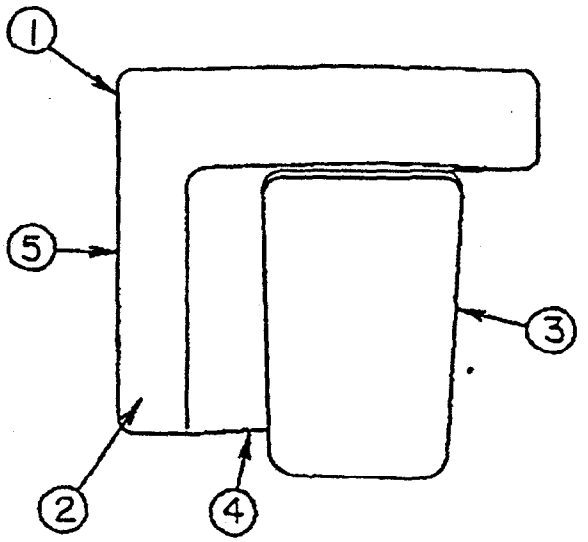
LUMINAIRE REQUIREMENTS

1. HOUSING-DIECAST ALUMINUM. SEALED AND GASKETED. UL LISTED FOR WET LOCATONS. PROVIDE INTERNAL GREEN GROUNDING SCREW. (DIMENSIONS: APPROXIMATELY 16"L X 10"H X 11"D)
2. REFRACTOR-BOROSILICATE PRISMATIC GLASS. PROVIDE ALUMINUM REFLECTOR.
3. BALLAST-HIGH POWER FACTOR (≥ .8) MULTI VOLTAGE.
4. FINISH-DARK BRONZE. UNLESS OTHERWISE NOTED.
5. LAMP SOCKET SHALL BE ADJUSTABLE.
6. PHOTO CELL-PROVIDE WHEN SPECIFIED.

TYPE A - 70W HIGH PRESSURE SODIUM
TYPE B - 100W HIGH PRESSURE SODIUM
TYPE C - 150W HIGH PRESSURE SODIUM
TYPE D - 175W METAL HALIDE
TYPE E - 35W LOW PRESSURE SODIUM

EXTERIOR COMMERCIAL WALL MOUNT H.I.D.

