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Operable Unit 1 Remedial Design Pre-Final Design Package I

Volume 2 of 2

Fernald Environmental Management Project
Fernald, Ohio
Fernald Area Office



March 1996

EDC

United States Department of Energy

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COMPANY SPECIFICATIONS

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Debris and Process Shredder Performance Specification

Operable Unit 1
Project Order 145
March 1996
Revision D

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487



25 Merchant Street
Cincinnati, Ohio 45246

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U.S DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

FERMCO Subcontract No. 2-21487

Debris and Process Shredder Performance Specification
Divisions 13, 15, and 16

PARSONS

Approved by: _____
S.J. Mallette, CRU-1 Project Manager Date

FERNALD ENVIRONMENTAL RESTORATION MANAGEMENT CORPORATION

Approved by: _____
Thurle Moss, CRU-1 Engineering Manager Date

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Date: 03/06/96
Rev.: D RE: KM

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1 of 1

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/PO-145

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U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERMCO SUBCONTRACT NO. 2-21487

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PROJECT ORDER 145

PERFORMANCE SPECIFICATIONS

SECTION 00003

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U.S. DEPARTMENT OF ENERGY

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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

FERMCO SUBCONTRACT NO. 2-21487

Division 13 - Special Construction

SHREDDER(S) PERFORMANCE SPECIFICATION

PARSONS

Prepared by: _____

Checked by: _____

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1 of 1

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U.S. DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

FERMCO SUBCONTRACT NO. 2-21487

SECTION 13652

SHREDDER(S)

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SECTION 13652
SHREDDER (S)

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for the design, engineering support, fabrication, delivery, and installation assistance for the debris shredder.
- B. Requirements for the design, engineering support, fabrication, delivery, and installation assistance for the process shredder.

1.2 RELATED SECTIONS

- A. Section 15172 - Motors for Shredder(s).
- B. Section 16052 - Basic Electrical Materials and Methods for Shredder(s).

1.3 REFERENCES

- A. American Bearing Manufacturers Association, Inc. (ABMA).
- B. American Gear Manufacturers Association (AGMA).
- C. American Iron and Steel Institute (AISI).
- D. American Society for Testing and Materials (ASTM):
 - 1. ASTM A36/A36M-94 Standard Specification for Carbon Structural Steel.
 - 2. ASTM A325-94 Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
- E. American Welding Society, Inc. (AWS):
 - 1. AWS D1.1-94 Structural Welding Code - Steel, Thirteenth Edition.

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- F. Code of Federal Regulations (CFR):
 - 1. 40 CFR 261, Subparts C and D.
 - 2. 29 CFR 1910/1926.

- G. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code, 1996 Edition.

- H. Steel Structures Painting Council (SPC):
 - 1. SP6-91 Surface Preparation, Specification No. 6 - Commercial Blast Cleaning.

- I. Codes
 - 1. Uniform Building Code - UBC 1994.
 - 2. Ohio Basic Building Code - OBBC 1995.

- J. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7-95 Minimum Design Loads for Building and Other Structures.

1.4 SYSTEM DESCRIPTION

- A. Debris Shredder
 - 1. The debris shredder will be one component in a waste drying facility. The debris shredder will provide size conditioning of debris to meet waste acceptance criteria for final disposal.
 - 2. Waste materials will be excavated from process pits located on the site. Gross materials separation will be performed at the pits. This waste will be transported in batch fashion to the waste preparation facility and will be temporarily stored. Waste material will then be moved in batches from temporary storage and passed through a grizzly with 12 inch by 12 inch openings. The oversized material off the grizzly will be collected and manually separated into two categories: shreddable and non-shreddable. The undersized material that falls through the grizzly will be caught on a conveyor belt and passed through a metal detector. Any metal identified by the detector is to be diverted to a pile. This

diverted pile will be manually separated into two categories: shreddable and non-shreddable. Shreddable materials from these two sources and shreddable materials separated at the pits will be fed to the debris shredder. The following materials are expected to be fed to the debris shredder:

- a. Agglomerated clay, magnesium fluoride slag, and lime - greater than 4-inch diameter.
 - b. Dust collector bags.
 - c. Graphite crucibles and molds.
 - d. Rocks, bricks, and ceramics (12 inch by 12 inch by 2 inch).
 - e. 55- to 85-gallon steel drums.
 - f. Reinforced concrete blocks (2 feet by 2 feet by 12 inches).
 - g. Wood and pallets approximately 4 feet wide by 4 feet long, made of 4-inch by 4-inch pressure-treated wood.
 - h. Light gage structural steel such as 2-inch by 2-inch by 1/4-inch angles, 2-inch by 6-inch by 1/4-inch channels, etc. I-beams are not to be processed through the shredder.
 - i. Polyethylene and plastic materials.
3. Materials will be fed into the debris shredder through a top-mounted hopper. A backhoe with grapple attachment (furnished by others) will load the waste material into the debris shredder system in bulk batches. Access to the top of the hopper must remain clear for this purpose. The debris shredder system will be required to size reduce the materials to no more than 4 inches in any two dimensions, and the third dimension cannot exceed 4 feet. The shredder will discharge out at the bottom onto an apron conveyor (furnished by others).
4. The Seller shall provide the debris shredder (mounted on a base frame) and the feed hopper, sized to support the operating system. The base frame will be mounted to a support frame (supplied by others) which will position it relative to the other facility equipment. The Seller shall also supply the hydraulic power unit (if applicable) on

a separate skid with all interconnecting hoses and a local control. An option shall be provided for the inclusion of a dust suppression system.

B. Process Shredder System

1. The process shredder system is another component in a waste drying facility. The process shredder system provides size conditioning of waste soils and debris to meet size limitations of "downstream" process equipment.
2. Waste materials will be excavated and separated as described in Article 1.4, Paragraph A, Subparagraph 2. Waste materials that have had tramp materials removed and are less than 12 inches in size will be discharged to a pile. A front-end loader will load this waste material into a skip hoist that feeds the process shredder system. The following materials are expected to be fed to the process shredder system:
 - a. Agglomerated wet sludges (see test data in Appendix B).
 - b. Agglomerate clay, magnesium fluoride slag, and lime - less than 12-inch diameter.
 - c. Graphite crucibles and molds.
 - d. Rocks and ceramics.
 - e. Concrete block fragments.
 - f. Wood fragments.
 - g. Polyethylene and plastic materials.
 - h. Random pieces of metal (<12-inch size) that could not be detected at the metal detection system.

The majority of the feed material will be agglomerated wet sludges (about 95 percent by weight); the balance is made up of random amounts of the other materials.

3. Materials will be fed into the process shredder system through a top-mounted hopper. A skip hoist (furnished by others) will load the waste material into the process shredder top-mounted hopper. The process shredder system will be required to size reduce the feed materials to no more than 4 inches in any dimension. The process shredder will

discharge out the bottom onto a conveyor (furnished by others).

- 4. The Seller shall provide the process shredder system complete with feed hopper. The system may consist of two shredders in series or any other arrangement the Seller may suggest to size reduce waste to less than 4 inches in any direction. The Seller shall also supply the hydraulic power unit (if applicable) on a separate skid with all interconnecting hoses and a local push-button control station. An option shall be provided for the inclusion of a dust suppression system.

1.5 SUBMITTALS

- A. The following shall be provided with the proposal for each shredder:
 - 1. Description of shredding process focusing on how the Seller's equipment meets or exceeds the requirements of this specification. Include estimated capacities for each shredder.
 - 2. Preliminary dimensioned outline drawings for the equipment and systems, including estimated weights and mounting bolt locations, and locations for all Seller-supplied equipment.
 - 3. Preliminary Instrument and Control Diagrams depicting instruments, logic, control, and interlocks for motor starters and control panel.
 - 4. Preliminary magnitude and location of all static and dynamic loads from all major equipment.
 - 5. The Seller may propose different components than those specified as additional alternatives, providing they meet the technical requirements of this specification. These alternates shall be included in the proposal package. Also, the Seller shall take exception to the specification when conflicts exist. Both Seller's alternates and exceptions shall be stated according to the requirements of Article 1.6.
 - 6. Quality assurance/quality control procedures.
 - 7. The Seller shall complete and return Data Sheets located in Appendix A for each shredder system.

8. The Seller shall provide written notification of any flammable hydraulic fluids and any hazardous substance as defined under 40 CFR 261, Subparts C and D, integral to the equipment and required for shipping, installation, operations, or maintenance of the equipment supplied under this specification.
9. The Seller shall provide spare parts requirements with prices and deliveries for 1 year's operation, with mandatory start-up spares identified. The Seller shall also include consumable requirements for normal operation. Consumables are items which must be replenished due to deterioration, wear, failure, or maintenance within a 6-month period of normal operation.
10. A weekly schedule (bar chart) of Seller activities from date of award to delivery of the shredder to the site. The schedule shall include specific hold points that will be placed in the Seller's production process to allow FERMCO to witness fabrication, inspections, and tests. Each hold point shall not exceed 2 weeks, but shall be subject to negotiation at subcontract award.
11. The Seller shall provide a warranty on all major components and subassemblies for workmanship and materials that is good for 2 years minimum from the final acceptance.
12. The Seller shall provide the construction/installation schedule for the shredder package, indicating the Seller's involvement and services.

