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FINAL DESIGN FOR
BUILDINGS 106 AND 780

NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. N62467-89-D-0317/076

Prepared by:

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Prepared for:

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Naval Facilities Engineering Command
2155 Eagle Drive
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December 1995

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

SPECIFICATION NO.
18-89-0317

CONTRACT NO.
N62467-89-D-0317/076

APPROPRIATION:
ENVIR

BUILDINGS 106 AND 780

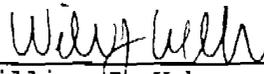
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NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

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For Commander, NAVFAC: _____

Date: _____



The engineering design and professional opinions rendered in the set of planning documents that describes the Buildings 106 and 780 remediation, NAS Jacksonville, Florida, were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice. These planning documents are intended to be implemented by Southern Division, Naval Facilities Engineering Command's Response Action Contract (RAC) Contractor.

William J. Weber

Professional Engineer No. 49658
Expires February 28, 1997

William J. Weber
10/28/95

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SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 Project Description

The United States (U.S.) Navy is conducting environmental programs at Naval Air Station (NAS) Jacksonville through the Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOM). The various programs were initiated to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities.

SOUTHNAVFACENGCOM and NAS Jacksonville propose an interim removal action (IRA) at potential Source of Contamination (PSC) 48, specifically Building 106. Building 106 is a dry cleaning facility. The IRA shall consist of the installation of an air sparge system to strip volatile organic compounds (VOCs) from groundwater, and a soil vapor extraction system (SVE) to capture VOCs from the subsurface. The IRA is designed to reduce contaminant concentrations in hot spots or source areas.

Air will be injected into the groundwater by a blower via vertical air sparge wells. The wells will be located between Buildings 106 and 103, and between Buildings 103 and 105. The pressurized air will strip contaminants from the groundwater into the soil vapor. Soil vapor will be extracted from the subsurface by a blower via horizontal trenches. The horizontal trenches will be located between Buildings 106 and 103; and between Buildings 103 and 105. The extracted vapor will pass through a moisture separator, be treated using vapor phase granular activated carbon (GAC), and be discharged to the atmosphere.

An IRA shall also be conducted at Building 780. Building 780 is not located within a PSC, but has exhibited contamination that warrants its investigation. Building 780 was a paint stripping facility until 1992 when it was converted into a "closed-loop" solvent recycling facility. The IRA shall consist of the installation of an SVE system to remove VOC laden air from the subsurface and a groundwater pump and treat system. The IRA is designed to reduce contaminant concentrations in hot spots or source areas.

Soil vapor will be extracted from the subsurface by a blower via vertical wells. The extracted vapor will pass through a moisture separator, be treated using thermal oxidation, and discharged to the atmosphere. The installation of the thermal oxidation system will be temporary because GAC may replace thermal oxidation when vinyl chloride and 1,1-dichloroethene concentrations drop to levels economically favorable to GAC. It is estimated that the thermal oxidation system may be operated for 2 to 24 months before GAC becomes economically favorable. Groundwater will be extracted from the subsurface by a pump via a well. A metals sequestering agent will be added to the groundwater which will keep the heavy metals in suspension during the treatment process. The groundwater will be filtered through a bag filter prior to organics removal in the air stripper. Groundwater will pass through a tray air stripping system to strip chlorinated VOCs from

the water. VOC laden air will combine with extracted soil vapor for treatment in the thermal oxidation system or GAC to remove/destroy VOCs prior to discharge to the atmosphere.

1.1.2 Location

Buildings 106 and 780 are located within Operable Unit 3 (OU 3). OU 3 is adjacent to the St. John's River, and consists primarily of the Naval Aviation Depot (NADEP).

1.1.3 Scope of Work

- 1.1.3.1 General: The Contractor shall provide all labor, materials, and equipment necessary to perform the work as described in the Specifications. This scope includes, but is not limited to: pavement cutting, removal and disposal; excavation and disposal of soil; providing earthwork materials; providing and installing vapor extraction wells, air sparge wells, groundwater extraction well, associated piping, treatment equipment (i.e., blowers, pumps, thermal oxidation system, GAC, tray air stripper), instrumentation and electrical services and control systems, structural pads, building, repair and replacement of bituminous and concrete surfaces, and necessary labor.

The primary contaminants of concern at Buildings 106 and 780 are chlorinated VOCs. Prior to discharge to the atmosphere, process vapor shall be treated to levels indicated in Section 01680. Prior to discharge to the Federally Owned Treatment Works (FOTW), groundwater shall be treated to levels indicated in Section 01680.

- 1.1.3.2 Building 106: Activities at Building 106 shall generally consist of the following:

- A. Sawcutting of existing pavement along the pipe trench alignment and the air sparging well locations, and removal and disposal of the existing pavement.
- B. Installation of air sparging wells and piping, and soil vapor extraction (SVE) piping, including all valves and appurtenances.
- C. Installation of monitoring probes.
- D. Backfilling of the pipe trench and placement of portland cement concrete and bituminous concrete to the limits shown on the Drawings.
- E. Construction of concrete equipment support pads, fencing, and gates.
- F. Installation of the SVE and air sparging blowers, instrumentation, electrical controls, valves and appurtenances, granular activated carbon canisters, and associated piping.
- G. Power connection.
- H. System startup.
- I. System operation and maintenance.

- 1.1.3.3 Building 780: Activities at Building 780 shall generally consist of the following:
- A. Sawcutting of existing pavement along the pipe trench alignment and the SVE well locations, and removal and disposal of the existing pavement.
 - B. Excavation of the pipe trench shall be conducted by hand. There are numerous underground utilities in the area surrounding Building 780.
 - C. Installation of SVE wells and the groundwater extraction well, including associated piping and appurtenances.
 - D. Backfilling of the pipe trench and placement of portland cement concrete and bituminous concrete to the limits shown on the Drawings.
 - E. Installation of monitoring probes.
 - F. Installation of electrical and instrumentation conduit and wiring, chemical feed piping, water level sensor, groundwater extraction pump, and all other appurtenances.
 - G. Construction of a prefabricated metal building with associated lighting, electrical service, plumbing, foundation, and slab.
 - H. Installation of the tray air stripper, SVE, and air stripper blowers, instrumentation, electrical controls, valves and appurtenances, thermal oxidation unit, chemical feed pump, and all other appurtenances.
 - I. Power connection.
 - J. System startup.
 - K. System operation and maintenance.

1.2 WORK NOT COVERED BY CONTRACT DOCUMENTS

The following work is assumed to be included with Contractor's existing contract through SOUTHNAVFACENCOM.

- A. Decontamination of personnel and equipment.
- B. Transportation and disposal of hazardous materials including sediment and water from decontamination, and personal protective equipment.

1.3 CONTRACTOR ACCESS AND USE OF PREMISES

1.3.1 NAS Jacksonville Regulations

Ensure that Contractor personnel employed on the Station become familiar with and obey NAS Jacksonville regulations. Keep within the limits of the work and avenues of ingress and egress. Do not enter restricted areas unless required to do so and until cleared for such entry. Permission to interrupt any station roads, railroads, or utility services shall be requested in writing a minimum of (15) fifteen calendar days

prior to the desired date of interruption. The Contractor's equipment shall be conspicuously marked for identification.

1.3.2 Working Hours

Regular working hours shall consist of a period established by the Contracting Officer's Representative.

1.3.3 Work Outside Regular Hours

Work outside regular working hours requires Contracting Officer's Representative approval. Provide written request (15) fifteen calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Contracting Officer's Representative.

1.3.4 Utility Cutovers and Interruptions

- A. Make utility cutovers and interruptions after coordination with the base. Conform to procedures required in the paragraph "Work Outside Regular Hours."
- B. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.
- C. Interruption to Water, Sanitary Sewer, Electric Service, shall be considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours." This time limit includes time for deactivation and reactivation.

1.4 PRECONSTRUCTION CONFERENCE

Prior to commencement of any work at the site, meet with the Contracting Officer's Representative to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, submittals, scheduling, programming and prosecution of work.

1.5 HEALTH AND SAFETY

Activities conducted as part of this work shall be in accordance with the Contractor's Health and Safety Plan. Work will include exposure to contaminated vapors and handling of potentially contaminated soil. Groundwater at Buildings 106 and 780 is known to be contaminated with chlorinated VOCs. It is anticipated that subsurface construction activities will be conducted using Level B personal protective equipment, and that engineering controls may also be required. The tables below summarize the contaminants of concern at Buildings 106 and 780.

BUILDING 106 - CONTAMINANTS OF CONCERN

Compound	Media	Maximum Concentration (ug/L)
Tetrachloroethene	Soil Gas	3,400
Trichloroethene	Soil Gas	1,600
Tetrachloroethene	Groundwater	36,000
Trichloroethene	Groundwater	11,000
1,2-Dichloroethene	Groundwater	4,000
Vinyl Chloride	Groundwater	150

BUILDING 780 - CONTAMINANTS OF CONCERN

Compound	Media	Maximum Concentration (ug/L)
Tetrachloroethene	Soil Gas	400
Trichloroethene	Soil Gas	2,900
Trichloroethane	Soil Gas	160,000
1,1-Dichloroethene	Soil Gas	10,000
Vinyl Chloride	Soil Gas	28
1,1-Dichloroethane	Soil Gas	4,400
1,2-Dichloroethane	Groundwater	1,800
1,1-Dichloroethane	Groundwater	8,300
Chloroethane	Groundwater	6,400
Trichloroethene	Groundwater	11,000
1,2-Dichloroethene	Groundwater	66,000
1,1-Dichloroethene	Groundwater	23,000
Vinyl Chloride	Groundwater	8,900
Trichloroethane	Groundwater	230
Tetrachloroethene	Groundwater	14
Toluene	Groundwater	1,100
Ethylbenzene	Groundwater	100
Naphthalene	Groundwater	17

--End of Section--

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.1 DEFINITIONS

1.1.1 Submittal

Shop drawings, product data, samples, and administrative and closeout submittals presented for review and approval.

1.1.2 Types of Submittals

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

- A. Shop Drawings: As used in this Section, drawings, schedules, diagrams, and other data prepared specifically for this Contract, by the Contractor or through the Contractor by way of a subcontractor, manufacturer, supplier, distributor, or other lower tier contractor, to illustrate a portion of the work.
- B. Product Data: Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate a portion of the work, but not prepared exclusively for this Contract.
- C. Samples: Physical examples of products, materials, equipment, assemblies, or workmanship that are physically identical to a portion of the work, illustrating a portion of the work or establishing standards for evaluating the appearance of the finished work or both.
- D. Administrative Submittals: Data presented for reviews and approval to ensure that the administrative requirements of the project are adequately met but not to ensure directly that the work is in accordance with the design concept and in compliance with the Contract documents.

1.1.3 Approving Authority

The person authorized to approve a submittal.

1.1.4 Work

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

1.2 SUBMITTALS

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

1.2.1 SD-18, Records

A. Submittal register

1.2.1.2 Submittal Register Preparation

Prepare and maintain a submittal register. Additional details concerning the use of the submittal register will be explained at the preconstruction conference.

1.3 PROCEDURES FOR SUBMITTALS

1.3.1 Reviewing, Certifying, Approving Authority

The QC organization shall be responsible for reviewing and certifying that submittals are in compliance with contract requirements. The approving authority on submittals is the QC Manager or the Contracting Officer's Representative as appropriate for that submittal item.

1.3.2 Constraints

- A. Submittals listed or specified in this Contract shall conform to the provisions of this Section, unless explicitly stated otherwise.
- B. Submittals shall be complete for each definable feature of work; components of the definable feature interrelated as a system shall be submitted at the same time.
- C. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, the submittal will be returned without review.
- D. Approval of a separate material, product, or component does not imply approval of assembly in which the item functions.

1.3.3 Scheduling

- A. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of the work so that work will not be delayed by submittal processing. Allow for potential requirements to resubmit.
- B. Except as specified otherwise, allow a review period, beginning with receipt by the approving authority, that includes at least 15 working days for submittals for QC Manager approval and 25 working days for submittals for Contracting Officer's Representative approval. The period of review for submittals with Contracting Officer's Representative approval begins when the Government receives the submittal from the QC organization. The period of review for each resubmittal is the same as for the initial submittal.

1.3.4 Variations

Variations from contract requirements require Government approval pursuant to Contract Clause entitled "Specifications and Drawings for Construction" and will be considered where advantageous to the Government. When proposing a variation, submit a written request to

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

Certified by Submittal Reviewer _____, Date _____ (Signature when applicable).

Approved by QC Manager _____, Date _____ (Signature)

- G. Sign the certifying statement or approval statement. The person signing the certifying statements shall be the QC organization member designated in the approved QC plan. The signatures shall be in original ink. Stamped signatures are not acceptable.
- H. Update the submittal register as submittal actions occur and maintain the submittal register at the project site until final acceptance of all work by the Contracting Officer's Representative.
- I. Retain a copy of approved submittals at the project site, including the Contractor's copy of approved samples.
- J. When the approving authority is the QC Manager, forward two copies of each approved submittal, except "Samples," where one set is required, to the Contracting Officer's Representative.

1.3.7 Government's Responsibilities

When the approving authority is the Contracting Officer's Representative, the Government will:

- A. Note the date on which the submittal was received from the QC Manager, on each submittal for which the Contracting Officer's Representative is the approving authority.
- B. Review submittals for approval within the scheduling period specified and only for conformance with project design concepts and compliance with the Contract documents.
- C. Identify returned submittals with one of the actions defined in the paragraph entitled "Actions Possible" and with markings appropriate for the action indicated.
- D. Retain three copies of each submittal, except "Samples," where one copy will be retained.

1.3.8 Actions Possible

Submittals will be returned with one of the following notations:

- A. Submittals marked "not reviewed" will indicate the submittal has been previously reviewed and approved, is not required as a submittal, does not have evidence of being reviewed and approved by the Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is

not reviewed. Returned submittals deemed to lack review by the Contractor or to be incomplete shall be resubmitted with appropriate action, coordination, or change.

- B. Submittals marked "approved" or "approved as submitted" authorize the Contractor to proceed with the work covered.
- C. Submittals marked "approved as noted" or "approved except as noted; resubmission not required" authorize the Contractor to proceed with the work as noted provided the Contractor takes no exception to the notations.
- D. Submittals marked "revise and resubmit" or "disapproved" indicate the submittal is incomplete or does not comply with the design concept or the requirements of the Contract documents and shall be resubmitted with appropriate changes.

1.4 FORMAT OF SUBMITTALS

1.4.1 Transmittal Form

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

1.4.2 Identifying Submittals

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

- A. Project title and location.
- B. Construction Contract number.
- C. The Section number of the specification Section by which the submittal is required.
- D. The submittal description (SD) number of each component of the submittal.
- E. When a resubmission, an alphabetic suffix on the submittal description, for example, SD-10A, to indicate the resubmission.
- F. The name, address, and telephone number of the subcontractor, supplier, manufacturer and any other second tier contractor associated with the submittal.
- G. Product identification and location in project.

the Contracting Officer's Representative, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to the Government. If lower cost is a benefit, also include an estimate of the cost saving. Identify the proposed variation separately and include the documentation for the proposed variation along with the required submittal for the item. When submitting a variation for approval, the Contractor warrants the following:

1.3.4.1 Variation Is Compatible

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

1.3.4.2 Contractor Is Responsible

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

1.3.4.3 Review Schedule Is Modified

In addition to the normal submittal review period, a period of 15 working days will be allowed for consideration by the Government of submittals with variations.

1.3.5 Contractor's Responsibilities

- A. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and Contract documents.
- B. Transmit submittals to the QC organization in orderly sequence, in accordance with the Submittal Register, and to prevent delays in the work, delays to the Government, or delays to separate contractors.
- C. Advise the Contracting Officer's Representative of variation, as required by the paragraph entitled "Variations."
- D. Correct and resubmit submittal as directed by the approving authority. Direct specific attention, in writing or on resubmitted submittal, to revisions not requested by the approving authority on previous submissions.
- E. Furnish additional copies of submittals when requested by the Contracting Officer's Representative, to a limit of 20 submittals.
- F. Complete work which must be accomplished as a basis of a submittal in time to allow the submittal to occur as scheduled.
- G. Ensure no work has begun until submittals for that work have been returned as "approved," or "approved as noted" or "approved except as noted; resubmission not required", except to the extent that a portion of the work must be accomplished as a basis of the submittal.

1.3.6 QC Organization Responsibilities

- A. Note the date on which the submittal was received from the contractor on each submittal for which the QC Manager is the approving authority.
- B. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and Contract documents.
- C. Review submittals for conformance with project design concepts and compliance with the Contract documents.
- D. Act on submittals, determining the appropriate action based on the QC organization's review of the submittal.
 - (1) When the QC Manager is the approving authority, take the appropriate action on the submittal from the possible actions defined in the paragraph entitled, "Actions Possible."
 - (2) When the Contracting Officer's Representative is the approving authority or when a variation has been proposed, forward the submittal to the Government with the certifying statement or return the submittal marked "not reviewed" or "revise and resubmit" as appropriate. The QC organization's review of the submittal determines the appropriate action.
- E. Ensure that material is clearly legible.
- F. Stamp each sheet of each submittal with the QC certifying statement or approving statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.
 - (1) When the approving authority is the Contracting Officer's Representative, the QC organization will certify submittals forwarded to the Contracting Officer's Representative with the following certifying statement:

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

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Certified by QC Manager _____, Date _____
(Signature)

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

1.4.3 Format for Product Data

- A. Present product data submittals for each Section as a complete, bound volume. Include a table of contents listing page and catalog item numbers for product data.
- B. Indicate, by prominent notation, each product which is being submitted; indicate the specification Section number and paragraph number to which it pertains.
- C. Supplement product data with material prepared for the project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for the project.

1.4.4 Format for Shop Drawings

- A. Shop drawings shall not be less than 8 1/2 by 11 inches nor more than 30 x 42 inches.
- B. Present 8 1/2 x 11-sized shop drawings as a part of the bound volume for the submittals required by the Section. Present larger drawings in sets.
- C. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to the information required in the paragraph entitled "Identifying Submittals."
- D. Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Identify materials and products for work shown.

1.4.5 Format of Samples

- A. Furnish samples in the sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately the same size as specified:
 - (1) Sample of Equipment or Device: Full size.
 - (2) Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.
 - (3) Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.
 - (4) Sample of Linear Devices or Materials: 10-inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.
 - (5) Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.
 - (6) Color Selection Samples: 2 inches by 4 inches.
 - (7) Sample Panel: 4 feet by 4 feet.
 - (8) Sample Installation: 100 square feet.

- B. Samples Showing Range of Variation: Where variations are unavoidable due to the nature of the materials, submit sets of samples of not less than three units showing the extremes and middle of the range.
- C. Reusable Samples: Incorporate returned samples into the work only if so specified or indicated. Incorporated samples shall be in undamaged condition at the time of use.
- D. Recording of Sample Installation: Note and preserve the notation of the area constituting the sample installation but remove the notation at the final clean up of the project.

1.4.6 Format of Administrative Closeout Submittals

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

1.5 QUANTITY OF SUBMITTALS

1.5.1 Number of Copies of Product Data

- A. Submit three copies of submittals of product data requiring review and approval only by the QC organization and three copies of product data requiring review and approval by the Contracting Officer's Representative.

1.5.2 Number of Copies of Shop Drawings

- A. For shop drawings presented on sheets larger than 8 1/2-inches by 14 inches, submit one reproducible and three prints of each shop drawing prepared for this project.
 - (1) Transmit reproducibles rolled in mailing tubes.
 - (2) After review, the approving authority will retain the prints and return only the reproducible with notation resulting from the review.

- B. For shop drawings presented on sheets 8.5 inches by 14 inches or less, conform to the quantity requirements for product data.

1.5.3 Number of Samples

- A. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by the approving authority and one will be returned to the Contractor.
- B. Submit one sample panel. Include components listed in technical section or as directed.
- C. Submit one sample installation, where directed.
- D. Submit one sample of non-solid materials.

1.5.4 Number of Copies of Administrative and Closeout Submittals

- A. Unless otherwise specified, submit administrative and closeout submittals which are 8.5 inches by 14 inches or smaller in size in the quantity required for product data.
- B. Unless otherwise specified, submit administrative and closeout submittals larger than 8.5 inches by 14 inches in size in the quantities required for shop drawings.

1.6 SCHEDULE OF SUBMITTAL DESCRIPTIONS (SD)

SD-01, Data

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

SD-02, Manufacturer's Catalog Data

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

SD-03, Manufacturer's Standard Color Charts

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

SD-04, Drawings

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

SD-05, Design Data

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

SD-06, Instructions

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

SD-07, Schedules

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

SD-08, Statements

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other lower tier contractor, the

purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality. A type of shop drawing.

SD-09, Reports

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

SD-10, Test Reports

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

SD-11, Factory Test Reports

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

SD-12, Field Test Reports

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

SD-13, Certificates

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

SD-14, Samples

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

SD-15, Color Selection Samples

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

SD-16, Sample Panels

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

SD-17, Sample Installations

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

SD-18, Records

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

SD-19, Operation and Maintenance Manuals

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

--End of Section--

SECTION 01680

TREATMENT FACILITY START-UP, OPERATION, AND MAINTENANCE

PART 1 - GENERAL

1.1 REFERENCES:

CODE OF FEDERAL REGULATIONS

40 CFR 433 Guidelines and Standards for Metal Finishing

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA)

Superfund Remedial Design and Remedial Action Guidance, June 1986.