SKETCH DATE SEPTEMBER 1988	STYLE NL-25



LAMPING

TYPE A: ONE-7W COMPACT FLUORESCENT

TYPE B: ONE-13W COMPACT FLUORESCWNT

TYPE C: TWO-7W COMPACT FLUORESCENT

TYPE D: TWO-13W COMPACT FLUORESCENT

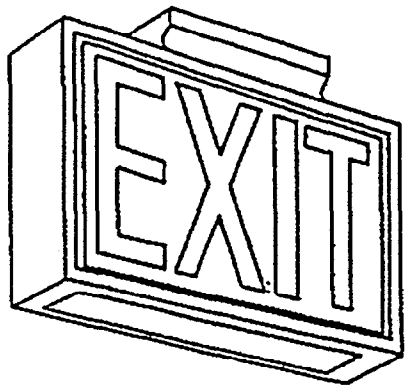
TYPE E: ONE-18W LOW PRESSURE SODIUM

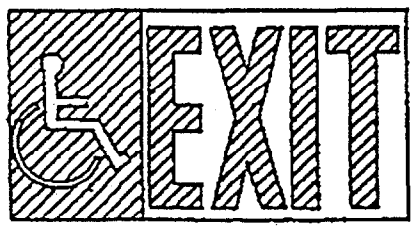
LUMINAIRE REQUIREMENTS

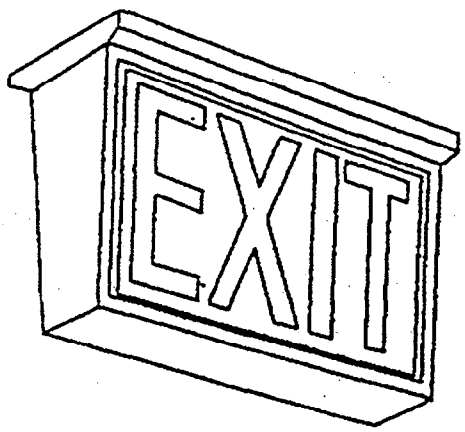
1. HOUSING SHALL BE ULTRA-VIOLET RESISTANT POLYCARBONATE DARK BRONZE UNLESS INDICATED OTHERWISE. APPROX. 10"H X 7"W X 9"
2. PROVIDE WITH ALUMINUM OR POLYCARBONATE BACK PLATE.
3. PROVIDE ACRYLIC OR POLYCARBONATE ULTRA-VIOLET RESISTANT PRISMATIC OR DIFFUSE LENS.
4. PROVIDE HIGH POWER FACTOR ($\geq$ .8) BALLAST.
5. PROVIDE INTERNAL GREEN GROUNDING SCREW.
6. PROVIDE U.L. WET LABEL.
7. PROVIDE PHOTO CELL WHEN SPECIFIED.

EXTERIOR COMPACT FLUORESCENT AND LOW PRESSURE SODIUM-WALL MOUNT

SKETCH DATE SEPTEMBER 1988	STYLE NL-26







LUMINAIRE REQUIREMENTS

1. LETTERS SHALL BE 6" TALL WITH 3/4" STROKES FORMED BY A STENCIL FACE.
2. PROVIDE RED FIBERGLASS PANEL BEHIND STENCIL FACE.
3. PROVIDE TWO 5 OR 7 WATT TWIN TUBE COMPACT FLUORESCENT LAMPS.
4. PROVIDE DOWN LIGHT PANEL IN FIXTURE. (TYPE A ONLY)
5. PROVIDE ILLUMINATED ARROWS AS INDICATED ON PLANS.
6. PROVIDE SINGLE OR DOUBLE FACE AS INDICATED ON PLANS.
7. PROVIDE CEILING, END WALL, BACK WALL OR PENDANT MOUNTING AS INDICATED ON PLANS.
8. UNITS MOUNTED EXPOSED TO THE ENVIRONMENT SHALL HAVE A DAMP OR WET U.L. LABEL AS APPROPRIATE AND SHALL NOT BE CONSTRUCTED OF STEEL.
9. PROVIDE INTERNAL GREEN GROUNDING SCREW.
10. PROVIDE INTERNATIONAL SYMBOL OF ACCESS ON SIGN WHEN INDICATED.
11. PROVIDE HIGH POWER FACTOR (≥ .8) BALLAST.

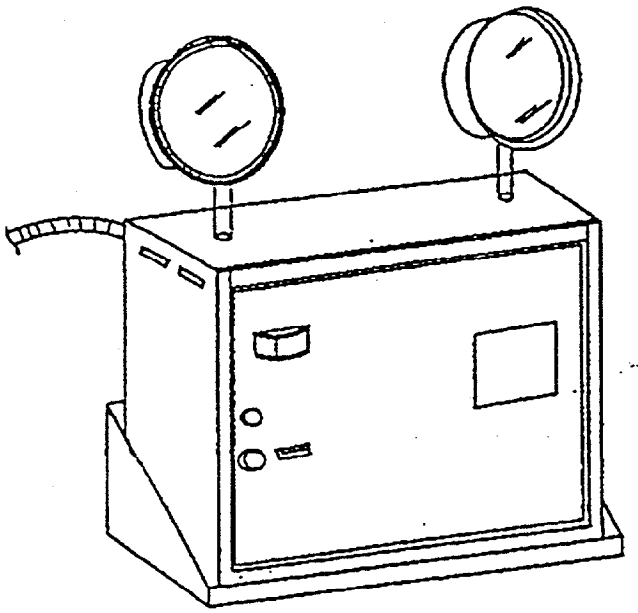
TYPE A - ALUMINUM, STEEL OR POLYCARBONATE HOUSING. PAINTED MATTE BLACK W/STENCIL FACE. (SEE NOTE 8)

TYPE B- PLASTIC HOUSING ENCLOSED IN POLYCARBONATE WITH STENCIL ON INSIDE OF POLYCARBONATE HOUSING. (SEE NOTE 8.)

TYPE C- VANDAL RESISTANT POLYCARBONATE HOUSING W/DAMP LABEL.