B. After Award of Subcontract: Within 6 weeks after award, the Seller shall submit the following information for each shredder for approval prior to start of fabrication:

1. Certified shop drawings for the equipment arrangement, including estimated weights and skid mounting bolt locations (size and structural loadings). Drawings shall indicate the extent of assembly of equipment or fabrication size which Seller will ship to the site. In addition, the

- 1 drawing shall bear the seal of a registered Professional Engineer. 1
- 2
- 3 2. Mounting bolt load (including sizes) calculations 3
- 4 bearing the seal of a registered Professional 4
- 5 Engineer. Mounting bolt load and size 5
- 6 calculations shall include the effects of wind and 6
- 7 seismic loads, as follows: 7
- 8 a. Seismic Load: Use provisions of the Uniform 8
- 9 Building Code (1994), using $Z = 0.13$, $C =$ 9
- 10 2.75 , $I = 1.25$ and $R_w =$ Reduction Factors 10
- 11 from Table 16-P. Total seismic load shall 11
- 12 include all normal operating components and 12
- 13 attachments. 13
- 14 b. Wind load: Basic wind speed of 80 mph (per 14
- 15 OBBC 1995). I (importance factor) = 1.07 , 15
- 16 exposure C. Determine the wind loads using 16
- 17 factors and coefficients as stipulated in 17
- 18 ASCE 7-95, Table 4. 18
- 19 3. Electric system control diagrams. 19
- 20 4. Electric system single line diagrams. 20
- 21 5. Hydraulic system schematic diagrams, if 21
- 22 applicable. 22
- 23 6. Materials of construction of the shredder. 23
- 24 7. Power requirements and connection points. 24
- 25 8. The Seller shall furnish the paint system 25
- 26 specification, including colors, name of 26
- 27 manufacturer, Material Safety Data Sheets (MSDSs), 27
- 28 and other pertinent information to FERMCO for 28
- 29 approval. 29
- 30
- 31 C. The following shall be submitted for each shredder 31
- 32 during fabrication: 32
- 33 1. Report for inspection during fabrication: The 33
- 34 Seller shall furnish reports describing resolution 34
- 35 of disagreements and nonconformance discovered 35
- 36 during prefinish inspection(s). 36
- 37
- 38 D. The following shall be submitted for each shredder at 38
- 39 shipment: 39
- 40 1. The Seller shall provide approved Operations and 40
- 41 Maintenance (O&M) Manuals. As a minimum, the O&M 41
- 42 Manuals shall contain the following information: 42

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- a. Operating procedures, including start-up instructions and emergency shutdown. 3
 - b. Instructions for maintenance. 4
 - c. Installation instructions. 5
 - d. Troubleshooting guide. 6
 - e. Maintenance schedule and service guide. 7
 - f. Parts list and diagrams of major components to be maintained. 8
2. The Seller shall provide certified test results from all shop testing of equipment provided under this specification. 9
 3. The Seller shall supply MSDSs for all chemical compounds supplied or required for operations and maintenance of equipment supplied under this specification, including preservatives, hydraulic fluids, oils, lubricants, and greases. 10
 4. The Seller shall provide a procedure for cleaning, handling, inspecting, repackaging, and storing all equipment supplied under this specification. 11
 5. The Seller shall provide a list of all equipment required for installing the equipment provided under this specification, including recommended rigging for each seller-supplied module. 12
 6. The Seller shall provide a detailed 2-year warranty for all components, workmanship, and materials. 13

1.6 SELLER'S STATED DEVIATIONS AND SUBSTITUTIONS 14

A. Seller's Responsibility 15

The Seller is to submit in writing to FERMCO exceptions or proposed changes to this specification as alternates in the proposal package. Each exception or proposed change shall: 16

1. Identify the item (component) as specified in this specification. 17
2. Identify the criteria that cannot be met or proposed for change. 18
3. Present the proposal for resolution and/or for alternate. 19

B. FERMCO's Responsibility
 All deviations from this specification or substitutions offered by the Seller will be evaluated during proposal technical evaluation by FERMCO. However, these deviations and substitutions will not be evaluated if they are not properly presented in the proposal package as required by this article. In addition, approved exceptions will ultimately result in revision to the specification to incorporate the exception.