Test Methods for Evaluating Solid Waste, November 1986.

1.2 DESCRIPTION OF WORK:

1.2.1 Work Included:

- A. Start-up and operate the air sparging and soil vapor extraction system at Building 106 and the groundwater treatment and soil vapor extraction system at Building 780 shown on the drawings and described in these specifications, in accordance with the system treatment objectives.
- B. Successful operation means that the system meets the treatment objectives with all process operations and equipment safely functioning in accordance with the original design intent.

1.2.2 Contaminant Treatment Objectives

- A. Off-gas treatment shall remove VOCs such that less than 15 pounds per day of total VOCs are released and discharge contaminant emission rates do not exceed the rates listed in Table 1.
- B. Groundwater effluent shall be treated to the concentrations specified in Table 2.

1.2.3 Description of Operation:

- A. Initially sparging and venting wells will be operated with all pit valves in the fully open position.
- B. Initially the groundwater extraction pump will be operated at a rate of 1.5 gpm.
- C. Vapor flow rates are estimated to be:
 - 100 scfm total combined flow to the sparging wells at Building 106;
 - 300 scfm total combined flow from the venting trenches at Building 106;
 - 120 scfm total combined flow from the venting wells at Building 780; and
 - 150 scfm total flow from the air stripper.

- D. The off-gas will be treated by the granular activated carbon (GAC) contactors at Building 106 and thermal oxidation at Building 780. The two GAC contactors will be operated in series. Building 780 may be switched to GAC treatment as the concentrations of contaminants decreases and GAC treatment becomes more economical.
- E. The sequestering agent is added to the extraction well at Building 780 to prevent the precipitation of iron and manganese during air stripping. The dosage rate shall be determined by the Contractor based on the specific sequestering agent selected and operational data.
- F. Tray air stripping is used to drive off the dissolved volatile organic compounds (VOCs) in the extracted groundwater at Building 780. A bag filter is positioned before the stripper to remove suspended solids and protect the stripper from fouling. The treated groundwater is discharged to the base sewer system.
- G. The off-gas from the air stripper is combined with the extracted soil vapor at Building 780 and treated by thermal oxidation. The treated air is vented to the atmosphere.

1.3 SUBMITTALS:

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

1.3.1 Project Data

- A. The start-up operation and maintenance log will be submitted at project close out. This shall include but is not limited to all operation and maintenance manuals for equipment, operation and maintenance procedures, and maintenance records.
- B. System performance monitoring reports.
- C. Field notebooks.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 START-UP, OPERATION AND MAINTENANCE REQUIREMENTS:

3.1.1 Equipment Start-Up

Perform system start-up to ensure that system components are functioning to specification within prescribed operating parameters. Perform start-up to ensure the following:

- A. Sparging and venting blowers are functioning correctly and meet flow requirements at the stated pressure and vacuum conditions.
- B. Well pumps are functioning correctly, and meet flow requirements at stated head condition.
- C. Piping is sound and leakproof.
- D. Sequestering agent metering system operates properly over the required range.

- E. The air stripper performs properly and the blowers meet required output.
- F. The carbon off-gas control system functions properly.
- G. The thermal oxidation off-gas control system functions properly.
- H. Instrumentation and control components operate properly. Test alarm conditions and change flowrates and air flow to simulate various operating conditions.
- I. Proper functioning of lighting, heating, and ventilation fan, etc.
- J. The entire facility meets the treatment objectives outlined in paragraph 1.2.2 of this Section.

3.1.2 Sampling and Analysis

System start-up and operation and maintenance shall include verification of treated water and off-gas quality by sampling water and vapor periodically for field analysis at the locations indicated in Tables 3 and 4 located at the end of this Section.

During the 14 day start-up period, provide field analysis equipment capable of detecting VOCs at target clean-up level concentrations in the effluent water and in the off-gas. The system start-up period shall continue until the required effluent limits are achieved for 14 consecutive days. Analytical equipment shall be capable of providing positive analysis for constituents of interest to at least the effluent limits prescribed.

The objective of performance monitoring is to verify groundwater and vapor treatment system effectiveness and efficiency. The Contractor shall determine the analytical methods necessary to meet this objective. Detection limits shall be low enough to demonstrate achievement of the treatment objectives.

Required calibration of analytical instrumentation and wet chemistries at a laboratory are generally addressed by the laboratory's quality assurance program. Generally, initial and continuing calibrations, matrix spikes, method blanks, analytical duplicates, and calibration check samples are required to be analyzed and to be within specified acceptance ranges.

Any piece of equipment used for on-site analysis should be calibrated according to manufacturer or analytical specifications. On-site analytical equipment might include metals analysis kits and temperature, conductivity, and pH. During plant start-up, on-site GCs will also require calibration. Equipment that is used for sampling should be calibrated with certified standard solutions each day they are used. Calibration of all on-site equipment should be documented in daily logs.

Samples will be preserved in accordance with USEPA SW-846 (see Subsection 5.3.1). Operator personnel will follow sampling protocol which generally requires shipping samples in coolers to maintain samples at 4°C.

Provide necessary tools, maintenance equipment, safety equipment, and chemicals during start-up.

Table 1
Vapor Treatment Criteria

Contaminant	Maximum Peak Emission Rate (lb/hr)
Building 106	
Vinyl Chloride	0.017
1,2-Dichloroethene	1.1
Trichloroethene	0.36
Tetrachloroethene	0.23
Building 780	
Vinyl Chloride	0.017
1,1-Dichloroethene	0.027
1,1-Dichloroethane	0.54
Trichloroethane	0.073
Trichloroethene	0.36
Tetrachloroethene	0.23
Toluene	0.50
Ethylbenzene	0.58
Naphthalene	0.069
1,2-Dichloroethane	0.0053
Chloroethane	3.5
1,2-Dichloroethene	1.1

Table 2
Groundwater Treatment Criteria

Contaminant	Maximum Effluent Concentration ($\mu\text{g/L}$)
Vinyl Chloride	2
Chloroethane	2
Tetrachloroethene	8
Trichloroethene	80
1,1-Dichloroethane	2
1,2-Dichloroethane	4
1,1-Dichloroethene	3
1,2-Dichloroethene	2
Trichloroethane	5,280
Toluene	1,750
Ethylbenzene	4,530
Naphthalene	230
TOTAL TOXIC ORGANICS (TTO) (1)	2,130

Note: (1) As defined in 40 CFR 433.

Table 3
 Treatment Plant Performance Monitoring/Sampling Frequency
 Building 106

Analytical Parameter	System Start-Up		Routine Operation and Maintenance	
	On-Site Analysis		On-Site Analysis	Off-Site Analysis
	Days 1-4	Days 5-14		
Air Sparging System				
Flow rate - instantaneous	1 day	1 day	1 week	-
Extracted Vapor				
Gas flow rate	12 hours	1 day	1 week	-
Volatile organics	12 hours	1 day	-	1 week
GAC				
Pressure differentials across carbon units	1 day	1 day	1 week	-
Volatile organics - between carbon units	12 hours	1 day	-	1 week
Volatile organics - discharge	12 hours	1 day	-	1 week

Notes:

Times given are the duration between sampling events.
 Volatile Organics = See treatment criteria.

Table 4
Treatment Plant Performance Monitoring/Sampling Frequency
Building 780

Analytical Parameter	System Start-Up		Routine Operation and Maintenance	
	On-Site Analysis		On-Site Analysis	Off-Site Analysis
	Days 1-4	Days 5-14		
Groundwater				
Flow rate - instantaneous	1 day	1 day	1 week	-
Flow rate - daily average	1 day	1 day	1 week	-
pH	1 day	1 day	1 week	-
Fe, Mn, Ca (filtered & unfiltered)	1 day	1 day	-	1 week
Alkalinity	1 day	1 day	-	1 month
TSS	1 day	1 day	-	1 month
Volatile organics	12 hours	12 hours	-	1 week
Sequestering Agent Feed Tank				
Sequestering Agent Use	1 day	1 day	1 week	-
Sequestering Agent Feed Rate	1 day	1 day	1 week	-
Extracted Vapor				
Gas flow rate	1 day	1 day	1 week	-
Volatile organics	6 hours	12 hours	-	1 week
Air Stripper Off-Gas				
Gas flow rate	1 day	1 day	1 week	-
Volatile organics	12 hours	1 day	-	1 week
Thermal Oxidation Off-Gas				
Gas flow rate	1 day	1 day	1 week	-
Volatile organics	12 hours	1 day	-	1 week
Supplemental fuel use - total	1 day	1 day	1 week	-
Temperature	1 day	1 day	1 week	-

Analytical Parameter	System Start-Up		Routine Operation and Maintenance	
	On-Site Analysis		On-Site Analysis	Off-Site Analysis
	Days 1-4	Days 5-14		
Air Stripper Effluent				
Flow rate - average daily	1 day	1 day	1 week	-
pH	1 day	1 day	1 week	-
TSS	1 day	1 day	-	1 month
Alkalinity	1 day	1 day	-	1 month
Volatile organics	12 hours	1 day	-	1 week

Notes:

Times given are the duration between sampling event.

TSS = Total Suspended Solids

Fe = Iron

Mn = Manganese

Volatile Organics = See treatment criteria.

Ca = Calcium

Filtered samples shall be collected through a membrane filter during collection.

--End of Section--

SECTION 02220

GENERAL EXCAVATION, FILLING, AND BACKFILLING

PART 1 - GENERAL

1.1 DESCRIPTION

Not used.

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 CONCRETE INSTITUTE (ACI)

ACI 301 1989 Structural Concrete for Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33 1990 Concrete Aggregate

ASTM C 143 1990 (Rev. A) Slump of Hydraulic Cement Concrete

1.3 REGULATORY REQUIREMENTS

Materials and workmanship specified herein with reference to State Standard shall be in accordance with the referenced articles, sections, and paragraphs of the standard except that contractual and payment provisions do not apply.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver and store materials in a manner to prevent contamination, segregation, freezing, and other damage.

1.5 PROTECTION

1.5.1 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer's Representative. Report damage to utility lines or subsurface construction immediately to the Contracting Officer's Representative.

PART 2 - PRODUCTS

2.1 PIPING

2.1.1 Vapor Extraction Trench Pipe

Provide schedule 40 0.20-slot PVC screened pipe for construction of the soil vapor extraction trenches at Building 106.

2.1.2 Other Below Grade Piping

Groundwater influent and effluent, sequestering agent, SVE solid pipe, and air sparging pipe materials as defined in Section 15060, "Piping and Valves."

2.2 SOIL MATERIALS

Provide soil materials as specified below free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, ice, or other deleterious and objectionable materials.

2.2.1 Sand Bedding

Clean, coarsely grained sand classified as Coarse Aggregate No. 9 in accordance with FDOT Standard Specifications.

2.2.2 Compacted Aggregate

Clean aggregate for use beneath building and equipment slabs classified as Coarse Aggregate No. 57 in accordance with FDOT Standard Specifications.

2.2.3 Stone Drainage

Clean stone drainage material for the extraction well vault classified as Coarse Aggregate No. 6 in accordance with FDOT Standard Specifications.

2.3 POLYETHYLENE MATERIAL

6 mil polyethylene sheeting.

2.4 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3-inch-minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

-Warning Tape Color Codes

Yellow:	Electric
Blue:	Water Systems
Green:	Vapor Systems

2.4.1 Warning Tape for Metallic Piping

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

2.4.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.5 CONCRETE

Contractor Mix Design as defined in Section 03302.

2.6 BITUMINOUS CONCRETE PAVING

Bituminous concrete paving to match thickness and properties of existing bituminous concrete surface and in compliance with FDOT regulations.

PART 3 - EXECUTION

3.1 PROTECTION

3.1.1 Protection Systems

It is the Contractor's responsibility to maintain safe sideslopes. Provide shoring, bracing, and sheeting where sloping is not possible either because of space restriction or stability of material excavated.

3.1.2 Site Drainage

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

3.2 CUTTING PAVEMENT, CURBS AND GUTTERS

Make cuts with neat, parallel, straight lines where indicated on the drawings. Dispose of waste pavement material per instructions from Contracting Officer's Representative.

3.3 GENERAL EXCAVATION AND TRENCHING

Keep excavations free from water while construction is in progress. Notify the Contracting Officer's Representative immediately in writing if it becomes necessary to remove rock or hard, unstable, or otherwise unsatisfactory material. Make trench sides as nearly vertical as practicable except where sloping of sides is allowed. Sides of trenches shall not be sloped from the bottom of the trench up to the elevation of the top of the pipe. Excavate ledge rock, boulders, and other unyielding

material to an overdepth at least 6 inches below the bottom of the pipe unless otherwise indicated or specified. Blasting will not be permitted. Use bedding material in 6-inch-maximum layers to refill overdepths to the proper grade. The excavations shall be cut to an overdepth of not less than 4 inches and refilled to required grade. Grade bottom of trenches accurately to provide uniform bearing and support for each section of pipe on bedding material as indicated or specified at every point along its entire length. Trench dimensions shall be as indicated on the trench detail.

3.4 BEDDING

Provide materials and depths as indicated for utility lines and utility line structures. Place bedding in 6-inch-maximum loose lifts. Provide uniform and continuous support for each section of structure except at bell holes or depressions necessary for making proper joints.

3.5 BACKFILLING

Backfill pipe trenches as indicated on the drawings. Where settlements greater than the tolerance allowed herein for grading occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation. Provide buried warning and identification tape installed in accordance with the manufacturer's recommendation.

3.6 COMPACTION OF PIPE AND CONDUIT BACKFILL

Compact backfill material surrounding pipes, to 90 percent of ASTM D 1557. If necessary, alter, change, or modify equipment or compaction methods to meet specified compaction requirements.

3.7 FINISH OPERATIONS

3.7.1 Disposition of Surplus Material

Surplus or other soil material not required or suitable for filling, backfilling, or grading shall be disposed per instructions from Contracting Officer's Representative.

3.7.2 Pavement Repair

Repair pavement, curbs, and gutters to match or be better than initial conditions. Do not repair pavement until trench or pit has been backfilled and compacted as specified herein.

--End of Section--

SECTION 02670

GROUNDWATER EXTRACTION, VAPOR EXTRACTION, AND AIR SPARGING WELLS

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)

ANSI/ASME B1.20.1 1983 Pipe Threads, General Purpose (Inch)

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 C 150 1989 Portland Cement

ASTM A 312/A312M Specification for Seamless and Welded Austenitic
Stainless Steel Pipe

ASTM A 403/A403M Specification for Wrought Austenitic Stainless
Steel Piping Fittings

ASTM C 494 1990 Chemical Admixtures for Concrete

ASTM A774/A774M Specification for As-Welded Wrought Austenitic
Stainless Steel Fittings for General Corrosive
Service at Low and Moderate Temperatures

ASTM A778-88 Specification for Welded, Unannealed Austenitic
Stainless Steel Tubular Products

ASTM D 1785 Specifications for Poly (Vinyl Chloride) (PVC)
Plastic Pipe, Schedules 40, 80, and 120

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C206 1988 Field Welding of Steel Water Pipe

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 570/9-75-001 Water Well Construction Practices

1.2 DESCRIPTION OF WORK

The Contractor shall provide necessary personnel, equipment, and materials required to install one groundwater extraction well, six vertical soil venting wells, 11 air sparging wells, eight groundwater piezometers/vapor observation probes, soil and water testing, and appurtenances. The Contractor shall obtain approval for the well locations from the Contracting Officer's Representative prior to drilling. Grain size

analyses from the groundwater extraction well boring shall be used to confirm the well screen slot size and sand pack. Scheduling of extraction well shall accommodate soil sampling and grain size analyses schedules such that the grain size analyses shall be available prior to final selection of the well screen.

1.3 SUBMITTALS

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

1.3.1 SD-04, Drawings

Submit drawings or catalog cuts showing groundwater extraction well components and details of well casings and well screens.

1.3.2 SD-12, Field Test Reports

A. Grain Size Analysis

Upon completion of the groundwater extraction well test boring, provide a recommendation for permanent wells and submit data obtained. Include in the recommendations the appropriate screen slot sizes, and sand or gravel size (if other than natural cave). Submit a drillers log drawn to scale with coarseness and fineness modules of each strata, time penetration log (time to drill through each formation), and sieve analysis to substantiate recommendations.

1.4 DELIVERY, STORAGE, AND HANDLING

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.

1.5 GENERAL REQUIREMENTS

Provide each system complete and ready for operation. Each system, including equipment, materials, installation, and workmanship shall be in accordance with EPA 570/9-75-001, 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's Representative.

PART 2 - PRODUCTS

2.1 EQUIPMENT, MATERIALS, TOOLS, CONTAINERS, ETC.

Equipment, materials and tools shall conform to the respective specifications and other requirements as specified herein.

2.1.1 Drill Rigs and Tools:

Drill rigs shall be specifically designed and manufactured for production well drilling. Drill rigs and tools that are not adequate, in the opinion of the Contracting Officer's Representative, will not be permitted.

2.1.2 Casings

- A. Extraction well: 6-inch schedule 40 stainless steel
- B. Vapor extraction wells: 4-inch schedule 40 PVC
- C. Air sparging wells: 2-inch schedule 40 PVC
- D. Piezometer: 1-inch and 2-inch schedule 40 PVC
- E. Vapor observation probe: 3/4-inch schedule 40 PVC

2.1.3 Well Screens

- A. Extraction well: 6-inch wire wound type 304 stainless steel

Velocity through openings shall not exceed 0.1 foot per second and shall be sized to retain 95% of the sand pack. Selection of screen opening size is subject to approval by the Contracting Officer's Representative. Provide joints of the same material as the screen, with either threaded rings or butt-type welding rings.
- B. Vapor extraction wells: 4-inch schedule 40 continuous 0.02" slot PVC
- C. Air sparging wells: 2-inch schedule 40 continuous 0.03" slot PVC
- D. Piezometer: 1-inch and 2-inch 0.01" PVC
- E. Vapor observation probe: 3/4-inch 0.02" PVC

2.1.4 Bentonite

Provide commercially available bentonite pellets designed for well sealing.

2.1.5 Cement Grout

Provide neat cement grout, Type I or II portland cement conforming to ASTM C 150, and water. The mixed grout shall contain no more than 7 gallons of water per bag (1.0 cubic foot or 94 pounds) of cement.

2.1.6 Water Level Meter

A hand held water level meter with an accuracy of ± 0.01 feet shall be provided.

2.1.7 Auxiliary Equipment

Provide discharge piping and storage to collect pumped water during development of each well.

2.1.8 Well Caps

The top of all wells shall be provided with a watertight well cap as indicated on the drawings.

2.1.9 Backfill Materials:

- A. Extraction well: Size sandpack based on results of the grain-size analysis.
- B. Soil venting wells: Well sand, Grade #0
- C. Air sparging wells: Well sand, Grade #1
- D. Piezometer: Well sand, Grade #00
- E. Vapor observation probe: Well sand, Grade #0

- F. Well sand shall be clean silica sand with a minimum of 99% SiO₂ by weight, shall have an acid solubility of 0.08 to 0.11%, and a specific gravity of 2.55 to 2.70. Sand shall conform to the following gradation requirements:

Grade #00 Well Sand	
Sieve No.	% Retained
30	0 - 1
35	26 - 30
40	27 - 33
50	34 - 41
70	2 - 4
Pan	0 - 1
Grade #0 Well Sand	
Sieve No.	% Retained
16	0 - 1
18	7 - 9
20	37 - 44
25	30 - 35
30	12 - 15
35	3 - 5
40	0.2 - 1
50	0 - 0.5
Grade #1 Well Sand	
Sieve No.	% Retained
12	1 - 2
14	27 - 31
16	24 - 28
18	22 - 22
20	13 - 16
25	2 - 4
30	0.5 - 2
35	0.2 - 1
40	0 - 0.5

PART 3 - EXECUTION

3.1 WELL LOGS

- A. During the progress of each boring, the Contractor shall keep a continuous and accurate log of the materials encountered and a complete record of the operation of installing casing. Soil cuttings observed at the cyclone discharge shall be described on a boring log in accordance with the Unified Soil Classification System.
- B. Records shall include at least the following data:
 - 1. Names of driller and inspector.
 - 2. Dates and times of beginning and completion of work.
 - 3. Identifying number and location of test boring.
 - 4. Diameter and description of casing.
 - 5. Total length of each size of casing.
 - 6. Length of casing extending below ground surface at the completion of the boring.
 - 7. Depth to top of each different material penetrated.
 - 8. Depth to water surface in borehole at completion and at end of each major work stoppage.
 - 9. Loss or gain of drilling water or mud.
 - 10. Sudden dropping of drill rods or other abnormal behavior.

3.2 WELL CONSTRUCTION

3.2.1 Groundwater Extraction Well Soil Characterization

- A. Relatively close to the proposed groundwater extraction well location, a test boring shall be advanced for visual characterization of soils and grain-size analysis. The boring will be advanced using a 4.25-inch hollow-stem auger. Split-spoon samples will be obtained at five-foot intervals, starting at five feet below grade, to clay (estimated at 15 feet bgs). Enough sample material must be collected from each split-spoon to perform grain-size analysis using ASTM Method D422.
- B. Assuming a 5-foot screen will be installed for the extraction well, up to two samples will be forwarded to the laboratory for grain-size analysis.