FLUORESCENT EXIT SIGN

SKETCH DATE SEPTEMBER 1988	STYLE NL-48

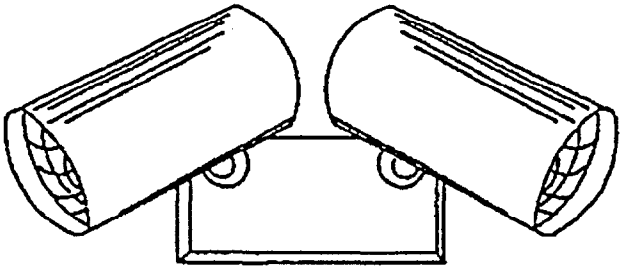


LUMINAIRE REQUIREMENTS

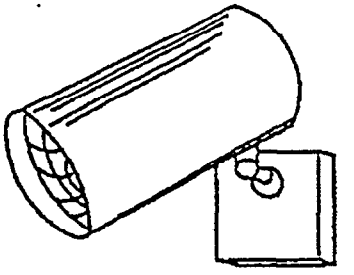
1. SEALED BATTERY. SPECIFICALLY DESIGN FOR EMERGENCY LIGHTING. SOLID STATE FULLY AUTOMATIC - THREE RATE CHARGER FOR NICKEL CADMIUM BATTERY AND TWO RATE HIGH/LOW CHARGER FOR LEAD CALCIUM OR LEAD ACID SEALED BATTERIES.
2. MINIMUM 0.032" THICK STEEL HOUSING WITH BAKED ENAMEL PAINTED FINISH (BROWN OR BEIGE). OR NONMETALLIC PLASTIC HOUSING.
3. TEST SWITCH
4. "AC ON" PILOT LIGHT.
5. AUTOMATIC OVERLOAD PROTECTION - FUSE OR CIRCUIT BREAKER.
6. HEADS SHALL BE FULLY ADJUSTABLE VERTICALLY AND HORIZONTALLY.
7. SEALED BEAM HALOGEN LAMPS MINIMUM 8 WATT UNLESS OTHERWISE INDICATED IN SCHEDULE.
8. INPUT VOLTAGE AS INDICATED IN SCHEDULE.
9. VOLTMETER.
10. 3/C #16. SO CORD SET - (HARD WIRE TO CIRCUIT)
11. PROVIDE MINIMUM 0/032" THICK STEEL WALL MOUNTING SHELF. OR MOUNTING BRACKETS OR HOLES IN HOUSING FOR MOUNTING UNIT ON WALL.
12. LOW VOLTAGE. DEEP DISCHARGE DISCONNECT.
13. PROVIDE INTERNAL GREEN GROUNDING SCREW.

EMERGENCY LIGHTING UNIT

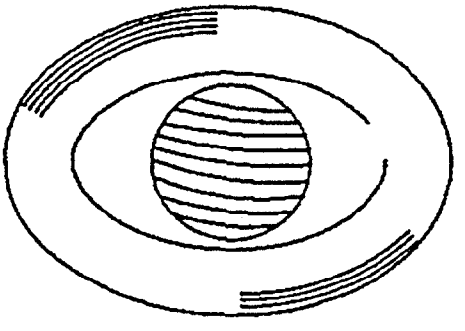
SKETCH DATE	SEPTEMBER 1988	STYLE	NL-51



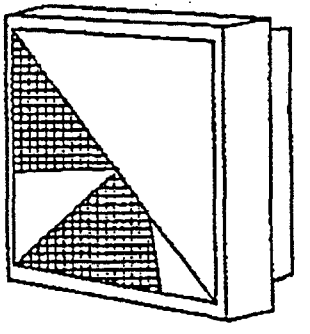
TYPE - A



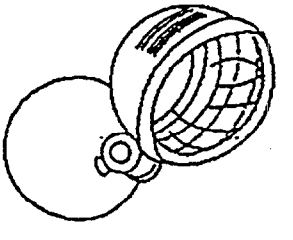
TYPE - B



TYPE - C



TYPE - D



TYPE - E

REMOTE EMERGENCY LIGHTING UNITS

NOTES:

1. LAMPS AND FINISHES SHALL BE COMPATIBLE WITH PRIMARY UNIT WITH WHICH USED.

REMOTE FIXTURES FOR USE WITH BATTERY UNIT

SKETCH DATE	SEPTEMBER 1988	STYLE	NL-54