3.2.2 Vertical Soil Vapor Extraction Well Installation

Six vertical vapor extraction wells shall be installed at Building 780 as shown on the drawings. Each location will consist of a 4-inch vapor extraction well screened entirely in the vadose zone. Each vapor extraction well will be finished at the land surface with a flush, roadway box.

3.2.3 Air Sparging Well Installation

Eleven vertical air sparging wells shall be installed at Building 106 as shown on the drawings. Each location will consist of a 2-inch air sparging well screened entirely below the water table. Each air sparging well will be finished at the land surface with a flush, roadway box.

3.2.4 Piezometer/Vapor Observation Probe Installation

Eight piezometers/vapor monitoring points will be installed as shown on the drawings. Each location will consist of a 2-inch piezometer screened entirely below the groundwater table and a 3/4-inch vapor monitoring point screened in the vadose zone. A sand pack will be installed around the screened areas and a bentonite seal will be placed between the piezometer and vapor observation probe screened areas. Each piezometer/vapor observation probe will be finished at the land surface with a flush, roadway box.

3.2.5 Groundwater Extraction Well Installation

The extraction well shall be completed as shown on the Drawings. Sand filter pack shall be placed around the extraction well screen. Two feet above the top of the well screen provide a 2-foot bentonite chip seal. The bentonite chip seal shall be allowed to hydrate for a minimum of one hour prior to well completion. Cement/bentonite grout shall be placed from the bentonite chip seal to the bottom of the well vault. The remainder of the borehole shall be used for the installation of the concrete well vault.

3.2.5.1 Well Development

Well development will be conducted prior to manhole placement and piping of the well to the treatment facility. Well development will be conducted using surge and pump techniques until fine sediment is removed from the well and filter envelope. The groundwater extraction well will be considered developed when the following criteria are met:

- A. The well water is clean (i.e., contains no fine sediment particles).
- B. Specific conductance, pH, and temperature measurements vary by no more than 10 percent.
- C. Turbidity measurements are below 50 Nephelometric Turbidity Units (NTUs) or show no significant decrease.
- D. Further well development shows no increase in specific capacity for the well.

3.2.5.2 Manhole Placement and Piping Completion

Upon completion and development of the well, place the manhole and cover over the extraction well and complete the piping connection to the treatment plant.

3.3 PERMITS AND REGULATIONS

Permits and licenses of a temporary nature necessary for the execution of the Contractor's work shall be secured and paid for by the Contractor. The Contractor shall give all notice and comply with laws, ordinances, rules, and regulations bearing on the conduct of the work as described in the scope of work specified.

3.4 PROTECTION OF WORK, PUBLIC AND PROPERTY

- A. The means, methods, procedures, and techniques to be used by the Contractor are the responsibility of the Contractor, and shall be designed to meet the intent of the specifications.
- B. The Contractor shall continuously protect its work from damage and protect adjacent property as provided by law. The Contractor shall maintain lights and other safety devices as required. The Contractor shall promptly repair damages caused by its operations. When using internal combustion equipment, the Contractor shall have available at the work site emergency fire extinguishers or other approved fire fighting apparatus.

3.6 DISPOSAL OF CUTTINGS AND WELL DEVELOPMENT WATER

- A. Store cuttings and decontamination fluids in Federal DOT-approved containers for soils and fluids supplied by the Contractor and dispose at an off-site facility. Characterization and drum disposal will be the responsibility of the Contractor. Any drums stored at the site must be stored together and in a secure location. Contractor shall ensure transportation and disposal means and methods comply with state and Federal regulatory authorities. Contractor shall furnish the Contracting Officer's Representative with written documentation and records verifying receipt and the quantity received of each load at the disposal facility and verification of proper disposal.
- B. Collect well development water for disposal. Transport appropriately characterized and containerized well development water to an off-site disposal facility. Characterization and disposal will be the responsibility of the Contractor. Contractor shall ensure transportation and disposal means and methods comply with state and federal regulatory authorities. Contractor shall furnish Contracting Officer's Representative with written documentation and records verifying receipt and the quantity received of each load at the disposal facility and verification of proper disposal.

3.7 FIELD SAMPLING AND TESTING

3.7.1 Material Samples

During drilling of test hole, take samples of materials found in each soil stratum. Preserve samples in approved containers furnished by the Contractor. Label samples to show depth below ground surface and thickness of the stratum from which the samples were obtained. Describe water-bearing strata in detail as to whether material is loose or compact, the color of material, and if gravel, whether it is water worn or angular according to standard U.S. Soil Classification procedures. The presence of clay must be noted. Provide a sieve analysis for soil samples in each soil stratum.

3.7.2 Well Plumbness and Alignment Test

Upon completion of each permanent well, provide a well plumbness and alignment test using a plummet in accordance with Article 51 of the EPA 570/9-75-001. Perform the test on the entire depth of the well. The plumb or dummy shall move freely through the entire depth of the well. The well shall not vary from the vertical in excess of two-thirds of the smallest inside diameter of that part of the well being tested per

100 feet of depth. Correct defects in plumbness and alignment, and repeat test until the work is in compliance with contract requirements. Wells shall be surveyed vertically to the nearest 0.01 foot and horizontally to the nearest 1.0 foot.

3.8 ABANDONMENT AND COMPLETION OF BORINGS

- A. Borings shall not be abandoned before reaching the final depth authorized by the Contracting Officer's Representative except with the approval of the Contracting Officer's Representative. No payment will be made for borings abandoned because of an accident or negligence attributable to the Contractor.
- B. Borings abandoned before reaching required depth, because of an obstruction or other reasonable cause not permitting completion of the boring by standard procedures, shall be replaced by a supplementary boring adjacent to the original and carried to the required depth. Penetration to the completed depth of the original boring may be made by means other than specified above only with the Contracting Officer's Representative approval.
- C. Payment will be made for the approved portion of the abandoned hole plus the supplementary boring provided (1) the boring is abandoned for reasons acceptable to the Contracting Officer's Representative, (2) the Contractor presents soil samples and records as specified, plus a report on the obstruction which necessitated relocating the boring.
- D. Specific backfilling procedures required for the boring in which the well is to be installed are described in Part 3 - Execution. Abandoned well borings may be allowed to collapse and backfill with native sand.
- E. The Contracting Officer's Representative makes no representations as to the exact character of the subsurface materials through which the borings are to be advanced, or that any boring location given will be found free from obstruction.

3.10 CLEAN UP

Upon completion of the work, the Contractor shall remove its rigs and surplus and unused material and leave the site in a clean condition to the satisfaction of the Contracting Officer's Representative.

3.11 DECONTAMINATION

Drill rigs, pumps, and tools (casing and rods) shall be steam cleaned, and if necessary, scrubbed with tri-sodium phosphate (TSP) and potable water prior to setting up at the drilling location and prior to departure. More frequent decontamination of rigs may be required depending on actual exposure to contaminated conditions. Containerize decontamination water as described in the article entitled Disposal of Cuttings and Well Development Water in this Section. Alternative decontamination procedures and methods shall be approved by the prior to their use. Perform decontamination at a specially designated decontamination area as authorized by the Contracting Officer's Representative.

3.12 INSPECTION OF WORK

The Contracting Officer's Representative shall have access to the work, and the Contractor shall provide proper facilities for such access and for inspection. Drilling and well installation shall be in accordance with the requirements of these specifications and authorizations of the Contracting Officer's Representative and will be inspected by a representative of the Contracting Officer's Representative at its discretion.

--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 A 185	1990 (Rev. A) Steel Welded Wires Fabric, Plain, for Concrete Reinforcement
ASTM A 497	1990 (Rev. B) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615	1990 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	1990 Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	1990 Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C 33	1990 Concrete Aggregates
ASTM C 94	1990 Ready-Mixed Concrete
ASTM C 143	1990 (Rev. A) Slump of 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	1989 Blended Hydraulic Cements
ASTM C 618	1991 Fly Ash and Raw or Calcined Natural Pozzolan For Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 920	1987 Elastomeric Joint Sealants
ASTM C 989	1989 Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1107	1991 Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 1190	1974 (R 1980) Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 1850	1974 (R 1979) Concrete Joint Sealer, Cold-Application Type
ASTM D 4397	1984 (R 1989) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications

CORPS OF ENGINEERS (COE)

COE CRD-C-572	1974 Polyvinylchloride Waterstop
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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.

1.3 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until ready for concrete placement. Store concrete aggregates to prevent contamination or segregation. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Provide for accurate identification after bundles are broken and tags removed.

PART 2 - PRODUCTS

2.1 CONCRETE

2.1.1 Contractor Mix Design

ACI 301, except as modified herein. Unless indicated otherwise, concrete shall have a 28-day compressive strength of 3000 psi or 4,000 psi for the specific application shown on the Contract Drawings. Slump shall be between 3 and 5 inches in accordance with ASTM C 143. Provide ASTM C 33 aggregate Size No. 67.

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 50 percent by weight of the total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

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

2.2.1.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 120.

2.2.2 Water

Water shall be potable.

2.2.3 Aggregates

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

2.2.5.1 Reinforcing Bars

ASTM A 615 and ASTM A 617/A 617M, Grade 60; or ASTM A 616/A 616M, Grade 60.

2.2.5.2 Welded Wire Fabric

ASTM A 497 or ASTM A 185, 4 by 4, W2.9 by W2.9, unless otherwise indicated.

2.2.6 Materials for Curing Concrete

2.2.6.1 Impervious Sheeting

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

2.2.6.2 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B. Do not use where finished appearance is important. Only use where approved.

2.2.6.3 Liquid Chemical Sealer-Hardener Compound

Compound shall be magnesium fluosilicate which when mixed with water seals and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions.

2.2.7 Joint Sealant

2.2.7.1 Horizontal Surfaces (3 percent slope, maximum)

ASTM D 1190 or ASTM D 1850.

2.2.7.2 Vertical Surfaces (greater than 3 percent slope)

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

2.2.8 Polyvinylchloride Waterstops

COE CRD-C-572.

2.2.9 Nonshrink Grout

ASTM C 1107.

2.2.10 Contractors Option for Material Only

At the option of the Contractor, those applicable material sections of the State of Florida Department of Transportation Standard Specifications for Class II and Class III concrete shall govern in lieu of this specification for concrete. Do not change the selected option during the course of the work.

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.

3.2 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

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

3.2.1 Cover and Splicing

ACI 301, unless otherwise indicated.

3.2.2 Setting Miscellaneous Material

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

3.2.3 Construction Joints

ACI 301. Continue reinforcement across joints, unless otherwise indicated.

3.2.4 Contraction Joints

ACI 301. Provide contraction joints, either formed or saw cut or cut with a jointing tool to the indicated depth after the surface has been finished. Sawed joints shall be completed within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter. Fill joints with joint sealant.

3.3 MEASURING, MIXING, TRANSPORTING, AND PLACING CONCRETE

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

3.3.1 Cold Weather

ACI 306.1. 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.

3.3.2 Hot Weather

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

3.4 SURFACE FINISHES

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

3.4.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area 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.

3.4.2 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.

3.4.3 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 twice and finally hand trowel for exposed concrete floors.

3.5 MISCELLANEOUS CONSTRUCTION

3.5.1 Sumps

Place bottoms and walls monolithically or provide waterstops and keys.

3.6 CURING AND PROTECTION

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

3.6.1 Moist Curing

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

3.6.1.1 Ponding or Immersion

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

3.6.1.2 Fog Spraying or Sprinkling

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

3.6.1.3 Pervious Sheeting

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

3.6.2 Impervious-Sheeting Curing

Wet the entire exposed surface thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting.

3.6.3 Liquid Membrane-Forming Compound Curing

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Provide and maintain compound on the concrete surface throughout the curing period. Provide a continuously wetted, permeable cover as specified in paragraph entitled, "Hot Weather."

3.6.3.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats shall be 200 square feet maximum per gallon of undiluted compound, unless otherwise recommended by the manufacturer's written instructions. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Respray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.6.3.2 Protection of Treated Surfaces

Prohibit foot and vehicular traffic and other sources of abrasion for not less than 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.6.4 Liquid Chemical Sealer-Hardener Curing

Provide for interior floors that do not receive a floor covering, or in lieu of liquid membrane-forming compound curing for other surfaces. Apply sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied, as required by the joint sealant manufacturer.

3.6.5 Curing Periods

Allow 7 days.

3.7 SAMPLING AND TESTING

3.7.1 Sampling

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

3.7.2 Testing

3.7.2.1 Slump Tests

ASTM C 143. Take samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. For structural concrete (building and equipment pads), perform tests at commencement of concrete placement and for each batch (minimum) or every 10 cubic yards (maximum) of concrete. For other concrete, perform tests at a minimum once per day that concrete is poured.

3.7.2.2 Air Content

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

--End of Section--

SECTION 11318
EXTRACTION WELL PUMP

PART 1 - GENERAL

1.1 REFERENCES

Not Used.

1.2 SUBMITTALS

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

1.2.1 SD-02, Manufacturer's Catalog Data

- A. Pump Construction
- B. Materials
- C. Motor data
- D. Accessories
- E. Head/capacity curves

1.3 QUALITY CONTROL

1.3.1 Suggested Manufacturers:

- A. Goulds 5GS05422R
- B. Grundfos
- C. or others meeting the requirements of Part 2.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE PUMPS AND MOTORS

2.1.1 Provide and install extraction well pump EW-780 to deliver a minimum flow rate of 1.5 gpm @ a minimum TDH of 130 feet.

2.1.2 Capable of operating over the entire range of suction water levels possible (ranging between maximum static head and minimum operating head with drawdown).

2.1.3 Pump Control: See Division 16, "Electrical."

2.1.4 Motor: ½ HP, 240 v., 1 phase, 60 cycle, 3500 RPM.

2.1.5 Capable of continuous operation.

2.1.6 Pump Construction

- A. Provide materials resistant to corrosion by the water encountered in the well.
- B. Pump casing, bowls, shaft, and motor casing: Stainless steel.
- C. Diffusers and impellers: Stainless steel or FDA compliant glass filled polycarbonate.
- D. Check valve: Stainless steel.
- E. Provide adequate lightning and overload protection for the motor.
- F. Bearings and valve seats to be NBR.

G. Stainless steel inlet strainer.

2.2 ACCESSORIES

- 2.2.1 Cable: Supply suitable lengths of three wire cable between the motor and the top of the well casing.
- 2.2.2 Furnish a stainless steel wire safety cable to support the pump at the top of the well casing and to allow removal of the pump.
- 2.2.3 Discharge Tubing: Provide 1 inch flexible tubing. Tubing shall be compatible with the chemicals contained in the groundwater at the estimated influent concentrations shown in Section 11368 Subsection 2.1.1 and shall have a maximum working pressure at 70°F of 130 psi or greater.

PART 3 - EXECUTION

3.1 INSTALLATION

- 3.1.1 Install all equipment in strict accordance with the manufacturer's recommendations.
- 3.1.2 Before ordering any materials or doing any work, verify all measurements concerning equipment and layout.
- 3.1.3 No extra compensation will be allowed for differences between actual dimensions and those shown on the Contract Drawings.

3.2 TESTING

- 3.2.1 Test pump function and well level control systems for each well.
- 3.2.2 Demonstrate that each pump is capable of producing the required flow rate and head. Test the pumps over a variable flow range of 50% and 100% of desired capacity after an initial 8 hour shake down period and test the operation and accuracy of the liquid level controls over this range of pump capacity.
- 3.2.3 Perform tests when the groundwater treatment plant is functional.

--End of Section--

SECTION 11345
VAPOR PHASE CARBON

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D-2854	Test Method for Apparent Density of Activated Carbon
ASTM D-2862	Test Method for Particle Size Distribution of Granular Activated Carbon
ASTM D-2866	Test Method for Ash Content (Total) of Activated Carbon
ASTM D-2867	Test Method for Moisture in Activated Carbon
ASTM D-3467	Test Method for Carbon Tetrachloride Activity of Activated Carbon
ASTM D-3802	Test Method for Ball-Pan Hardness of Activated Carbon
ASTM D-4607	Test Method for Iodine Number of Activated Carbon

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA DCS	1985 HVAC Duct Construction Standards - Metal and Flexible
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1.2 SUBMITTALS

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

1.2.1 SD-02, Manufacturer's Catalog Data

- A. Vapor phase carbon canisters
- B. Flow/Head loss curve
- C. Adsorption capacity for VOCs in waste stream.

1.3 GUARANTEES

- 1.3.1 Provide Manufacturer's guarantee on canisters against leakage due to materials and fabrication from the date of acceptance by the Government.

1.4 QUALITY ASSURANCE

1.4.1 Suggested Manufacturers

The system was designed based upon 5,000-pound GPC 48 canisters as manufactured by CarbonAir. Other manufacturer's systems may be acceptable if they meet the requirements of Part 2.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 2.1.1 The vapor phase carbon system shall be designed to reduce total VOC concentrations in the air exiting the Building 106 SVE blower to meet the treatment criteria specified in Section 01680, "Treatment Facility Start-up, Operation, and Maintenance." The estimated influent concentrations are as follows:

Trichloroethene	380 µg/L
Vinyl Chloride	0.5 µg/L
1,2-Dichloroethene	57 µg/L
Tetrachloroethene	690 µg/L

2.2 MATERIALS AND DESIGN

2.2.1 Carbon Adsorption Units

- A. Canisters to contain 5,000 pounds of activated carbon.
- B. Canisters to be provided with inlet connection and distributor, outlet connection for the purified air stream and a corrosion-resistant septum to distribute air across bed.
- C. Capable of processing 300 scfm at 55°C with a maximum allowable pressure drop of 1.5 inches of water per canister.
- D. Provide a minimum exhaust stack height of 10 feet above ground surface with a hood to protect from rain.

2.2.2 Activated Carbon

- A. Particle Size: 4 x 10 US mesh (ASTM D-2862)
- B. Minimum Iodine Number: 900 (ASTM D-4607)
- C. Minimum Carbon Tetrachloride Activity: 45% by weight (ASTM D-2867)
- D. Maximum Ash Content: 8% (ASTM D-2866)
- E. Maximum Moisture (as packed): 5% (ASTM D-2867)
- F. Minimum Hardness Number: 90 (ASTM D-3802)
- G. Minimum Apparent Density (bulk density, dense packing): 0.45 g/cc (ASTM D-2854)

2.2.3 Flexible Ducts

- A. UL 181, Class I, UL listed, SMACNA DCS, and additional requirements herein specified. Provide to connect between rigid pipe and carbon adsorber units. There shall be no erosion, delamination, loose fibers, or odors from the ducts

into the air stream. Minimum rating pressured shall be 10 inches water positive and 1/2 inch negative, up to 1,000 fpm. Flexible ducts shall be maximum 10 feet in length. Minimum bend radius shall be twice the duct diameter or smaller.

- B. Interlocking spiral or helically corrugated type constructed of aluminum.
- C. Make airtight slip joints, seal with pressure-sensitive vapor-seal adhesive tape or duct sealer, and secure with sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- 3.1.1 Install vapor phase carbon units in accordance with the Drawings and manufacturer's recommendations.
- 3.1.2 Configuration of canisters: 2 in series.
- 3.1.3 Arrange with carbon manufacturer regarding the future return of canisters containing spent carbon.
- 3.1.4 Conform to local and state codes.
- 3.1.5 Install all pipe, fittings, and valves as required for a complete installation.

--End of Section--

SECTION 11346

THERMAL OXIDATION TREATMENT SYSTEM

PART 1 - GENERAL

1.1 REFERENCES

NATIONAL FIRE PROTECTION ASSOCIATION

NFPA 58

Standard for the Storage and Handling of
Liquified Petroleum Gases

1.2 SUBMITTALS

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

1.2.1 SD-02 Manufacturer's Catalog Data

- A. Thermal oxidation unit.
- B. Propane storage tank.

1.3 QUALITY CONTROL

1.3.1 Suggested Manufacturers

- A. Environmental Instruments, Inc., Concord, California.
- B. or others meeting the requirements of Part 2.

PART 2 - PRODUCTS

2.1 OXIDATION UNIT

2.1.1 General

- A. Provide a trailer or skid mounted unit.
- B. Provide National Electric Code Class I, Group D, Division II enclosure for control systems.
- C. Provide automatic dilution of gas stream with ambient air as necessary to prevent explosive gas compositions in the oxidation chamber.
- D. Provide a minimum exhaust stack height of 10 feet above ground surface with a hood to protect from rain.
- E. Provide a unit that meets the requirements for vaporizing burners in NFPA 58.

2.1.2 Performance

- A. Provide a unit capable of achieving a minimum of 99% destruction efficiency of chlorinated VOCs with initial anticipated influent concentrations of:

Vinyl Chloride	3.3 $\mu\text{g/L}$
1,1-Dichloroethene	1,100 $\mu\text{g/L}$
1,1-Dichloroethane	1,200 $\mu\text{g/L}$
Trichloroethane	14,000 $\mu\text{g/L}$

Tetrachloroethene	19 µg/L
Trichloroethene	180 µg/L
Toluene	0.54 µg/L
Ethylbenzene	0.05 µg/L
Naphthalene	0.008 µg/L

- B. Provide system controls for safe unattended operation.
- C. Provide a minimum combustion temperature of 1,400°F.
- D. Capable of adjusting to rapid changes in flow rate.

2.1.3 Capacity

- A. Provide a unit able to treat a maximum of 300 cfm of influent gas at 75 to 110°F with an influent pressure of 15 inches of water.
- B. Provide a minimum residence time of 0.5 seconds in the oxidation chamber.

2.1.4 Materials of Construction

- A. Shell: Carbon Steel
- B. Insulation: Ceramic Fiber

2.1.5 Accessories

- A. Furnish with all accessories required for complete installation including but not limited to: prewired, shop-tested control panel containing all controls and alarms for start-up, operation, and shutdown.
- B. Provide continuous Lower Explosive Limit (LEL) monitoring.
- C. Provide continuous data recording of oxidizer temperature, process gas flow rate (SCFM), and process gas percent LEL.
- D. Provide controls to maintain the minimum combustion temperature.

2.1.6 Alarms and Shutdown

- A. Provide alarms for the following conditions:
 - 1. Low oxidizer temperature.
 - 2. High VOCs concentration.
 - 3. Low oxygen concentration.
 - 4. High supplemental fuel pressure.
 - 5. Low supplemental fuel pressure.
 - 6. Low process gas feed pressure.
- B. Provide automatic system shutdown for the following conditions:
 - 1. High oxidizer temperature.
 - 2. Flame out condition.
 - 3. Low oxidizer temperature.
 - 4. Low oxygen concentration.
- C. Provide a signal to the treatment plant control panel for any automatic shut-down triggered at the local thermal oxidizer control panel.

2.1.7 Instrumentation and Controls

- A. Class I, Group D, Division II control panel with main disconnect switch, alarm interlocks, panel light, UL listed. Control panel shall be powered by 208 v, 3 phase, 20 amp service.

2.2 PROPANE SUPPLY

Provide a supply of propane to the thermal oxidizer that meets the pressure requirements of the oxidizer. Provide a supply that allows a minimum of 3 days of operation without refuelling accounting for possible significant decreases in inlet concentration with time. The maximum storage tank size shall be 2,000 gallons. The supply, storage, and management of propane shall conform with NFPA 58 and all local, State and NAS Jacksonville requirements with the approval of the Station's fire department. Requirements for the storage tank shall include but not be limited to: placement of physical barriers around the tank; securing the tank to prevent tipover; painting the tank white with red lettering; marking the tank "Flammable", "No Smoking or Open Flames Within 100 Feet."

PART 3 - EXECUTION

3.1 FACTORY TESTING

Test all wiring and controls before shipping.

3.2 INSTALLATION

3.2.1 The contractor shall install all equipment in strict accordance with the manufacturer's recommendations.

3.2.2 Before ordering any materials or doing any work, verify all measurements concerning equipment layout. No extra compensation will be allowed for differences between actual dimensions and those on the Contract Drawings.

3.3 SERVICE

If necessary, the equipment manufacturer shall furnish competent personnel for a period not to exceed five (5) days to check the completed installation and instruct the Owner's personnel in its use.

--End of Section--

2.1.2 Capacity

- A. Pump shall be capable of pumping the range of .08 to 5 gallons per day at 150 psi.
- B. Equip with an diaphragm-type anti-siphon/pressure relief valve, designed to stop pump if pressure exceeds pump rating by 35%.
- C. Capable of capacity adjustment while operating.
- D. Maximum speed of 60 strokes per minute.
- E. Accuracy: \pm 1 percent of rated capacity.

2.1.3 Pump Drive

- A. Totally enclosed pump drive with no exposed moving parts.
- B. Solid state electronic pulser shall be fully encapsulated.
- C. House electronics in chemical resistant enclosure.
- D. Furnish with drives suitable for operation at 120 volts, 60 hertz, 1 phase.
- E. Feed capacity selected by stroke length and stroke rate.

2.1.5 Materials of Construction

- A. Metering pump housing: chemically resistant glass fiber reinforced thermoplastic.
- B. Exposed fasteners: stainless steel.
- C. Head fittings/ball checks: polypropylene/ceramic
- D. Diaphragm: Teflon
- E. Seal Rings: Teflon

2.1.6 Accessories

- A. Furnish with all accessories required for a complete installation.
- B. Provide 16 ft of tubing complete with compression connections.
- C. Provide a foot valve with integral one piece strainer for the suction line.
- D. Provide floor or wall mounted stand, either integral with the pump and motor or separate, suitable for mounting on a concrete pad or wall where shown on the Drawings.
- E. Supply two (2) spare diaphragms, "O" rings, and ball check valves.

2.2 SEQUESTERING AGENT FEED TANK

- A. Provide 50 gallon polyethylene tank and cover fitted for pump and accessories.
- B. Provide liquid level switch assembly suitable for mounting in the 50 gallon feed tank.
- C. Provide means for manual mixing of sequestering agent solution.

2.3 SEQUESTERING AGENT

- A. Provide a sequestering agent to prevent iron and manganese precipitation in the influent pipe, treatment system, or effluent pipe. The sequestering agent shall be a liquid blend of ortho and polyphosphates and stable at temperatures up to 100°F and for storage up to 6 months. The agent shall be composed of items Generally Recognized As Safe (GRAS) under the provisions of 21 CFR 182 and be certified to meet the requirements of ANSI/NSF 60. Iron has been detected at concentrations as high as 92 mg/L in groundwater.

2.4 TRANSFER PUMP

- A. Provide a manual drum pump for transfer of sequestering agent from 55-gallon drums to the sequestering agent feed tank.

PART 3 - EXECUTION

3.1 INSPECTION

Verify that equipment and appurtenances are complete and not damaged.

3.2 INSTALLATION

- 3.2.1 Install chemical metering pumps and appurtenances according to Drawings and following installation manuals furnished by manufacturer.
- 3.2.2 Make all electrical and control connections in accordance with Drawings, installation manual, and observe all electrical codes and practices.

--End of Section--

SECTION 11368
TRAY AIR STRIPPER

PART 1 - GENERAL

1.1 REFERENCES

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 433 Guidelines and Standards for Metal Finishing

1.2 SUBMITTALS

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

1.2.1 SD-02 Manufacturer's Catalog Data

- A. Tray aerator
- B. Blower
- C. Blower head/capacity curves
- D. Blower motor data
- E. Aerator instrumentation and controls

1.2.2 SD-04 Drawings

- A. Dimensions for tray aerator and accessories
- B. Position and size of each nozzle or connection

1.3 GUARANTEES

- 1.3.1 Provide Manufacturer's guarantee on tank against leakage due to materials and fabrication for a twelve (12) month period from the date of acceptance by Owner.

1.4 QUALITY ASSURANCE

1.4.1 Suggested Manufacturers

The system was designed based upon Shallow Tray Model 1321 as manufactured by North East Environmental Products, Inc. Other manufacturer's systems may be acceptable if they meet the requirements of Part 2.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 2.1.1 The air stripper system shall be designed to reduce expected maximum contaminant concentration in the influent wastewater as follows, when operating at the design flow rate of 1.5 gpm with a water temperature of 56°F.

Contaminant (2)	Estimated Influent Concentration ($\mu\text{g/L}$)	Maximum Effluent Concentration ($\mu\text{g/L}$)
Vinyl Chloride	8,900	2
Chloroethane	6,400	2
Tetrachloroethene	14	8
Trichloroethene	11,000	80
1,1-Dichloroethane	8,300	2
1,2-Dichloroethane	1,800	4
1,1-Dichloroethene	23,000	3
1,2-Dichloroethene	66,000	2
TOTAL TOXIC ORGANICS (TTO) (1)	129,000	2,130

Note: (1) As defined in 40 CFR 433.

(2) Table includes only those specific chemicals where the estimated influent concentration exceeds the maximum effluent concentration.

2.1.2 The stripper shall provide off-gas at a pressure necessary to meet the minimum influent pressure requirements of the thermal oxidizer as specified in Section 11346.

2.2 MATERIALS AND DESIGN

2.2.1 General

- A. Provide forced draft, positive pressure, counter current air stripping through baffled aeration trays to remove volatile organic compounds from water.
- B. Influent water will be sprayed into the inlet chamber through a coarse mist spray nozzle. The water will flow over a distribution weir and along the baffled aeration tray. Air will be blown up through holes in the aeration tray, to form a froth of bubbles and generate a large transfer surface area where the contaminants are volatilized.
- C. Provide inlet and outlet fittings to allow contaminated water in, clean water out, clean air in, and off-gas out to treatment systems.
- D. Integral water collection sump / air plenum constructed of 304L stainless steel with discharge coupling.
- E. Provide a minimum of two modular, interlocking, gasketed aeration trays of 304L stainless steel designed for vertical stacking.
- F. Tray cleanout ports will be provided which allow cleaning of the stripper without the need for complete disassembly.
- G. Stainless steel Demister and air discharge coupling on top aeration tray.
- H. Internal water distribution piping and nozzles.

- I. Inlet screen and damper, air pressure gauge, spray nozzle, sight tube, gaskets, stainless steel latches.
- J. System shall be resistant to corrosion and chemical degradation by contaminants of concern.
- K. Provide air stripping system completely shop-assembled and skid-mounted and factory tested. Skid shall contain all equipment, piping, valves, piping specialties, instrumentation, and controls, pre-piped, pre-wired, and tested on a structural steel frame ready for setting on skid foundation.
- L. Design and arrangement of skid shall include sufficient space for easy access to equipment, valves, instrumentation, and controls for routine operation and maintenance activities, including easy disassembly, removal and replacement.

2.2.2 Blowers

- A. Blower 7.5 HP, 150 cfm @ 26" wc, 3 phase, 460V. Air to be introduced into collection tank/air plenum.
- B. Motor in accordance with National Electric Code Class I, Group D, Division II
- C. Maximum blower shaft speed to be 1800 RPM.
- D. Provide blower with sound absorbing enclosure, if required to reduce noise level to below 84 dB at one meter distance.
- E. Provide an intake silencer.

2.2.3 Accessories

- A. Inlet and discharge line sampling ports with isolation valves.
- B. Interconnecting piping to be Schedule 40 Galvanized Steel.
- C. Influent water flow indicator with totalizer.
- D. Stripper groundwater influent temperature and pressure gauges.
- E. Viewport set with lexan windows.
- F. Washer wand with high pressure spray nozzle.

2.2.4 Instrumentation and Controls

- A. Class I, Group D, Division II control panel with pump level controls and main disconnect switch with alarm interlocks, panel light, UL listed. Blower motor starter to be supplied by others.
- B. High and low air pressure alarm switch on the blower.
- C. High water level alarm switch.
- D. High differential pressure switch within the tray stripper unit.
- E. Panel to be purged in accordance with National Electric Code for Class I, Group D, Division II.
- F. Common trouble signal back to main PLC.

PART 3 - EXECUTION

3.1 INSTALLATION

- 3.1.1 Install air stripper system in accordance with the Drawings and manufacturer's recommendations.
- 3.1.2 Conform to local and state codes.

3.1.3 Install all pipe, fittings, and valves as required for a complete installation.

--End of Section--

SECTION 11372

AIR BLOWERS AND ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

Furnish and install one positive displacement and two regenerative blowers. The positive displacement blower shall be a belt driven air blower complete with electric motor and all accessories called for on Drawings or otherwise necessary for proper operation. The regenerative blowers shall be direct driven air blowers complete with electric motors and include all accessories called for on Drawings or otherwise necessary for proper operation.

1.2 SUGGESTED MANUFACTURERS

- A. Positive Displacement Blowers
 - 1. Gardner-Denver Co., Quincy, IL
 - 2. Roots Connersville, Div. of Dresser Industries, Connersville, Indiana
 - 3. Tuthill Corporation, M-D Pneumatics Division, Springfield, Missouri
 - 4. or other manufacturer that meets the requirements of Part 2.
- B. Regenerative Blowers
 - 1. EG&G Rotron, Saugerties, NY
 - 2. or other manufacturer that meets the requirements of Part 2.

1.3 SUBMITTALS

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

1.3.1 SD-02, Manufacturer's Catalog Data

- A. Blowers
- B. Filters
- C. Silencers
- D. Moisture Separator's
- E. Pressure/Vacuum Relief Valves

PART 2 - PRODUCTS

2.1 PERFORMANCE AND REQUIREMENTS:

- A. Building 106 positive displacement air sparging blower capable of operating continuously under the following design conditions:
 - Number of units 1
 - Inlet air temperature 70°F
 - Maximum horsepower 7.5 HP
 - Maximum blower speed 1800 RPM
 - Design Operating Point 100 CFM @ 130 in. water differential
 - Motor enclosure TEFC
- B. Building 106 regenerative SVE blower capable of operating continuously under the following design conditions:

Number of units	1
Inlet air temperature	70°F
Maximum horsepower	10 HP
Maximum blower speed	1800 RPM
Design Operating Point	300 CFM @ 45 in. water differential
Motor enclosure	TEFC
Maximum Allowable temperature increase	85°F

- C. Building 780 regenerative SVE blower capable of operating continuously under the following design conditions:

Number of units	1
Inlet air temperature	70°F
Maximum horsepower	3.0 HP
Maximum blower speed	1800 RPM
Design Operating Point	120 CFM @ 40 in. water differential
Motor enclosure	Class I, Group D, Division II

2.2 MATERIALS:

2.2.1 Building 106 Positive Displacement Blower

- A. Rotary lobe positive displacement type.
- B. Three lobe rotor.
- C. Suitable for heavy duty, continuous industrial service.
- D. Tuthill/M-D Blower Model 4006-47 or other manufacturer that meets the performance and materials requirements.

2.2.2 Building 106 Positive Displacement Blower Motor

- A. Single speed - 1800 rpm.
- B. 7.5 HP, 460 V, 3 ph, 60 hz.
- C. TEFC design with 1.15 service factor.
- D. Suitable for outdoor operation at ambient temperatures from 0° to 40°C.
- E. Induction type.

2.2.3 Building 106 Positive Displacement Blower Drive:

- A. V-belt.
- B. Notched belt, multiple groove type, oil and heat resistant; minimum service factor of 1.4.
- C. Furnish with OSHA approved drive guards.

2.2.4 Building 106 Positive Displacement Blower and Motor Mounting:

- A. Equip each with common steel bedplate, anchor bolts, and sleeves for attachment to concrete pad.
- B. Mount motor on adjustable baseplate to facilitate belt and sheave removal.

2.2.5 Building 106 Positive Displacement Blower Accessories:

- A. Inlet Filter:
 - 1. Dry felt element, replaceable.
 - 2. Rated to filter 98 percent of 10 micron and larger particles.

3. Provide spare filter element for each blower.
 4. Covered to provide adequate operation during heavy rain.
 5. Universal CCF Series air filter or other manufacturer that meets the requirements.
- B. Inlet Silencer:
1. Heavy duty, welded carbon steel.
 2. Baffled interior.
 3. Minimum noise attenuation: 20 dB.
 4. Chamber type.
 5. Universal URB Series discharge silencer or other manufacturer that meets the requirements.
- C. Discharge Silencer:
1. Heavy duty, welded carbon steel.
 2. Baffled interior.
 3. Minimum noise attenuation: 20 dB.
 4. Chamber type.
 5. Universal URB Series discharge silencer or other manufacturer that meets the requirements.
- D. Flexible Connectors:
1. Flanged, bulb type for each blower on suction and discharge.
 2. Same as line size.
- E. Pressure Relief Valve:
1. Provide one (1) for each blower.
 2. Spring-loaded type.
 3. Set at $\frac{1}{2}$ psig above maximum working pressure.
 4. Capable of discharging total blower output with 10 percent pressure accumulation.
 5. MGD Pneumatics Pressure Relief Valve 1351-6.4 or other manufacturer that meets the requirements.
- F. Spring-loaded vibration pad isolators.
- G. Silencer for vent to atmosphere.
1. Heavy duty, welded carbon steel.
 2. Minimum noise attenuation: 20 dB

2.2.6 Building 106 SVE Regenerative Blower

- A. Provide regenerative type blower, Rotron Model DR8BB72W, or other manufacturer that meets the requirements.
- B. Blower motor shall be 10 HP, 460 v., 3 ph., 60 cycle TEFC, with a minimum service factor of 1.15.
- C. Blower housing, impeller and manifold shall be aluminum alloy.
- D. Suitable for heavy duty, continuous industrial service.
- E. Suitable for outdoor operation at ambient temperature of 0° to 40°C.

2.2.7 Building 780 SVE Regenerative Blower

- A. Provide regenerative type blower, Rotron Model EN606m721, or other manufacturer that meets the requirements.
- B. Blower motor shall be 3.0 HP, 460 v., 3 ph., 60 cycle, with a minimum service factor of 1.0. Blower motor in accordance with National Electric Code Class 1, Group D, Division 2.
- C. Blower housing, impeller and manifold shall be aluminum alloy.
- D. Suitable for heavy duty, continuous industrial service.
- E. Suitable for indoor operation at ambient temperature of 0° to 40°C.

2.2.8 Regenerative Blower Accessories

- A. Moisture Separator:
 - 1. Minimum water removal efficiency: 95%.
 - 2. Rotron MS350B (Building 106) and Rotron MS200D (Building 780) or other manufacturer that meets the requirements.
- B. Inlet Filter:
 - 1. Dry polyester element, replaceable.
 - 2. Rated to filter 97 percent of 10 micron and larger particles.
 - 3. Provide spare filter element for each blower.
 - 4. Rotron 515256 (Building 106) and Rotron 515254 (Building 780) or other manufacturer that meets the requirements.
- C. Discharge Silencer:
 - 1. Heavy duty, welded carbon steel.
 - 2. Minimum noise attenuation: 20 dB.
 - 3. Rotron 515185 (Building 106) and Rotron 522948 (Building 780) or other manufacturer that meets the requirements.
- D. Flexible Connectors:
 - 1. Flanged, bulb type for each blower on suction and discharge.
 - 2. Same as line size.
- E. Spring-loaded vibration pad isolators.
- F. 1. Vacuum relief valve
 - a. Spring-loaded type.
 - b. Set at $\frac{1}{2}$ inch mercury below maximum working vacuum.
 - c. Capable of supplying total blower input with 10 percent vacuum accumulation.
- G. Dilution Air Silencers
 - 1. Heavy duty, welded carbon steel.
 - 2. Minimum noise attenuation 20 dB.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that structure and equipment are compatible.
- B. Inspect blowers and appurtenances, verify equipment is complete and not damaged.

3.2 INSTALLATION

- A. Install blowers and appurtenances according to Contract Drawings and in accordance with installation manual furnished by manufacturer.
- B. Connect anchor bolts.
- C. Grout under pedestals.
- D. Make all electrical and control connections in accordance with Contract Drawings, installation manual, and observing all electrical codes and practices.

3.3 SERVICE

If necessary, the equipment manufacturer shall furnish the service of a factory representative to advise the Contractor during installation, inspect and adjust the final installation and instruct in the operation and maintenance of the equipment.

3.4 FIELD TEST

- A. After installation the equipment will be given a field test to verify that there are no mechanical defects and that the blowers operate in accordance with Contract Specification and Drawings for all modes of operations and conditions.
- B. Field test shall be made by the Contractor in the presence of the Engineer and manufacturer's representative.

--End of Section--

SECTION 11393

BAG FILTERS

PART 1 - GENERAL

1.1 REFERENCES

Not Used.

1.2 SUBMITTALS

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

1.2.1 SD-02 Manufacturer's Catalog Data

A. Bag Filters

PART 2 - PRODUCTS

2.1 BAG FILTER

2.1.1 Filters shall consist of a bag filter in one stainless steel housing, such as Rosedale Bag Filter Model 4-12-1P-2-150-D-S-T-N-HWM or other manufacturer that meets the requirements.

2.1.2 Sized for flow rate of 2 gpm.

2.1.3 One-inch diameter threaded pipe fittings.

2.1.4 Minimum 1.0 square feet of filter area.

2.1.5 Filter bag: Nylon with SS plated ring. 25 microns with heavy wire mesh filter bag basket.

2.1.6 Drain valve: 1/2" NPT.

2.1.7 Housing: 304 SS with Teflon cover gasket, 150 psi, 140°F maximum.

2.1.8 Clamp cover, side inlet and outlet.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Install all equipment in strict accordance with the manufacturer's recommendations.

3.1.2 Before ordering any materials or doing any work, verify all measurements concerning equipment and layout.

3.1.3 No extra compensation will be allowed for differences between actual dimensions and those shown on the Contract Drawings.

3.1.4 Conform to local and state codes.

3.1.5 Install all pipe, fittings, and valves as required for a complete installation.

3.2 TESTING

3.2.1 Test products to be sure they operate properly.

--End of Section--

SECTION 13121

PRE-ENGINEERED 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 IRON AND STEEL INSTITUTE (AISI)

AISI SG-671 1989 Design of Cold-Formed Steel Structural Members

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 525 1987 General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

ASTM D 659 1986 Method For Evaluating Degree of Chalking of Exterior Paints

ASTM D 2244 1989 Method for Calculating Color Differences from Instrumentally Measured Color Coordinates

ASTM E 84 1991 (Rev. A) Surface Burning Characteristics of Building Materials

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) BUILDERS HARDWARE MANUFACTURERS ASSOCIATION, INC. (BHMA)

ANSI/BHMA A156.1 1988 Butts and Hinges (BHMA 101)

ANSI/BHMA A156.2 1989 Bored and Preassembled Locks and Latches (BHMA 601)

ANSI/BHMA A156.13 1987 Mortise Locks and Latches (BHMA 621)

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA LRMBSM 1986 Low Rise Metal Building Systems Manual

SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL (SBCCI) INC.

SBC - 1994 Standard Building Code - 1994

STEEL DOOR INSTITUTE (SDI)

SDI 100 1985 Standard Steel Door and Frames

1.2 DESIGN REQUIREMENTS

MBMA LRMBSM, and AISI SG-671, except as specified otherwise herein. Design loads shall be as indicated and as specified herein. Wind loads shall be as indicated and as specified below.

1.2.1 Roof Dead and Live Loads

- A. Roof Equipment Loading: 5 psf (min)
- B. Roof Live Loading: 20 psf (min)

1.2.2 Wind Loads (Based on SBC)

- A. Basic Wind Speed: 100 mph
- B. Use Factor: I of 0.9

1.2.3 Blast Loads

- A. 150 psf of wind or blast load from either side of roof or walls.

1.2.4 Combination of Loads

- A. The combining of loads for design purposes shall be as prescribed by the MBMA LRMBSM and SBC.
- B. All allowable stresses for working stress design may be increased one-third when considering wind or earthquake forces either acting alone or when combined with vertical loads. An increase will not be allowed for vertical loads acting alone.

1.2.5 Deflection

The maximum deflection due to live load in roof panels shall not exceed 1/180th of their respective spans. The maximum deflection due to wind on wall panels shall be limited to 1/120th of their respective spans except that when interior finishes are used the maximum allowable deflection shall be limited to 1/180th of their respective spans.

1.2.6 Description of Building

The building covered by this specification shall be of self-framing interlocking panel design utilizing the roof and wall panels as the primary structural supporting members. Roof slope shall be a minimum of 1/2 inches per foot rise to a maximum of 12 inches per foot. The building shall be supplied with all necessary components including foundation anchors and accessories specified to form a complete building system.

1.2.7 Fasteners

Design fastening system to withstand the design loads specified.

1.2.8 Louvers

Design louvers to provide up to 150 cfm of air for the air stripper in addition to the general building requirements.

1.3 SUBMITTALS

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

1.3.1 SD-02, Manufacturer's Catalog Data

A. Pre-engineered metal building materials,

Submit sufficient data indicating conformance to specified requirements on materials provided under this section.

1.3.2 SD-03, Manufacturer's Standard Color Charts

A. Factory-finish,

Coordinate the selection of building finish color with the Contracting Officer's Representative.

1.3.3 SD-04, Drawings

A. Pre-engineered building,

Submit as necessary to erect the building and install components.

1.3.4 SD-05, Design Data,

Submit design calculations for the entire pre-engineered building prepared and stamped by a professional engineer registered in the State of Florida. Also submit for components requested, and stamp with the seal of a professional engineer.

1.4 GUARANTEES

1.4.1 Durability of the roof panels due to rupture, structural failure, or perforation shall be guaranteed for a period of 20 years by the building manufacturer. A specimen copy of the document must accompany the bid, clearly stating the conditions under which the guarantee is valid.

1.4.2 The exterior color coating for the wall panels shall be guaranteed by the building manufacturer for ten (10) years against blistering, peeling, cracking, flaking, checking, and chipping. Excessive color change and caulking shall be guaranteed for ten (10) years. Color change should not exceed 5 NBS units (per ASTM D-2244) and chalking shall not be less than a rating of 8 per ASTM D-659. A specimen copy of the guarantee must accompany the bid, clearly stating the conditions under which the guarantee is valid.

1.5 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.

PART 2 - PRODUCTS

2.1 MATERIALS

MBMA LRMBMSM except as specified otherwise herein. Design roof and wall 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 and Wall Panels (Wind Bracing)	14 Manufacturer's Standard (MFG STD) gauge
Roof and Wall Panels	
Steel	24 MFG STD gauge
Gable and Eave Trim, Fascia Closure Strips, Rake Flashings, Copings, Liner Panels, and Interior Corner Trim	
Steel	26 MFG STD gauge

2.1.2 Steel Framework

Structural members having cross sectional areas other than those indicated and connections that differ from the connections indicated may be used, provided they conform to design requirements, and provided drawings indicating such changes are submitted and approved.

2.1.3 Roof and Wall Panels

2.1.3.1 Roof Panel

- A. Roof panels shall be supplied in a single continuous length from eave line to ridge line and shall be designed to tightly interlock so that no fasteners are required at intermediate points along the panel side laps.
- B. Roof panels shall be a maximum of 16" wide with a flat surface between the interlocking side ribs. The interlocking ribs shall be a minimum 3" high, and shall be turned upward. All roof panels shall be factory punched for connection at the eave line of the building.
- C. Roof panels shall be minimum 24 gauge galvanized steel conforming to ASTM A 525 specifications with the galvanized coating conforming to G90 (1 1/4 oz.) standards. Minimum yield strength of panel materials shall be 50,000 psi.
- D. All exterior surfaces of the galvanized steel roof panels, shall receive two factory, roller applied, paint coats having a combined coating thickness of .8 to 1.2 mils of dry film thickness. The finish coat for roof panels shall be a white siliconized polyester formulation.
- E. Roof insulation shall consist of 48" wide x 3-inch thick fiberglass faced on its exposed side with a metalized polypropylene scrimkraft facing. Minimum R-value shall be 10.4.

2.1.3.2 Wall Panel

- A. Exterior wall panels of the building shall be a single continuous length from the base channel to the roof line of the building at the sidewalls and end walls of the building except where interrupted by wall openings.
- B. Wall panels shall contain 3" minimum deep inward turned interlocking side ribs located 16" on center which shall be the vertical structural members for the building.
- C. Wall panels shall be fastened internally to the base channel and eave cap of the building with electrogalvanized chain bolts placed within the panel interlock. The fastening system shall be designed so that no wall fasteners are exposed on the exterior surfaces of the walls.
- D. Wall panels shall be minimum 24 gauge galvanized steel conforming to ASTM A 525 Specifications with the galvanized coating conforming G90 (1 1/4 oz.) standards. Minimum yield strength of panel material shall be 40,000 psi.
- E. The bases of the wall panels shall be closed off with polystyrene closures conforming to the panel profile.
- F. All exterior surfaces of the galvanized steel wall panels and exterior trim shall receive two factory, roller applied, paint coats having a combined coating thickness of .8 to 1.2 mils of dry film thickness. The finish coat for wall panels shall be a siliconized polyester formulation.
- G. The interior of the building wall panels shall be insulated with 3" thick fiberglass faced on its exposed side with a white metalized polypropylene scrimkraft facing. Minimum R-value shall be 5.4.

2.1.4 Sheet Metal Accessories, Interior Corner Trim

Of same material and finish as used for adjacent wall or roof panels, except as specified otherwise herein.

2.1.4.1 Caps, Strips, and Plates

Form ridge caps, eave and edge strips, fascia strips, miscellaneous flashings, and miscellaneous sheet metal accessories, unless specified otherwise herein, from the same material and gauge 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 14-gauge.

2.1.5 Insulation

Roof and wall insulation shall consist of 3" thick, .6# density fiberglass faced on its exposed side with a white metalized polypropylene scrimkraft facing. The faced insulation materials shall have a UL Flame Spread Rating of 25 when tested in accordance with UL 723 ASTM E 84 procedures.

2.1.6 Doors and Frames

2.1.6.1 Doors

Personnel door shall be 1 3/4" thick flush construction. Door leaves shall be minimum 20 gauge galvanized steel solid panel (Type S), reinforced by lamination to a small cell honeycomb core and

manufactured in accordance with ANSI/SDI-100, Grade 1, Model 1 (STC rating 30 and U value .41).

2.1.6.2 Frames

The hinge reinforcement shall be minimum 7 gauge and the lock reinforcement shall be minimum 16 gauge. Door frames shall be 4 3/4" deep, double rabbeted type, of minimum 16 gauge galvanized steel for single door openings and a minimum of 12 gauge galvanized steel for double door openings. All leaves and frames shall be factory painted with one coat of baked on primer.

2.1.6.3 Hardware

- A. (3) 4-1/2" x 4-1/2" steel hinges per ANSI #A8132 (Old Govt. Spec. FFH116C Type T2127) US26D (626) Satin Chrome Finish with non removable pins.
- B. 3 11/16" wide 5/8" high extruded aluminum threshold.
- C. 3/16" x 1/2" polyurethane and vinyl weatherstripping.
- D. Mortise cylinder lock set per ANSI A156.13, Series 100, Grade 1, Function F13, (Old Govt. Spec. 86B) US26D (626) Satin Chrome Finish.

2.1.6.4 Door Assembly

All doors shall be provided "assembled" in their frames with all hardware, except door levers or knobs, installed on door leaf.

2.1.7 Intake Vents

Fixed louvers shall be general purpose type of self framing design of the building manufacturer's standard construction. Finish shall be bright galvanized. All louvers shall be complete with #8 insect screening. The louver frame shall be of minimum 14 gauge formed aluminum and the louver blades shall be minimum 12 gauge extruded aluminum. Louver size shall be a minimum 1' - 6" square.

2.1.7.1 Building Ventilation Intake Vent

One (1) intake vent shall be provided to minimize accumulation of hazardous vapors. The vent shall be general purpose type of self framing design of the building manufacturer's standard construction and mounted on exterior wall at 12 inches above the floor. Finish shall be anodized aluminum. Unit shall be minimum of 22 inch square with a fixed outside louver designed to keep rain out. The louver frame shall be of minimum 14 gauge formed aluminum and the louver blades shall be minimum 12 gauge extruded aluminum. The vent shall have a UL approved fire damper with folding blades held upon by a 165 degree fusible link and an insect screen.

2.1.7.2 SVE Blower\Air Stripper Intake Vent

One (1) intake vent shall be provided for operation of the SVE Blower and Air Stripper. The vent shall be general purpose type of self framing design of the building manufacturer's standard construction. Finish shall be anodized aluminum. The unit shall provided a minimum of 270 scfm total air capacity with a fixed outside louver designed to keep rain out. The louver frame shall be of minimum 14 gauge formed

aluminum and the louver blades shall be minimum 12 gauge extruded aluminum.

2.1.8 Exhaust Fan

An exhaust Fan shall be provided which provides six (6) air changes per hour. The exhaust fan shall have a direct drive aluminum non-overheating centrifugal wheel in spun aluminum exterior housing. The motor shall be sealed from contaminants in the building's exhausted air stream and cooled through a separate outside fresh air tube and UL approved for a Class I, Division 2, Group D area. All electrical connections and motor shall be accessible through a removal cover. The building's exhaust air wall opening shall be within one (1) foot of the floor line. The opening through the wall shall lead to a 12 gauge duct which shall run up the wall to within six (6) inches of the roof line. At the top of the duct, the fan shall be installed. The fan shall run continuously.

PART 3 - EXECUTION

3.1 ERECTION

Erect in accordance with the manufacturer's approved erection instructions and diagrams, except as specified otherwise. Correct defects and errors in the fabrication of building components in a manner approved by the Engineer. If defects or errors in fabrication of components cannot be corrected, remove and provide nondefective components. Plumb, guy, and stay panels and frames in both directions. When installing wall and roof systems, install flashing, sealing material, and other accessories in a manner approved by the Engineer or as recommended by the manufacturer so that the systems are weathertight, 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.

3.1.1 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.

3.1.2 Wall Construction

Apply panels with the configurations in a vertical position. Apply panels full wall heights from base to eave with no horizontal joints except at the junctions of door frames, window frames, louver panels, and similar locations. Seal side and end laps with the joint sealing material as recommended by the manufacturer. Flash or seal walls at the base, at the top, around windows, door frames, framed louvers, and other similar openings. Flashing will not be required where approved "self-flashing" panels are used. Minimum end laps for all types of panels shall be 2 1/2 inches. Minimum side laps for all types of panels shall be one corrugation, one configuration, or an interlocking joint. Provide liner panels to height indicated.

3.1.3 Roof Construction

Apply roofing panels with the configurations parallel to the slope of the roof. Apply the roofing panels in full lengths from ridge or ridge panel to eaves top eave to bottom eave on shed roofs with no transverse joints. 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 interlocking rib. Provide a leak proof installation.

3.1.4 Installation of Insulation

3.1.4.1 Roof Insulation

Insulation shall be supported at the roof line by means of mechanical clips spaced on maximum 4' centers and shall be sealed by means of 2" side tabs on the facing.

3.1.4.2 Wall Insulation

The insulation shall be retained between the interlocking panel ribs with a white PVC hat clip over the panel ribs.

3.2 FIELD QUALITY CONTROL

At the discretion of the Contracting Officer's Representative, 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-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 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 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)

1.2 RELATED REQUIREMENTS

This section applies all Sections of Division 15, "Mechanical, General Requirements" of this project specification, unless specified otherwise in the individual Section.

1.3 QUALITY ASSURANCE

1.3.1 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.

1.3.2 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 6,000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.3 Service Support

The equipment items shall be supported by service organizations. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.4 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.

1.3.5 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's Representative.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 SAFETY REQUIREMENTS

1.5.1 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.

1.5.2 Warning Sign

Provide a permanent placard or sign at the entrance to confined spaces contained in the equipment. The sign shall warn personnel not to enter the space until the atmosphere inside has been tested and systems have been de-energized.

1.5.3 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."

1.6 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."

--End of Section--

SECTION 15060
PIPING AND VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

Not Used.

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 SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1 Code for Power Piping.

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D 1784 Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

ASTM D 1785 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

ASTM D 2467 Specification for Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

ASTM D 2774 Underground Plastic Pipe and Fittings Materials

ASTM D 3261 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

ASTM D 3350 Polyethylene Plastic Pipe and Fittings Materials

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600-87 Installation of Ductile-Iron Water Mains and Their Appurtenances

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe and valve material specifications are listed in the Piping Materials Specifications -General Service Index at the end of this section.
- B. Materials and components shall be in accordance with ASTM D 1784, ASTM D 1785, ASTM D 2467, ASTM D 3350.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Fabricate, assemble and erect piping systems in accordance with ASME B31.1.

3.1.2 General:

- A. Install in a neat workmanlike manner.
- B. Run parallel to building walls when possible.
- C. Install as shown on the Drawings.
- D. Piping Support: Provide support of all piping as required by ASME B31.1.
- E. Accommodate thermal expansion and contraction of piping when supporting piping.

3.1.3 All Horizontal Pipe Runs: Pitch to drain.

3.1.4 At locations where ferrous and non-ferrous pipe are being joined, use dielectric bushings or unions.

3.1.5 Valve all branch lines as close to the junction with the main line as possible with the type of valve specified.

3.1.6 Exterior Buried HDPE Piping:

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Join pipe and fittings by using a heating element especially made for butt fusion. When stub fittings are used, do not use stainless steel band clamps. Install pipe in accordance with ASTM D 2774. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose.

3.1.7 Unions: Provide on threaded piping in proximity to all pieces of equipment so that equipment may be readily removed for repairs.

3.1.8 Make ample clearances and allowances for all expansion and contraction of piping, the operation of doors and windows, mechanical equipment, and the passage of personnel without blocking aisles or work spaces.

3.1.9 Wall and Floor Penetrations:

- A. Provide sleeves at all penetrations of walls, floors and partitions.
- B. Size sleeves in accordance with Table 1 attached at the end of this section.
- C. Sleeves shall be standard weight carbon steel or Schedule 80 PVC pipe unless noted otherwise.
- D. Seal space between pipe or insulation and sleeve with oakum or fiberglass and caulk both ends of sleeve with elastic cement.
- E. Where fire rated walls or floors are penetrated, seal space between pipe and sleeve with T & B/Thomas & Betts Corp, Flame-Safe Compound, or other similar material.

- F. Provide Link Seal or similar mechanical seal for exterior, below grade penetrations unless noted otherwise. Size sleeves in accordance with the seal manufacturer's recommendations.

3.1.10 Ells or 90 Degree Bends: Use long radius fittings unless noted otherwise.

3.1.11 Use valves of the same size as the pipe unless noted otherwise.

3.2 PROTECTION OF EQUIPMENT

3.2.1 General:

- A. Exercise particular care during construction and start-up to prevent foreign materials from getting into the piping systems and lodging in valves, fittings, instrumentation or other equipment.
- B. Temporarily block off equipment openings with solid diaphragms until after the piping systems have been cleaned and inspected.

3.2.2 Cleaning:

- A. Inspect the interior of all equipment to establish that it is free from dirt or other foreign matter prior to its connection with the piping system.
- B. The Contractor shall be responsible for the repair of equipment damaged by passage of such dirt or foreign matter.

3.2.3 Temporary Strainers:

- A. Install a flat screen strainer between flanges at the inlet connections of pumps and other equipment prior to initial operation as necessary to prevent damage.
- B. Remove, clean and replace as directed and finally remove when the Contracting Officer's Representative is satisfied that they are no longer required.

3.2.4 Permanent Strainers:

During the initial period of operation remove, clean, and replace the baskets of all permanently installed strainers as directed, until the Contracting Officer's Representative is satisfied that a clean system exists.

3.2.5 Scavenging:

- A. Upon completion, thoroughly clean and flush or blow out all pipe lines.
- B. Furnish and install temporarily connected blow-out lines, through which steam or water may be discharged.
- C. Temporary lines shall be properly supported and restrained.
- D. Take adequate precautions to prevent impingement of the discharge on structures or to areas where personnel might be injured.
- E. When the Contracting Officer's Representative is satisfied that the line is clean, remove the temporary line and seal the opening in the scavenged system.
- F. Provide steam and water for blowing out and washing out pipe lines and provide for appropriate disposal of the discharge.

3.3 EXAMINATION

- 3.3.1 Examine pressure piping system and components in accordance with ASME B31.1.
- 3.3.2 Examination shall be performed by qualified and certified personnel.
- 3.3.3 Repair or remove and replace all unacceptable defects or imperfections and re-examine.

3.4 TESTING

3.4.1 General:

- A. Test finished work in accordance with ASME B31.1 and also by an operating test under normal service conditions.
- B. Furnish and remove the test pump and gauge, test piping connections, drains, vents, blanks, etc., where these are required.
- C. All nonperforated groundwater and gas/vapor handling pipelines shall be tested.

3.4.2 Fluid for Tests:

- A. Test medium shall normally be water unless noted otherwise.
- B. Furnish and dispose of test fluid at Contractor's expense unless noted otherwise.
- C. Use potable water for testing.

3.4.3 Precautions:

- A. Properly support piping under hydrostatic test to prevent damage to its hangers and supports.

3.4.4 Equipment Furnished by Others:

Valve bonnets and other joints in equipment furnished by others but installed by the Contractor shall be taken up or otherwise adjusted by the Contractor as required to make the work tight.

3.4.5 Repairs:

- A. At the completion of the tests, immediately make tight, to the satisfaction of the Contracting Officer's Representative, any leaks which develop under the test; correct loose or otherwise faulty hangers; and apply such devices as may be necessary to eliminate sway or vibration of pipe or supports.
- B. Remove, repair, or replace any insulation or other material affected by test conditions or by leaks or other defects whether part of his work or that of others.
- C. Any material or work which is defective, shall be replaced by new material.
- D. The Contractor shall be responsible for the tightness of all work made up by him and shall promptly eliminate all leaks which develop.

3.4.6 Tests for HDPE Pressure Lines

Test pressure lines in accordance with the applicable standard specified in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 50 psi in excess of the maximum working pressure of the system, but not less than 100 psi, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test. Test pressure lines in accordance with the requirements of AWWA C600-87 for hydrostatic testing. No leakage will be allowed on pressure lines.

3.5 SCHEDULES AND TABLES

3.5.1 Schedules and tables attached include:

- A. Table 1, Sleeve Size.
- B. Piping Materials Specifications General Service Index.
- C. P-120.
- D. P-513
- E. P-514 (2 pages).
- F. Valve specifications.

TABLE 1
SLEEVE SIZE FOR PIPE PENETRATIONS

BARE PIPE NOMINAL SIZE (IN.)	INSULATED PIPE O.D. OF INSULATION (IN.)	PIPE SLEEVE NOMINAL SIZE (IN.)
up to 1	up to 1½	3
1½ - 2½	1½ - 3	4
3	3½ - 4	6
4	4½ - 5½	8
6	5 ¾ - 7½	10
8	7 ¾ - 9	12
10	9½ - 11	14
12	11½ - 13	16
14	13½ - 15	18
16	15½ - 17	20
18	17½ - 19	22
20	19½ - 21	24
22	21½ - 23	26
24	23½ - 25	28
26	25½ - 27	30
28	27½ - 29	32
30	29½ - 31	34
32	31½ - 33	36

PIPING MATERIAL SPECIFICATIONS GENERAL SERVICE INDEX			
SERVICE	SIZE	SPECIFICATION SECTION	SECTION 15060 SPEC. NO.
Bldg. 780 Extraction Well	1"	15060	P-120
Bldg. 780 Groundwater Inf. buried	1"	15060	P-513
Bldg. 780 Treated Effluent buried	2"	15060	P-513
Bldg. 780 Groundwater ¹	2" and down	15060	P-120
Bldg. 780 Sequestering Agent	3/8"	15060	P-120
Bldg. 780 SVE buried	4" and down	15060	P-514
Bldg. 780 SVE ¹	4" and down	15060	P-120
Bldg. 780 Stripper Exhaust	6" and down	15060	P-120
Bldg. 106 Air Sparging ¹	4"	15060	P-120
Bldg. 106 Air Sparging buried	4" and down	15060	P-514
Bldg. 106 SVE ¹	16" and down	15060	P-120
Bldg. 106 SVE buried	6" and down	15060	P-514

Notes:

- (1) Piping at treatment system only. See Drawings for pipe sizes.
- (2) Piping material symbols as charted on Drawings.

GS Galvanized Carbon Steel
PVC Polyvinyl Chloride
HDPE High Density Polyethylene

DESIGN PRESSURE RANGE 0 TO 125 PSIG		DESIGN TEMPERATURE RANGE Ambient TO °F		NOTES:
SERVICES: SEE GENERAL SERVICE INDEX				
P-120 Galvanized Carbon Steel				
ITEM	SIZE	RATING OR SCHEDULE	DESCRIPTION	STANDARD REFERENCE
Construction	16" DN		Screwed, galv. steel	
Pipe	16" DN	Std. wt.	Screwed, galv. steel, IPS	ASTM A120
Fittings	16" DN		Malleable iron, banded per ANSI B16.3 (all fittings galvanized)	ASTM A197
Flanges	16" DN	150#	Screwed, flat face per ANSI B16.1	ASTM A105
Bolts			Machine bolts per ANSI B18.2.1 Threads per ANSI B1.1 CL 2A	ASTM A307 GR B
Nuts			Unfinished heavy hex per ANSI B18.2.2. Threads per ANSI B1.1 CL 2B	ASTM A194 GR 1

DESIGN PRESSURE RANGE 0 TO 150 PSIG			NOTES:	
SERVICES: SEE GENERAL SERVICE INDEX				
P-120 Galvanized Carbon Steel				
ITEM	NOM SIZE INCHES	CONN	DESCRIPTION	Suggested Valve manufacturers
Ball	½" - 8"	SCR	150#; wrench operated; renewable seat; brass or bronze body; brass, bronze, or 316SS disc; filled TFE seat; brass, bronze or 316SS stem.	Jamesbury, Marpac, Worcester
Water Check Valve	8"	Flanged	150#; swing disc; renewable seat; 316SS body; 316SS seat; 316SS stem.	Crane, Jenkins, Powell
Butterfly	6" - 8"	Flanged	150# renewable seat; cast iron body; ductile iron disc; Buna-N seat; 304SS stem.	Dresser, Clow
Butterfly	1½" - 4"	SCR	150#; renewable seat; nickel plated cast iron body; phosphate coated cast iron disc; Buna-N seat; 316SS stem.	Stockham, Crane, Lunkenheimer
Globe	1"-3"	SCR	150#; renewable seat; bronze body; 316SS disc; 316SS seat, bronze stem.	Crane
Air Release Valve	½"	Threaded	Cast iron body and cover; stainless steel float; Buna-N seat, brass other parts.	Apco
Air Check Valve	4"-6"	Socket or Threaded	Carbon steel or as recommended by blower manufacturer.	As recommended by blower manufacturer
Pressure Relief Valve	1"-2"	Socket or Threaded	4.0 - 15.0 PSIG, aluminum valve body, steel valve spring.	As recommended by blower manufacturer

DESIGN PRESSURE RANGE 0 TO 100 PSIG		DESIGN TEMPERATURE RANGE Ambient TO 100 °F		NOTES:
SERVICES: SEE GENERAL SERVICE INDEX				
P-513 Buried Polyethylene				
ITEM	SIZE	RATING OR SCHEDULE	DESCRIPTION	STANDARD REFERENCE
Construction	1"-18"		Butt fusion with victaulic coupling transition to steel piping.	
Pipe	1"-18"	150#	High density polyethylene SDR 11.	ASTM D 3350
Fittings	1"-18"	150#	High density polyethylene, but fusion welded.	ASTM D 3261

Notes:

1. All specifications and standards listed shall conform to the latest edition.
2. Maximum operating pressures based on water service.

DESIGN PRESSURE RANGE 0 TO 150 PSIG											NOTES
SERVICES: SEE GENERAL SERVICE INDEX											
PRESSURE CORRECTIONS FOR HIGHER THAN AMBIENT (75°F) TEMPERATURES FOR SCH 40 SOCKET WELD PIPING SYSTEM											
NOMINAL PIPE SIZE	MAXIMUM OPERATING PRESSURE (PSI) AT °F (SEE NOTE)										
	75	80	90	100	110	115	120	125	130	140	
1/2	600	540	450	372	300	270	240	210	180	132	
3/4	480	432	360	298	240	216	192	168	144	106	
1	450	405	338	279	225	203	180	158	135	99	
1 1/4	370	333	278	229	185	167	148	130	111	81	
1 1/2	330	297	248	205	165	149	132	116	99	73	
2	280	252	210	174	140	126	112	98	84	62	
2 1/2	300	270	225	186	150	135	120	105	90	66	
3	260	234	195	161	130	117	104	91	78	57	
4	220	198	165	136	110	99	88	77	66	48	
6	180	162	135	112	90	81	72	63	54	40	
8	160	144	120	99	80	72	64	56	48	35	
10	140	126	105	87	70	63	56	49	42	31	
12	130	117	98	81	65	59	52	46	39	29	

Note:

The chart above is calculated on maximum operating pressures and temperature correction factors as listed in Chemtrol Industrial Thermoplastic Pipe and Fittings Catalog (Bulletin No. 319 - Revised February, 1976) Page 3.

DESIGN PRESSURE RANGE 0 TO 150 PSIG			NOTES:	
SERVICES: SEE GENERAL SERVICE INDEX				
ITEM	SIZE	RATING OR SCHEDULE	DESCRIPTION	STANDARD REFERENCE
Const.	12" DN		Socket weld with flanged joints to equipment or where applicable.	
Pipe	12" DN	Sch 40	IPS per ASTM D1785.	
Fittings	8" DN	Sch 40	Socket type per ASTM D2467.	ASTM D1784 CL 12454-B (TYPE 1 GR 1)
	10" - 12"		Socket type PVC, glass over-wrapped.	ASTM D1784 CL12454-B (TYPE 1 GR 1)
Flanges	12" DN	150#	Flat face per ASTM D2467 for socket type.	ASTM D1784 CL1245-B (TYPE 1 GR 1)
Unions	3" DN	Sch 40	Socket weld with viton O rings.	02467 (Type 1)
Bolts			Machine bolts per ANSI B18.2.1 threads per ANSI B1.1 CL2A.	ASTM A307 GR B
Nuts			Unfinished heavy hex per ANSI B18.2.2 threads per ANSI B1.1 CL2B.	ASTM A194 GR 1

Notes:

1. All specifications and standards listed shall conform to the latest edition.
2. Maximum operating pressures based on water service.

DESIGN PRESSURE RANGE 0 TO 150 PSIG				NOTES:
SERVICES: SEE GENERAL SERVICE INDEX				
P-514 PVC				
ITEM	NOM SIZE INCHES	CONN	DESCRIPTION	Suggested Valve manufacturers
Ball	1/4" - 6"	Socket	150# PVC True union, PVC Ball, TFE renewable seat.	Chemtrol
Ball Check	1/2" - 4"	Socket	150# PVC True Union, PVC Ball, VITON or EPDM Seals and Seat.	Chemtrol
Ball - Full port	1/4" - 2"	Socket	150# 316SS Body, 3 piece, reinforced PTFE seal and seat rings, 316SS ball and stem, lever handle.	Crane

--End of Section--

- ASTM B 88 1989 (Rev. A) Seamless Copper Water Tube
AMERICAN WELDING SOCIETY, INC. (AWS)
- ANSI/AWS Z49.1 1988 Safety in Welding and Cutting
CODE OF FEDERAL REGULATION (CFR)
- 29 CFR 1910.219 Mechanical Power Transmission Apparatus
FEDERAL SPECIFICATIONS (FS)
- FS WW-U-516 (Rev. B) (Valid Notice 1) Unions, Brass or
Bronze, Threaded Pipe Connections and
Solder-Joint Tube Connections
- FS WW-U-531 (Rev. F) Unions, Pipe, Steel or Malleable
Iron: Threaded Connection, 150 LB, 250 LB
and 300 LB WSP
- FS QQ-B-654 (Rev. A) (Valid Notice 1) Brazing Alloys,
Silver
- FS WW-T-696 (Rev. E) (Valid Notice 1) Traps, Steam and
Air

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
- MSS SP-89 1985 Pipe Hangers and Supports -
Fabrication and Installation Practices

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

- SAE J 513 1990 Refrigeration Tube Fittings

1.3 RELATED REQUIREMENTS

Section 15011, "Mechanical, General Requirements", applies to this Section, with the additions and modifications specified herein.

1.4 SUBMITTALS

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

1.4.1 SD-02, Manufacturer's Catalog Data

- A. Air compressor and receiver
- B. Air dryer
- C. Oil coalescing pre-filter

D. After filter

1.5 QUALITY ASSURANCE

Design, fabrication, installation, and testing of compressed air systems shall conform to ASME B31.1, ASME BPVC SEC VIII D1, and ASME BPVC SEC IX, except as specified otherwise. In ASME B31.1, ASME BPVC SEC VIII D1, and ASME BPVC SEC IX, the advisory provisions shall be considered mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Engineer.

1.6 SAFETY PRECAUTIONS

1.6.1 Temperature Restriction

Compressors or other equipment shall not discharge compressed air to the piping systems above 100 °F unless approved by the Engineer. Aftercoolers or other devices shall be provided to comply with the temperature restriction.

1.6.2 Rotating Equipment

Fully guard 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.

1.6.3 Brazing

Safety in cutting, and brazing of pipe shall conform to ANSI/AWS Z49.1.

PART 2 - PRODUCTS

2.1 LOW PRESSURE AIR COMPRESSOR UNIT

- A. Compressor Capacity: 11 cfm actual capacity at 100 psig.
- B. Receiver Capacity: 60 gallons
- C. Mounting: Common sub-base for receiver and compressor.
- D. Compressor Type: Reciprocating
- E. Nameplate: Metal, securely fastened to equipment or base, listing:
 - 1. Manufacturer's name and address
 - 2. Model and serial numbers
 - 3. Compressor operating data and rating
- F. Receiver: ASME BPVC SEC VIII D1 labelled and rated for 125 psig. Provide required valves and trimmings including, service valve, pressure gage, and ASME BPVC SEC VIII D1 and ASME BPVC SEC IX code safety valve.
- G. Receiver Condensate Drain: Automatic float-type trap per FS WW-T-696.
- H. Compressor Accessories: Air inlet filter and silencer. Air-cooled intercooler and/or aftercooler which reduce air discharge temperature to 100 °F, automatic low oil level shutdown switch, totally enclosed OSHA-type belt guards, interconnecting piping between compressor, receiver, and controls.
- I. Unloaded start with enclosed diaphragm-type pressure switch automatically controlling start-and stop.

J. Motor:

1. TEFC motor conforming with National Electric Code Class 1, Group D, Division 2 suitable for operation on the indicated power supply. Rated horsepower of motor shall equal or exceed power required for continuous operation of compressor at full load.
2. 3 Horsepower/480 volt/60 hertz
3. Provide motor starter with compressor.

K. Noise: 84 dBA maximum sound level one meter from compressor unit.

L. Vibration isolation mounting.

M. Suggested manufacturers:

1. Ingersoll-Rand Type T30
2. Gardner Denver
3. Atlas Copco
4. Or other manufacturer that meets the requirements

2.2 COMPRESSED AIR DRYERS

Provide desiccant air dryer of the heaterless regenerative type to remove water vapor from the compressed air system to -40°F dewpoint at operation pressure, suitable for instrument air for process control. Provide for electrical Class I, Hazardous Group D, Division II Location. Electrical input of 115V 60 Hertz, single phase. Provide locally mounted pressure gauges standard with air dryer. Design pressure of 150 psig. Provide controlled shutdown option where the dryer is electrically interlocked with the compressor. Such that the compressor is maintained at line pressure.

Suggested manufacturers:

Pneumatics Products Corporation (PPC) model 10HA700000J
Zeks
Airtek
or other manufacturers that meet the requirements.

2.3 COMPRESSED AIR PIPING AND ACCESSORIES

2.3.1 Copper Tubing

- A. Tubing: ASTM B 88, Type K or L, hard drawn, Class 1.
- B. Fittings: ASME/ANSI B16.22 wrought copper or bronze, with silver brazed joints.
- C. Brazing Filler Metal: FS QQ-B-654, Class III.
- D. Unions: Bronze, FS WW-U-516, brazed joint type.
- E. Flanges and Flanged Fittings: ANSI B16.24, bronze, 150-pound, gaskets, oil resistant synthetic rubber, bolts ASTM A 193/A 193M, Grade B7, and nuts ASTM A 194/A 194M, Grade 7.
- F. Flared fittings: ASTM B 88, Type K or L, annealed, with ASME/ANSI B16.26 or SAE J 513 flared fittings.

2.3.2 Valves

2.3.2.1 Gate Valves

Bronze Gate Valves: MSS SP-80, Class 150, 2 inches and smaller, wedge disc, rising stem, inside screw type, with brazed joints ends when used with copper tubing.

2.3.2.2 Pressure Regulators

Pressure regulators are provided with the electro-pneumatic valves; therefore, they will not be specified here.

2.3.3 Pressure Gages

ANSI/ASME B40.1, Accuracy Grade A, for air, with steel or brass case, and nonshatterable safety glass, and a pressure blowout back to prevent glass from flying out in case of an explosion. Gages shall have a 3 1/2-inch minimum diameter dial and a dial range of approximately twice working pressure.

2.3.4 Hangers and Supports

Provide pipe hangers and supports conforming to MSS SP-58, MSS SP-69, and ASME B31.1, except as specified or indicated otherwise. Furnish zinc plated pipe hangers and supports except for copper plated inserts for copper piping. Provide tubing supports of U-shaped steel bolts and nuts firmly secured to adequately support structures such as walls, columns, floors, or brackets. Clips shall fit closely around piping but shall have sufficient clearance to permit longitudinal movement of piping during normal expansion and contraction. Provide supports at valves, fittings, branch lines, outlets, changes in direction, equipment, and accessories.

2.3.5 Filters

Provide prefilter (before dryer) and afterfilter (after dryer) to remove entrained liquid oil and water, and particles.

Suggested manufacturers:

PPC

Ingersoll-Rand

Zeks

or other manufacturers that meet the requirements

2.3.5.1 Oil Coalescing Prefilter

Provide high efficiency oil coalescing filter with housing to remove 99.99% of liquid oil. Filter capacity shall be compatible with rated flow pressure and temperature. Provide cartridge housing of epoxy coated aluminum, drop away canister type with drain port. Size to be compatible with rated flow. Provide automatic drain valve (timer controlled solenoid valve) to drain oil/water sludges from prefilter.

2.3.5.2 After filter

125 psig operating pressure. Provide cellulose cartridge filters of graded density construction capable of removing liquids and solids of 5 microns and larger at 99.99% efficiency. Filter capacity shall be compatible with rated flow of equipment or pressure reducing valves provided. Resin impregnated cellulose medium. Plated carbon steel hardware, support core and end caps. Buna-N gaskets. Provide cartridge housing of epoxy coated aluminum, drop away canister type. Size to be compatible with rated flow.

2.3.6 Traps

FS WW-T-696 to drain water and other liquids from system. Type of traps, as indicated, and rated working pressure not less than system operating pressure.

2.3.7 Flexible Connections

Vibration isolation, wire braid reinforced corrugated metal hose type, line-sized, with bronze end connections, suitable for pressure indicated. Length as recommended by manufacturer.

2.3.8 Dielectric Unions

Steel female pipe thread end and copper solder-joint ends, conforming to dimensional, strength and pressure requirements of FS WW-U-531, Class 1. Steel parts shall be galvanized or plated. Union shall have a water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint. When dry, it shall also be able to withstand a 600-volt breakdown test.

2.4 IDENTIFICATION LABELS FOR PIPING

Labels for pipes 3/4 inch O.D. and larger shall bear printed legends to identify contents of pipes and arrows to show direction of flow. Except that of pipes smaller than 3/4 inch O.D., labels shall have color coded backgrounds to signify levels of hazard.

2.5 SOURCE QUALITY CONTROL

Certify satisfactory accomplishment of air compressors and compressed air dryers factory tests.

PART 3 - EXECUTION

3.1 INSTALLATION

Install materials and equipment as indicated and in accordance with the manufacturer's recommendations.

3.1.1 Piping

Unless specifically stated to the contrary, fabrication, assembly, and brazing shall conform to ASME B31.1 for all piping of the air system. Piping shall follow the general arrangement shown. Cut piping accurately to measurements established for the work. Work piping into place without springing or forcing, except where cold-springing is specified. Piping and equipment within buildings shall be entirely out of the way of lighting fixtures and doors, windows, and other openings. Locate overhead piping in buildings in the most inconspicuous positions. Do not bury or conceal piping until it has been inspected, tested, and approved. Where pipe passes through building structure, pipe joints shall not be concealed, but shall be located where they may be readily inspected and building structure shall not be weakened. Avoid interference with other piping, conduit, or equipment. Except where specifically shown otherwise, vertical piping shall run plumb and straight and parallel to walls. Piping connected to equipment shall be installed to provide flexibility for vibration. Adequately support and anchor piping so that strain from weight of piping is not imposed on the equipment.

3.1.1.1 Fittings

Use long radius ells where appropriate to reduce pressure drops. Pipe bends in lieu of fittings may be used for low pressure piping where space permits. Pipe bends shall have a uniform radius of at least five times the pipe diameter and must be free from any appreciable flattening, wrinkling, or thinning of the pipe. Mitering of pipe to form elbows, notching straight runs to form full sized tees, or any similar construction shall not be used. Make branch connections with welding tees, except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ASME B31.1 may be used.

3.1.1.2 Cleaning and Flushing Procedures

Before jointing and erection of piping or tubing, thoroughly clean interiors of pipe sections, tube, and components. In steel pipe, loosen scale and other foreign matter by rapping sharply and expel by wire brush and swab. Blow out both steel pipe and copper tube and components with compressed air at 100 psig or more. Maintain cleanliness by closure of pipe/tube openings with caps or plugs. Before making final terminal connections, blow out complete system with compressed air at 100 psig or more.

3.1.1.3 Changes in Pipe Size

Use reducing fittings for changes in pipe size. The use of bushings will not be permitted.

3.1.1.4 Drainage and Flexibility

Compressed air piping shall be free of unnecessary pockets and pitched approximately 3 inches per 100 feet in the direction of flow to low points. Where pipes must be sloped so that condensate flows in opposite direction to air flow, slope 6 inches per 100 feet or greater. 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.

3.1.2 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. Threads shall be smooth, clean, and full cut. Apply thread tape to male threads only. Work piping into place without springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Engage threads so that not more than three threads remain exposed.

3.1.3 Brazing Procedures

Perform brazing in accordance with qualified procedures using qualified brazers. Do not perform brazing when the quality of the completed braze could be impaired by the prevailing working or weather conditions.

3.1.4 Flare Fittings

Provide flare fittings only where necessary to connect copper tubing to equipment. Use short sections of annealed tubing soldered or brazed to hard drawn tubing using couplings on expanded ends on the annealed tubing made with special tools designed for that purpose. Make flares with the appropriate flaring tools. Cut annealed tubing only with cutting wheel tool. Do not ream out inside burr or lip left by the cutting wheel but fold back lip with flare tool to form seal/gasket inside flare. When new, the flare should cover not more than 75 percent of the flare seating surface of either the male or female flare fittings. Put the flare nut on the tube before making the flare.

3.1.5 Valves

ASME B31.1. Install valves at the locations indicated and elsewhere as required for the proper functioning of the system.

3.1.5.1 Gate Valves

Provide gate valves unless otherwise directed. Install valves in positions accessible for operation and repair. Install valve with stem horizontal or above.

3.1.6 Hangers and Supports

Selection, fabrication and installation of piping hangers and supports shall conform to MSS SP-58, MSS SP-69, and MSS SP-89.

3.1.7 Pressure Gages

Provide pressure gages with a shut-off valve or petcock installed between the gage and the line.

3.1.8 Equipment Installation

Install equipment strictly in accordance with these specifications, and the manufacturers' installation instructions. Grout equipment mounted on concrete foundations before piping is installed. Install piping in a manner that does not place a strain on any of the equipment. Do not bolt flanged joints tight unless they match properly. Extend expansion bends adequately before installation. Grade, anchor, guide and support piping without low pockets.

3.1.9 Cleaning of System

Clean the various system components before final closing as the installations are completed. Remove foreign matter from equipment and surrounding areas. Clean silverbrazed piping to remove residual flux remaining in the system after fabrication. Preliminary or final tests will not be permitted until the cleaning is approved by the Engineer.

3.1.10 Unions and Flanges

Provide unions and flanges where necessary to permit easy disconnection of piping and apparatus, and as indicated. Provide a union for each connection having a screwed-end valve. Provide unions or flanges not farther apart than 100 feet. Provide unions on piping under 2 inches in diameter, and provide flanges on piping 2 inches and over in

diameter. Install dielectric unions or flanges between ferrous and non-ferrous piping, equipment, and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous-to-ferrous or non-ferrous to non-ferrous connections.

3.1.11 Identification of Piping

Identify piping with commercially manufactured piping identification labels. Space identification marking on runs not farther apart than 50 feet. Provide two copies of the piping identification code framed under glass and install where directed.

3.2 FIELD QUALITY CONTROL

The Contractor shall perform brazing examinations. Visually examine all compressed air system. Repair defective joints. Perform testing after cleaning. Contractor shall provide everything required for tests. Tests shall be subject to the approval of the Engineer. Calibrate the test pressure gages.

3.2.1 Hydrostatic Tests and Leak Tightness Tests

- A. Preliminary Preparation. Remove or isolate from the system the compressor, air dryer, filters, instruments, and equipment which would be damaged by water during hydrostatic tests and reinstall after successful completion of tests.
- B. Performance of Hydrostatic Tests. Hydrostatically test piping systems in accordance with ASME B31.1. Vent or flush air from the piping system. Pressurize system for 10 minutes with water at one and one-half times design working pressure, then reduce to design working pressure and check for leaks and weeps.
- C. Compressed Air Leak Test. After satisfactory completion of hydrostatic pressure test, blow systems dry with clean, oil-free compressed air, and test with clean, dry air at design working pressure. Brush joints with soapy water solution to check for leaks. Install a calibrated test pressure gage in piping system to observe any loss in pressure. Maintain required test pressure for a sufficient length of time to enable an inspection of joints and connections.

3.2.1 Operational Tests

Test equipment as in service to determine compliance with contract requirements and warranty. During the tests, test equipment under every condition of operation. Test safety controls to demonstrate performance of their required function. Completely test system for compliance with specifications.

--End of Section--

SECTION 16011

ELECTRICAL, GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI C2 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 Designation Plates)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

- IEEE 100 1988 Dictionary of Electrical and Electronics Terms,
Fourth Edition

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA ICS 6 1988 (Rev. 1) Enclosures for Industrial Controls and
Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 1993 National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 11 and Division 15. This section applies to all sections of Division 16, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

- A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the contract drawings, shall be as defined in IEEE 100.
- B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- C. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that

describe products, systems, installation procedures, equipment, and test methods.

1.4 SUBMITTALS

Not Used.

1.5 QUALITY ASSURANCE

1.5.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

1.5.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.5.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6,000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4 Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.5.5 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.5.6 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer's Representative.

1.6 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- A. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- B. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- C. Safety precautions.
- D. The procedure in the event of equipment failure.
- E. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.7 NAMEPLATES

FS L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches. Lettering shall be a minimum of 0.25-inch high normal block style.

1.8 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 position on the tag shall identify the circuit. The third position shall denote the phase of the circuit and shall include the Greek "theta" symbol. The last position shall denote the cable size. 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.

1.8.1 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.

1.9 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to ANSI C2, NFPA 70, and requirements specified herein.

1.9.1 Motors and Equipment

Provide motors, controllers, and contactors with their respective pieces of equipment, except controllers indicated as part of the control panel shall be provided with the control panel. Motors, controllers, and contactors shall meet all additional requirements specified in the sections covering associated mechanical equipment. 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.

1.9.2 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. Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.10 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 and the additional requirements specified in the technical sections.

3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

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 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 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 C 139 1973 (R 1989) Concrete Masonry Units for Construction
of Catch Basins and Manholes
- ASTM C 478 1990 (Rev. B) Precast Reinforced Concrete Manhole
Sections

NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION (NEMA)

- NEMA TC 3 1993 PVC Fittings for Use with Rigid PVC Conduit and
Tubing
- NEMA TC 6 1990 PVC and ABS Plastic Utilities Duct for
Underground Installation
- NEMA TC 9 1990 Fittings for ABS and PVC Plastic Utilities Duct
for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 1993 National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

- UL 6 1981 (R 1989) (Bul. 1991) Rigid Metal Conduit
- UL 44 1983 (R 1990) (Bul. 1990) Rubber-Insulated Wires and
Cables
- UL 83 1991 (R 1991) Thermoplastic-Insulated Wires and Cables
- UL 467 1984 (R 1986) Grounding and Bonding Equipment
- UL 486A 1991 (R 1991) Wire Connectors and Soldering Lugs for
Use with Copper Conductors
- UL 486B 1991 (R 1991) Wire Connectors for Use with Aluminum
Conductors

PART 3 - EXECUTION

3.1 INSTALLATION

NFPA 70 and ANSI C2 and CALPUC G.O.128.

3.1.1 Concrete

Concrete work for electrical requirements shall conform to the requirements of the Contractor.

3.1.2 Underground Conduit/Duct Without Concrete Encasement

3.1.2.1 Conduit

The type of conduit shall be rigid galvanized steel. The top of the conduit shall be not less than 24 inches below grade, and shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points. Run conduit in straight lines except where a change of direction is necessary. As each conduit run is completed, draw a nonflexible testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. Provide not less than 3 inches clearance from the conduit to each side of the trench. A minimum clearance of 2 1/2 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 by Contractor.

3.1.3 Underground Duct with Concrete Encasement

Construct underground duct lines of individual conduits encased in concrete. Except where rigid galvanized steel conduit is indicated or specified, the conduit shall be PVC Type DB. Do not mix different kinds of conduit in any one duct bank. Ducts shall not be smaller than 5 inches in diameter unless otherwise indicated. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 1/2 inches, except separate light and power conduits from control conduits by a minimum concrete thickness of 3 inches.

3.1.3.1 Connections to New Handholes

Construct concrete-encased duct lines connecting to underground structures to have a flared section adjacent to the handhole to provide shear strength. Construct underground structures to provide for keying the concrete encasement of the duct line into the wall of the structure. Use vibrators when this portion of the encasement is poured to ensure a seal between the encasement and the wall of the structure.

3.1.4 Underground Conduit for Service Feeders

Underground conduit for service feeders into buildings shall be rigid steel from the service equipment to a point 5 feet beyond the building and projections thereof. Protect the ends of the conduit by threaded metal caps or bushings, and coat the threads with graphite grease or other suitable coating. Clean and plug conduit until cable is installed.

3.1.5 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).

3.1.6 Cable Pulling

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Accumulate cable slack at each manhole or junction box where space permits by training cable around the interior to form one complete loop. Maintain minimum allowable bending radii in forming such loops.

3.1.6.1 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.

3.1.6.2 Cable Pulling Tensions

Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

3.1.6.3 Secondary Cable Runs in Nonmetallic Duct Conduit

Although not indicated, include an insulated copper equipment grounding conductor sized as required by the rating of the overcurrent device supplying the phase conductors, in nonmetallic duct conduit, for secondary cable runs, 600 volts and less.

3.1.6.4 Installation of Cables in Handholes and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators at a maximum of 18 inches. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space opening or future cables, except as

otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

3.1.6.5 Cable Markers (or Tags) in Handholes

Provide as specified in Section 16011, "Electrical General Requirements."

3.1.7 Cable Terminating

Protect terminations of insulated power and lighting cables from accidental contact, deterioration of coverings and moisture by providing terminating devices and materials. Install terminations of insulated power and lighting cables cable joints and medium voltage terminations in accordance with the manufacturer's requirements. Make terminations with materials and methods as indicated or specified herein or as designated by the written instructions of the cable manufacturer and termination kit manufacturer.

3.1.7.1 Splices for 600 volt cables

Splice in underground systems with a compression connector on the conductor and by insulating and waterproofing by one of the following methods suitable for continuous submersion in water and pass ANSI C119.1.

- A. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package. Do not allow the cables to be moved until after the splicing material has completely set.
- B. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold. Do not allow cables to be moved until after the splicing materials have completely set.
- C. Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which should be applied by a clean burning propane gas torch. Cables may be moved when joint is cool to the touch.

3.1.8 Grounding Systems

Grounding systems shall be as indicated, and as required by NFPA 70 and ANSI C2.

3.1.8.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 6 inches, installed when indicated to provide an earth ground of the value before stated for the particular equipment being grounded.

3.1.8.2 Grounding Connections by Exothermite Type Process

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermite type process. Make thermit welds strictly in accordance with the weld manufacturer's written recommendations. Welds which have "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at thermit weldments.

3.1.8.3 Compression Ground Grid Connector

For accessible connections in lieu of a thermit type process, a compression ground grid connector of a type which uses a hydraulic compression tool to provide the correct circumferential pressure may be used. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.8.4 Grounding Conductors

Bare soft-drawn copper wire No. 4 AWG minimum unless otherwise indicated or specified.

3.1.8.5 Ground Rod Connections

Connect solid-copper ground rods only to insulated TW, or RHW copper ground conductor and weld the connection. Insulate entire area of the rod in the vicinity of the weld and the connecting wire and seal against moisture penetration.

3.1.8.6 Conduit

Provide empty conduits with a No. 14 AWG zinc coated steel wire or a plastic rope having a breaking strength of at least 200 lbs. Leave 24 inches of spare at each end of the pull.

3.1.9 Reconditioning of Surfaces

3.1.9.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct or direct burial cable. Preserve and replace sod or topsoil after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.2 FIELD QUALITY CONTROL

As an exception to requirements that may be stated elsewhere in the contract, notify the Contracting Officer's Representative 5 working days prior to each any tests.

--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 Designation Plates)

FS W-C-375 (Rev. B) (Valid Notice 1) Circuit Breaker, Molded Case; Branch Circuit and Service

FS W-S-896 (Rev. E) (Valid Notice 1) Switches, Toggle (Toggle and Lock), Flush Mounted

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1 1991 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) Motors and Generators

NEMA ST 20 1986 Dry-Type Transformers for General Applications

NEMA TC 3 1990 PVC Fittings for Use with Rigid PVC Conduit and Tubing

NEMA TC 14 1984 (R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings

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 Flexible Metal Conduit, Eighth Edition

UL 5 1985 (R 1990) Surface Metal Raceways and Fittings, Tenth Edition

UL 6 1981 (R 1989) (Bul. 1991) Rigid Metal Conduit, Ninth Edition

UL 44 1983 (Bul. 1990) (R 1990) Rubber-Insulated Wires and Cables, Twelfth Edition

UL 50 1988 (R 1990) Cabinets and Boxes, Ninth Edition

UL 67 1988 (R 1990) (Errata 1990) Panelboards, Tenth Edition

UL 83 1983 (Bul. 1990) (R 1990) Thermoplastic-Insulated Wires and Cables, Ninth Edition

UL 467 1984 (R 1986) Grounding and Bonding Equipment, Sixth Edition

UL 486A 1980 (R 1989) Wire Connector and Soldering Lugs for Use with Copper Conductors, Seventh Edition

UL 486C 1983 (R 1989) (Errata 1991) Splicing Wire Connectors, First Edition

UL 489 1986 (R 1990) (Bul. 1991) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures, Seventh Edition

UL 498 1991 Attachment Plugs and Receptacles, Twelfth Edition

UL 508 1989 (R 1991) (Bul. 1991) Industrial Control Equipment, Fifteenth Edition

UL 510 1986 (R 1986) Insulating Tape, Sixth Edition

UL 514A 1983 (R 1990) Metallic Outlet Boxes, Seventh Edition

UL 514B 1989 (R 1990) Fittings for Conduit and Outlet Boxes, Second Edition

UL 719	1985 (R 1990) Nonmetallic-Sheathed Cables, Ninth Edition
UL 854	1991 Service-Entrance Cables, Eighth Edition
UL 857	1990 (Errata 1990) Busways and Associated Fittings, Tenth Edition
UL 869	1989 (R 1991) Service Equipment, Seventh Edition
UL 943	1985 (R 1990) (Bul. 1991) Ground-Fault Circuit Interrupters, Second Edition

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

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

1.3.1 SD-02, Manufacturer's Catalog Data

- A. Switches
- B. Wires and cables

1.3.2 SD-04, Drawings

- A. Panelboards

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's Representative.

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 IMC conduit, or flexible metal conduit, (liquid tight flexible conduit), conforming to the following:

2.2.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2, or fiberglass conduit, in accordance with NEMA TC 14.

2.2.3 Plastic-Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40 (40 mils thick).

2.2.4 Flexible Metal Conduit

UL 1.

2.2.4.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.5 Fittings for Metal Conduit, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.5.1 Fittings for Rigid Metal Conduit

Threaded-type. Split couplings unacceptable.

2.2.5.2 Fittings for Use in Hazardous (Classified) Locations

UL 886.

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

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 and signal circuits, classes 1, 2, and 3, may be stranded. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. Conductors 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 & 480/277 volt, 3-phase
 - (1) Phase A - brown
 - (2) Phase B - orange
 - (3) Phase C - yellow
- B. 120/240 volt, single phase: Red and black
- C. On 3-phase, 4-wire delta system, high leg shall be orange, as required by NFPA 70.

2.5.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600 volt, Type XHHW conforming to UL 44, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.5.4 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 wires No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlets, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, 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

FS W-S-896, totally enclosed with bodies of thermosetting plastic and mounting strap. Handles shall be ivory. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type ac only, 120 volts, with current rating and number of poles indicated.

2.8.2 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 4X, enclosure per NEMA ICS 6.

2.8.3 Breakers Used as Switches

For 120-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.9 RECEPTACLES

UL 498 and NEMA WD 1, general grade, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap.

2.9.1 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 (NEMA 3R)

UL 67 and UL 50. Panelboards for use as service disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit of panelboard. Directories shall also indicate source of service (upstream

panel, switchboard, etc.) to panelboard. 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. In addition to equipment grounding bus, provide second "isolated" ground bus, where indicated..

2.10.2 Circuit Breakers

FS W-C-375, UL 489, thermal magnetic-type with interrupting capacity as indicated of 22,000 minimum amperes rms symmetrical. Breaker terminals shall be UL listed as suitable for the type of conductor provided. Plug-in circuit breakers 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 MOTOR CIRCUIT PROTECTORS (MCP)

Motor circuit protectors; NEMA AB 1 and UL 489. MCPs shall consist of an adjustable instantaneous trip circuit breaker in conjunction with a combination motor controller which provides coordinated motor circuit overload and short circuit protection. MCPs shall be rated in accordance with NFPA 70. Circuit breaker shall be capable of being locked in the off position.

2.13 TRANSFORMERS

NEMA St 20, general purpose, dry-type, self cooled, and ventilated. Provide transformers in NEMA 1 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. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.14 MOTORS

NEMA MG 1; Hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.

2.14.1 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 or, alternatively, manually operated nonfused switch which disconnects motor from source of supply shall be placed within sight of motor location. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

2.15.1 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from a separate control source. Provide terminals and terminal boards. Provide separate control disconnect switch within controller. One secondary lead shall be fused; other shall be grounded.

2.15.2 Enclosures for Starters and Controllers

NEMA ICS 6.

2.15.3 Terminal Blocks

NEMA ICS 4.

2.16 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be sectional type, copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet or 20 feet as indicated.

2.17 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, installation and electrical equipment shall conform to appropriate hazardous area classifications.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 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. 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 conduit, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Provide bare or insulated, green equipment grounding conductor in feeder and branch circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide bare or insulated, green conductor for grounding conductors installed in conduit or raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be metallic on both sides of fire-rated walls, fire-rated partitions, or fire-rated floors for minimum distance of 6 inches.

3.1.3.1 Restrictions Applicable to Aluminum Conduit

Do not install underground or encase in concrete or masonry. Do not use brass or bronze fittings.

3.1.3.2 Service Entrance Conduit, Overhead

Rigid steel from service entrance to service entrance fitting or weatherhead outside building.

3.1.3.3 Service Entrance Conduit, Underground

Galvanized rigid steel. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.3.4 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to rigid steel conduit or steel IMC before rising through floor slab.

3.1.4 Conduit Installation

Unless indicated otherwise, conceal conduit within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.4.1 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finish slab.

3.1.4.2 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. Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 10-foot maximum intervals. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.

3.1.4.3 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.4 Pull Wire

Install pull wires in empty conduits in which wire is to be installed by others. Pull wire shall be plastic having minimum 200-pound tensile strength. Leave minimum 12 inches of slack at each end of pull wire.

3.1.4.5 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.

3.1.4.6 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.

3.1.4.7 Flexible Connections

Provide flexible connections of short length, 6-foot maximum, for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow slack. Provide liquid-tight flexible conduit in wet locations. Provide separate ground conductor across flexible connections.

3.1.5 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 when located in wet locations, when surface mounted on outside of exterior surfaces, when installed exposed up to 7 feet above interior floors and walkways, or when installed in hazardous areas. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture 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 installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports, or make adequate provisions for distributing load over ceiling support members in an approved manner. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.5.1 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. Telephone outlets shall be minimum of 4 inches square by 1 1/2 inches deep.

3.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Furnish boxes with

screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6 Mounting Heights

Mount panelboards, circuit breakers, and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor, receptacles 18 inches above finished floor, and other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.7 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. Identify control circuit terminations in accordance with Section 16900, "Controls and Instrumentation - General."

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 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. Make ground connection to driven 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.

3.1.10.1 Grounding Conductor

Provide bare or insulated, green equipment grounding conductor in feeder and branch circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide bare or insulated, green conductor for grounding conductors installed in conduit or raceways.

3.1.10.2 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer's Representative for further instructions.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer's Representative 5 working days notice prior to any tests.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 600 Volt Wiring Test

Test 600-volt wiring to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground does not exceed 5 ohms. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer's Representative, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

--End of Section--

SECTION 16510
INTERIOR/EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|------------|--|
| ANSI C82.1 | 1985 (Supp. 1990) Ballasts for Fluorescent Lamps |
| ANSI C82.2 | 1984 (R 1989) Fluorescent Lamp Ballasts - Methods of Measurement |

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

- | | |
|----------|--|
| IES LHBK | Lighting Handbook, Reference (1984) and Application (1987) Volumes |
|----------|--|

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- | | |
|----------|--|
| NFPA 70 | 1990 National Electrical Code |
| NFPA 101 | 1991 Code for Safety to Life from Fire in Buildings and Structures |

UNDERWRITERS LABORATORIES INC. (UL)

- | | |
|---------|--|
| UL 935 | 1984 (R 1990) (Bul. 1990) Fluorescent-Lamp Ballasts, Seventh Edition |
| UL 1570 | 1988 (R 1990) Fluorescent Lighting Fixtures, Third Edition |

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."

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.

PART 2 - PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1570.

2.1.1 Fluorescent Lamps

Provide the number, type, and wattage indicated. Slim line lamps shall be rated 40 watts, 3000 approximate initial lumens, 9000 hours average rated life.

2.1.2 Fluorescent Core and Coil Ballasts

UL 935, ANSI C82.1, and shall be labeled Certified Ballast Manufacturers (CBM) certified by Electrical Testing Laboratories (ETL). Ballasts shall be high power factor type unless indicated otherwise and shall be designed to operate on the voltage system to which they are connected. Ballasts shall be Class P and shall have sound rating "A" unless otherwise noted. Fixtures and ballasts shall be designed and constructed to limit the ballast case temperature to 90 degrees Celsius (C) when installed in an ambient temperature of 40 degrees C. Provide four lamp fixtures with two ballasts per fixture.

2.1.2.1 Energy-Saving Ballasts

Ballasts shall be high power factor (≥ 0.9) stl. CBM approved rapid start Class P energy saving ballast with an "A" sound rating. Provide energy-saving fluorescent ballasts of the CBM certified full light output type. Ballasts shall have an average input wattage of 86 or less when operating two F40T12 lamps, 50 or less when operating one F40T12 lamp, and 172 or less when operating four F40T12 lamps tested in accordance with ANSI C82.2 methods. Ballast shall be compatible for use with energy-saving lamps.

2.1.3 Open-Tube Fluorescent Fixtures

Provide with spring-loaded telescoping sockets, self-locking sockets, or lamp retainers (two per lamp).

2.1.4 Fixtures in Hazardous Areas

Provide fluorescent fixtures and lamps suitable for hazardous area classification where required.

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 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 for lighting fixture support in this section.

--End of Section--

SECTION 16900

CONTROLS AND INSTRUMENTATION, GENERAL

PART 1 - GENERAL

1.1 REFERENCES

Publications listed in Section 16011, "Electrical General Requirements," form a part of this specification and the 16900 series which follow.

1.2 DESIGN BASIS - INSTRUMENTATION CONTROL AND ALARM SYSTEM

1.2.1 General

The instrumentation and alarm system to be furnished and installed encompasses the following functions:

- A. Monitoring, indication, and control of treatment process parameters.
- B. Status monitoring of process equipment.
- C. Alarm indication of process parameter deviation from limits.
- D. Alarm indication of abnormal equipment operating and safety conditions.
- E. Motor starters for pumps and blowers.

1.2.2 System Overview

The instrumentation control system consists of the following equipment integrated in a complete system. The system will perform control, indication, alarming, motor start/stops.

- A. Control panels for both sites with the following equipment mounted, wired, and tested.
 - 1. Microprocessor based controller for level. Bldg. 780 only.
 - 2. Programmable Logic Controller (PLC) for motor control from panel mounted switches and process parameter interlocks. The PLC shall also provide I/O for digital alarm points, motor status and analog indications. The PLC shall also have I/O for motor start/stop and motor status.
 - 3. Annunciator for alarms from PLC outputs and direct inputs.
- B. Specifying:
 - 1. To maintain functional continuity of the specification presentation, instrumentation is treated on a system basis and grouped where feasible (e.g. flowmetering systems, level systems, etc.).
 - 2. Individual component instruments are specified in the pertinent sections covering the particular operating system in which they are contained.
- C. Manufacturer: It is intended that control panel receiving and control instruments (recorders, controllers) be of the same manufacture to present a unified appearance and permit grouped mounting.
- D. Tagging:
 - 1. All instrumentation items defined by instrumentation tag number as shown on Drawings P-1 and P-2 are to be permanently marked with such number by the supplier prior to delivery.

2. Marking to be permanently stamped on stainless steel tag pinned or securely fastened to device.
3. Instrument tag numbers within each section are not consecutive; some numbers within each series are unused.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CALIBRATING AND OPERATION

- A. Calibrate all components to process parameters.
- B. Fully test and adjust entire system to meet process dynamics to satisfaction of Owner and Engineer.
- C. Provide personnel to instruct Owner's operating personnel in operation of instrumentation, computers and PLC.
- D. Supply completed calibration data sheets for each instrument including final control parameters selected for system dynamics.

-- End of Section --

SECTION 16910

FLOWMETERING, PRESSURE AND VACUUM SYSTEMS

PART 1 - GENERAL

1.1 SUBMITTALS

1.1.1 SD-02, Manufacturer's Catalog Data

- A. Flow Meters
- B. Flow Switches
- C. Pressure Gauges
- D. Vacuum Switches

1.1.2 SD-04, Design Data

Provide capacity ratings, indicator scales, power requirements, and wiring methods.

1.2 DESCRIPTION

- 1.2.1 Furnish and install instrumentation systems to measure, indicate, and record various process flow rates, vacuums, and pressures, at locations indicated and specified herein.

PART 2 - PRODUCTS

2.1 FLOWMETERING SYSTEMS

2.1.1 Averaging Pitot Tube Flow Meters FI-106, FI-107, FI-108, FI-109, FI-119, FI-216, FI-217, FI-226

- 2.1.1.1 Insertion type pitot tube with multiple holes for averaging velocity and a static pressure tap. Provide the flow meters with local differential pressure indicator scaled in scfm appropriate to flow rate.

2.1.2 Flow Switch FS-202

- 2.1.2.1 Insertion type, pipe size 3/8" SPDT 5 amp contact with activation points as follows: FSL-202 ON at 0.6 gpm, OFF at 0.03 gpm.

2.1.3 Liquid Flow Meter and Flow Integrator (FM-203, FQI-203, FSL-203)

- 2.1.3.1 Flow meter-paddle wheel type, $\pm 1\%$ accuracy full scale, 1" GS pipe, mounting fitting, range 0-10 GPM with separate panel mounted, 120 VAC powered, flow indicator/integrator scaled to match flow meter, 4 digit LCD display indicator scale 0-10 GPM; integrator to accumulate every 10 gallons. Flow switch 2-3 Amp SPDT relays, shutdown at 1 GPM falling, 120 VAC power. Flow meter/indicator/integrator/flow switch system to be suitable for Class I, Group D, Div. II location.

2.2 PRESSURE SYSTEMS

2.2.1 Pressure Gauges & Vacuum Gauges PI-101, PI-118, PI-122, PI-123, PI-124, PI-125, PI-126, PI-127, PI-128, PI-129, PI-130, PI-131, PI-132, PI-133, PI-134, PI-204, PI-225, PI-232, VI-103, VI-110, VI-111, VI-113, VI-115, VI-214, VI-215, VI-218, VI-220, VI-221, VI-223, VI-228, VI-229, VI-230, VI-231

2.2.1.1 4 1/2" dial, black phenol case, bottom connection 1/2" MNPT 316SS, 316SS Bourdon Tube. Provide gauge guards (diaphragm seal). Pressure gauges 0-60" wc; vacuum gauges 30-0" wc vac. (PI-101 and PI-124 thru PI-134 0-150" wc and PI-204 and PI-232 0-120 psi.)

2.2.3 Pressure and vacuum switches PSH-102, PSH-120, PSH-227, VSH-104, VSH-114, VSH-222.

2.2.3.1 Diaphragm type pressure and vacuum switches W-2 - SPDT 15A 125/250 VAC, adjustable set point and dead band; NEMA 3 or 7, 9 to suite area classification, with set point to suite equipment to be protected. Pressure switches to have a range of 0-60" wc (except PSH-102 which shall have a range of 0-150" wc), vacuum switches 30-0" wc vacuum.

PART 3 - EXECUTION

3.1 Installation

3.1.1 Install and calibrate in accordance with manufacturer's recommendations.

--End of Section--

SECTION 16925

PROGRAMMABLE CONTROLLERS (PLC)

PART 1 - GENERAL

1.1 REFERENCES

Not used.

1.2 SUBMITTALS

1.2.1 SD-02, Manufacturer's Catalog Data

- A. Central processor
- B. Peripheral equipment

Provide manufacturer's information in such detail that one can judge PLC capability with that specified herein.

1.2.2 SD-04, Drawings

- A. PLC and control panel

Provide adequate wiring schematics and ladder logic.

1.3 DESCRIPTION

1.3.1 The programmable control systems to be furnished, installed and programmed under this contract are intended to provide start/stop functions for treatment systems equipment and pumps as well as digital inputs/outputs for alarms.

1.3.2 Specific items not covered by these specifications but deemed necessary by the supplier of the programmable control system shall provide such items to complete a functional system.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

2.1.1 The programmable controller systems shall conform with the following requirements:

- A. Perform logic decision-making for control applications without use of relays.
- B. Programming shall be performed in a ladder diagram type format and be performed by the Contactor or his control system supplier.
- C. Suitable for operation over an ambient temperature range of 0°C through 55°C in an environment subject to electrical transients, RFI, electromagnetic interference, and vibration, and also suitable for Class 1, Div. 2, Group D for Building 780.
- D. Designed and constructed in accordance with the latest applicable regulations and standards of the following agencies:
 - 1. National Fire Protection Association, National Electrical Code.
 - 2. Occupational Safety and Health Act.

3. National Electrical Manufacturer' Association.
4. American National Standards Institute.
5. Federal Communications Commission.

2.2 SYSTEM COMPONENTS

2.2.1 Central Processors

- A. Microprocessor-based completely solid-state unit capable of program storage and performing all logic, scanning sequences, and external and internal control functions required by the system, complete with programming module.
- B. CMOS semiconductor memory:
 1. Increments of 16 or 32-bit words, lithium battery protected.
 2. Memory modules offering 16K minimum shall be included.
 3. Batteries: Capable of protecting data in memory for a minimum of 6 months in the event of normal power failure.
 4. Processor speed minimum 10 MHZ.
- C. The central processor and its associated power supply unit shall operate within the following parameters:

input voltage	120VAC 60 hz
input voltage range	100 to 130 VAC
frequency range	47 to 63 hz

- d. Include prefabricated cabling requirements between the power supply unit and the central processor.

2.2.2 Processor Mounting: The central processor, its power supply, and programming module shall be housed in the associated Control Panel. All interconnecting cables shall be included.

2.2.3 Input/Output (I/O) Requirements

- A. Supplier to determine I/O requirement for each system. Thirty percent additional operational I/O capacity shall be included, beyond that required by the system. Include a minimum of three spare slots for future I/O cards.

2.2.4 Peripheral Equipment

- A. Programmer - A portable programmer for operation with the programmable controller shall be provided. Programming shall be done in relay ladder diagram language.
- B. Program Recorder - The PLC system shall include a printer interface for purposes of making permanent records of the program in memory and the reloading of new program material; interface shall communicate to printer through the treatment plant computer.
- C. Drawing and Documentation Requirements - System shall be capable of, but not limited to, the development of the following:
 - Pictorial representation of the ladder diagram with rung numbers
 - Rung commentary
 - Element descriptions
 - Rung cross-references and cross-reference report
 - Address usage report
- D. Printer - provide a wide carriage 24 pin dot matrix printer

2.2.5 Additional Features

- A. Arithmetic functions shall be included as well as enhanced instruction to support requirements of control logic.
- B. System shall support an operator's interface device through the treatment plant computer for the reading and setting of process timings.
- C. Clock: Date and time of day is required for some program decision making. Include a clock module as part of the system with date and time functions in day of week, month, year, hours, minutes, and seconds. Accuracy of ± 1 millisecond maximum with battery backup to hold time and date for 48 hours minimum on loss of power.

PART 3 - EXECUTION

3.1 GENERAL

Furnish a complete and operational system and perform such tests and demonstrations as may be required to assure compliance. Provide documentation of such tests and submit to government as part of records.

3.2 TRAINING

Include 3-days service from the Programmable Controller representative to instruct the Owner's personnel in operation, maintenance and troubleshooting of the equipment.

3.3 INSTALLATION

Install in accordance with manufacturer's instructions.

--End of Section--

SECTION 16930

TEMPERATURE INDICATION AND CONTROL SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

Not used.

1.2 SUBMITTALS

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

1.2.1 SD-02, Manufacturer's Catalog Data

A. Temperature Indicators (TI-100, TI-117, TI-224)

1.3 DESCRIPTION

1.3.1 Work included: Furnish and install temperature sensing and indicating systems for monitoring and control in soil vapor extraction and air sparge manifolds, as indicated on the drawings.

PART 2 - PRODUCTS

2.1 TEMPERATURE INDICATORS

2.1.1 Temperature Indicators (TI-100, TI-117, TI-224)

2.1.1.1 Thermometers - 5" dial, hermetically sealed, bimetallic, $\pm 1\%$ accuracy, SS bellows movement, every angle, 1/2" NPT connection, SS case 2 1/2 " (1/4" Dia. SS) stem. Range 0-200°F.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Install and calibrate in accordance with manufacturer's recommendations.

--End of Section--

SECTION 16962

LEVEL SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

Not used.

1.2 SUBMITTALS

1.2.1 SD-02, Manufacturer's Catalog Data

A. Level switches

Provide general description, features, and capabilities.

1.3 DESCRIPTION

1.3.1 Work Included: Furnish and install sensing and indicating systems for level switches and in certain process storage and collection vessels, pipes, and wells.

1.3.2 Work Not Included: Level activated devices (interlocks, alarms) which are an integral part of factory assembled equipment are detailed as to specific function in the appropriate section covering the equipment.

PART 2 - PRODUCTS

2.1 LEVEL SYSTEMS LSH-112, LSSL-201, LSL-213, LSH-219

2.1.1 Level Switches

2.1.1.1 Float type point level switches to be mounted on tanks, sumps or wells. Floats and rods to be appropriate to fluid and mounting locations. Switches shall be NEMA 4, 7, or 9 appropriate to location installed. Provide mounting brackets or connections as required. 10 amp S.P.D.T. switch shall be provided for each set point. Set switches at levels appropriate to protect equipment.

The settings are to be adjusted based on final equipment sizing and selection.

Ensure that level switch LSSL-201 fits into the 1" Sch. 80 PVC pipe mounted in the well, and is easy to maintain.

2.2.1 Level transmitter and controller LT-200, LIC-200

2.2.1.1 Level transmitter to be diaphragm head type level transmitter, $\pm 1/2\%$ accuracy, 4-20 ma output, atmospheric compensation, scale to match well level. Ensure transmitter sits in the 1 1/2" Sch. 80 PVC pipe mounted in the well and is easy to maintain.

2.2.1.2 Level controller microprocessor based, 3" x 6" nominal panel mounted, built in selectable easily accessible control algorithms including PID, Autotune, etc. 2 relay outputs for connection to

PLC to start and stop well pump. 4-20 ma output for future use.
Scale to match well. Suitable for Class 1, Group D, Div. 2.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Install and calibrate in accordance with manufacturer's
recommendations.

--End of Section--

SECTION 16966

ANNUNCIATORS

PART 1 - GENERAL

1.1 SUBMITTALS

1.1.1 SD-02, Manufacturer's Catalog Data

A. Annunciator panels

Provide general panel features.

PART 2 - PRODUCTS

2.1 ANNUNCIATOR SYSTEMS

2.1.1 Function: Visual and audible indication of abnormal conditions at the field sensing locations.

2.1.2 Separately Cased Solid State Annunciator.

- A. Flush panel mounted, size to match the number of alarms + 30% operational spare windows.
- B. Self-contained, with integral power supply and flasher unit.
- C. An adjustable volume alarm horn.
- D. Each shall have nominal 1-3/8" x 3" backlighted windows.
- E. All points fully equipped with logic circuitry.
- F. Alarm Sequence: Sequence "A", i.e. flashing window and audible signal in alarm condition; acknowledge silences audible alarm, lamp burns steady; clearing of alarm condition automatically resets the alarm point.
- G. Input Circuits: Capable of accepting either normally open or normally closed trouble contacts, individually selectable.
- H. Power Supply: 115V, 60Hz.
- I. Legend and Alarm Initiation Schedules: see drawings.
- J. Inputs will be from the PLC.
- K. Provide auxiliary output S.P.D.T. 10 amp rating for future Auto Dialer.
- L. Suitable for Class 1, Group D, Div. 2 in Bldg. 780.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Install as required by the manufacturer's instructions.

--End of Section--

SECTION 16980

ALARM/DATA TELEMETERING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

Furnish and install a two-channel automatic telephone dialer at the treatment plant. One channel shall transmit alarms; the other future use. Alarms will be generated by the PLC.

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

1.2 SUBMITTALS

1.2.1 SD-02 Manufacturer's Catalog Data

- A. Auto Dialer
- B. Battery Backup

1.2.3 SD-04 Drawings.

- A. Auto Dialer
- B. Dimensions of accessories to insure that the system will fit in control panel.

1.3 QUALITY ASSURANCE

1.3.1 Suggested Manufacturers:

- A. Adcor
- B. Ademco
- C. LSI
- D. or others meeting the requirements of Part 2.

PART 2 - PRODUCTS

2.1 AUTOMATIC DIALING EQUIPMENT (16980.01, .02)

2.1.1 Function:

- A. Monitors normally open trouble contacts.
- B. Activates the appropriate channel and calls a predetermined telephone number(s).
- C. Delivers a taped message stating the nature of the alarm.
- D. Provides the capability of calling several numbers, in succession, until a call is answered.
- E. Upon a successful call, the person receiving the call has the means to signal the automatic dialer that the call has been completed, whereupon the automatic dialer hangs up and resets itself, then being ready to react to a new input.
- F. When either channel is tripped, the tape recycles until acknowledged.

2.1.2 Adjustments:

- A. Provide an adjustment to delay starting the tape drive motor from 2 seconds to at least 90 seconds.
- B. If, during this delay time, or at any time that the automatic dialer is placing calls, the activating contact is reopened, the automatic dialer immediately disconnects and resets itself to the beginning of the first number to be called.
- C. When tripped, provide a memory circuit so that, after the completion of messages on either channel one or more of the contacts on the other channel are closed, the automatic dialer dials the numbers programmed on the other channel.

2.1.3 Telephone Company Compatibility:

- A. Upon activating, the automatic dialer seizes the regular telephone circuit.
- B. Connect to the telephone line through an alarm coupler furnished by the local telephone company.
- C. Provide proper connecting cable for connecting into the alarm coupler.
- D. Provide the necessary power and control switching for the coupler, with no auxiliary equipment or power source necessary.
- E. All dial pulses and voice message inputs to the coupler shall meet the requirements of the telephone companies.

2.1.4 Direct the first call to the Contractor's office on the base.

2.1.5 Program voice messages and alternate numbers on the tape as directed by the Contracting Officer's Representative.

2.1.6 Standby Operation:

- A. Equip with batteries and a recharging circuit powered by 115 VAC 60 hz.
- B. Provide a pilot light to indicate when AC power is on.
- C. Standby Capacity: Sufficient to sustain one hour of tape recycling or eight hours with the system in standby, after complete power failure.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 General:

- A. Completely install the system from the telephone jack to the control panel and either underground to the utility pole intended for this service, terminating at the elevation normal to such use or underground to the closest telephone manhole as directed by the telephone utility.
- B. Coordinate with the telephone utility for conduit sizing and routing.
- C. The Contractor shall be responsible for telephone charges until completion of the facility and acceptance by the Owner of such charges.

3.1.2 Auto Dialer:

A. Mount in the Control Panels.

3.2 TESTING

3.1.1 Test entire system including all inputs to assure proper operation, both on 115 VAC power and batter backup. Confirm that all call confirmation is working properly.

--End of Section--

SECTION 16992

INSTRUMENT CONTROL PANELS

PART 1 - GENERAL

1.1 SUBMITTALS

1.1.1 SD-02, Manufacturer's Catalog Data

A. Control panel

1.1.2 SD-04, Drawings

A. Control panel features

B. Layout dimensioned

C. Wiring diagrams including interface with other equipment, terminal numbers

D. Internal equipment layout

1.2 DESCRIPTION

1.2.1 General: This section covers the specific requirements for two (2) complete operational instrument control panels.

1.2.2 Work Included

A. The Contractor shall be responsible for furnishing and installing subject panel and insuring full operational capability and conformance to the Drawings and Specifications.

B. Certain process equipment systems to be supplied on this Contract will include control panels containing instrumentation and controls relating to operation of such equipment. Requirements for these panels are delineated in the specification sections for the equipment.

PART 2 - PRODUCTS

2.1 CONTROL PANELS

2.1.1 Construction

A. General panel arrangement is shown on the Drawings.

B. Unistrut or angle iron mounted on sufficient supports, single door-front access NEMA 3R control cabinet.

C. 72 in. by 48 in. by 20 in. minimum, Bldg. 780; 48 in. by 36 in. by 20 in. minimum, Bldg. 106.

D. Provide additional bracing as required to support equipment.

E. Bldg. 780 to be purged in accordance with NEC to be suitable for Class I, Group D, Div. II.

2.1.2 Panel Electrical Design and Wiring

A. Follow accepted standard control panel practice and conform to the National Electrical Code and State and local codes.

B. Terminations: Screw type terminal blocks; connections made with solderless spade type insulated connectors. DC signal blocks

located separate from blocks carrying AC voltages. A minimum of 10% spare termination points provided. AC terminals to be 600V rated DC terminals to be minimum 300V rated.

- C. Power Distribution: A main breaker panel provided for panel AC power distribution. Separate feeds used for PLC equipment, annunciator system, recorder plugs strip, combination starters and contactors.
- D. Control Devices: Pushbuttons, indicating lights, selector switches, etc. - industrial grade small oiltight units. Indicating lights - transformer type.
- E. Wiring: Grouped and arranged neatly to facilitate tracing of circuits. Signal leads grouped separately from power leads. As far as is practical, wiring run in plastic wiring ducts. Where grouped wires are run outside a duct neatly bundle with plastic wire ties and adequately support. Sufficient slack provided at all termination points to permit connection changes. All wires identified by adhesive markers affixed to each end.
- F. Wire Size and Type
 - 1. AC Power and Control - #14 AWG, stranded, type THW, 1/C.
 - 2. Electronic Signal - #16 AWG, stranded, 2/C twisted pair (where shielded signal wire is required, shield composition to be aluminum-polyester with tinned drain wire).
 - 3. Panel wiring color code:

120V Line leads		Black
120V Neutral leads		White
Ground leads		Green
Electronic cables -	positive	Black
	negative	White
Other wiring		Blue
 - 4. Motor and heater power wiring #10 or #12 AWG XHHW.
- G. Grounding: Instrument cases and wiring devices solidly grounded to the panel frame, by ground lug terminals, one at each end of the panel.
- H. Instrument Outlets: Install multiple outlets as "plug-in" strips for AC powered instruments, one receptacle per instrument, with a minimum of 8 spaces. All front of panel and rear of panel rack mounted equipment powered in this manner. Plug strip receptacles and AC power cords - grounding type.
- I. Lightning Protection: Provide control panels with solid state lightning protection. Such equipment shall dissipate excess voltage surge energy to ground protecting the installed equipment. The equipment shall have reversible action, i.e., "reset" when voltage returns to normal. Provide an internal test function.
- J. Auxiliary Equipment: Interior mounted equipment, such as alarm relays, programmable controller, starters, etc., grouped and mounted on suitable subpanels located for accessibility from rear.
- K. Starters, contactors, and other equipment shall conform to appropriate electrical sections.

2.1.3 Factory Test

Test panel at factory to ensure that wiring and devices are free from defects.

2.1.4 Finishing

- A. Should any chipping or damage occur during manufacture or installation, repair and repaint to match manufacturers finish.

2.1.5 Nameplates

- A. Provide for each instrument on both the front and rear of the panel and for each control and indicating device. Front of panel mounted nameplates - lamicaid type with white letters and contrasting medium brown field. Nameplates for rear of panel mounted devices - mylar or aluminum foil securely fastened to devices.

PART 3 - EXECUTION

3.1 INSTALLATION

- 3.1.1 Install according to manufacturer's instructions.

--End of Section--