1.7 **QUALITY ASSURANCE**

- A. Quality Assurance Program Requirements
1. The Quality Assurance Program shall include the following items:
 - a. Design Control: Provide a program to identify control measures used to ensure that design requirements, including quality standards, are defined and verified as applicable, and are accurately represented in drawings, specifications, and procedures.
 - b. Instructions, procedures, and drawings: The Seller's activity affecting quality shall be prescribed by and performed in accordance with documented instructions, procedures, or drawings. These documents include criteria for acceptance.
 - c. Document control: Control the preparation, issue, and change of documents that specify quality requirements or prescribe activities affecting quality to ensure that correct documents are employed.
 - d. Inspection: Plan and execute inspections to verify conformance to purchase order quality and technical requirements. These inspections shall be documented and approved by FERMCO. Notification of the site is required at least 2 weeks prior to the performance of the inspection. Witness hold points will be mutually agreed to between the Seller and FERMCO before the start of fabrication.

- e. Test control: Plan and execute tests verifying conformance of an item or process according to written procedures which contain the test requirements and acceptance limits. Notification of the site is required at least 2 weeks prior to the performance of the test.
- f. Control of test and measuring equipment: Control and calibrate all tools, gauges, instruments, and other devices used for activities affecting quality. Documentation shall be maintained and made available showing traceability of calibrated equipment to NIST NOT IN REFERENCES.
- g. Inspection, test, and operating status: Provide for the identification of acceptance status of items procured by the tagging, marking, or documents traceable to the items required by the specifications.
- h. Control of nonconforming items: Provide for items or processes that do not conform to procurement document requirements. Nonconformances shall be controlled to prevent inadvertent installation or use, and shall be documented.
- i. Quality assurance records: Generate, compile, and maintain all program records that furnish documentary evidence of quality, and provide records as specified by the procurement document.

B. Source Inspections/Test: Equipment will be tested at the shop to ensure that all components for each shredder operation function safely and according to operating parameters.

1. Successful completion of shop testing shall be confirmed by issuing certified copies of the test reports to FERMCO.
2. Shop testing and inspection shall take place at the Seller's shop, with both FERMCO and Seller present. The Seller shall be responsible for necessary modifications or adjustments to each shredder.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: The Seller shall prepare and package each shredder system for delivery to ensure that they are not damaged and that components are not lost or diverted during shipment to the site. Shipment shall be made in accordance with the Seller's approved shipping plan. The Seller will pay all shipping and insurance costs required to safely deliver each shredder to the site.

1. Shipping Plan: A shipping plan shall be prepared in accordance with the subcontract instructions and submitted to FERMC0 for approval a minimum of 6 weeks prior to shipment. The plan shall define routing, precautions, shipping weights of major components, loading and handling requirements, carrier, shipping documents, and any other data to ensure safe and timely delivery of the requisitioned item. Shipments which may present potential personnel safety hazards at the receiving site due to conditions such as pressurized containers, non-life-supporting atmospheres, hazardous materials, etc. shall be conspicuously marked or labeled with precautionary warnings.

2. Preparation for Delivery and Shipping: Upon completion of assembly, testing, and inspection, the Seller shall prepare all items for shipment and deliver them to the site. All equipment shall be thoroughly clean and dry. All liquid lubricants shall be drained from equipment prior to shipment.

3. Labeling: Each item or unit package shipped shall be clearly labeled with the name of the equipment contained, part and serial number, subcontract number, and destination. Labeled items shall be identifiable on the bill of material and referenced on the general arrangement and detail drawings to facilitate field assembly and installation.

4. Tags and nameplates: Each shredder must be identified by a permanent tag and nameplate, with lettering a minimum of 1/4 inch in height.

B. Acceptance at Site:

1. Acceptance testing and inspection shall take place at the site with both FERMCO and Seller present. The Seller shall be responsible for necessary modifications or adjustments to each shredder to meet the stated performance including all initial lubricants.
2. Acceptance of the debris shredder by FERMCO will be determined by successful completion of the test program. The test shall demonstrate the equipment's ability to consistently process the surrogate materials described in Table 1 of Article 2.4.
3. Acceptance of the process shredder by FERMCO will be determined by successful completion of the test program. The test shall demonstrate the equipment's ability to consistently process the surrogate materials described in Table 1 of Article 2.4.

C. Storage and Protection:

1. Materials, parts, subcomponents, and finished products shall be protected from the natural elements, industrial atmosphere, and hazardous conditions that could cause deterioration, corrosion, or damage. This requirement applies to both interim storage or handling during manufacturing and final shipment to the site.
2. All equipment shall be thoroughly cleaned of loose, spattered, or excess weld metal; metal chips; grease; oil; layout markings; and other foreign material. All components shall be dry prior to packing. All process connections shall be capped or plugged. Padding, bracing, blocking, and lock-wire shall be installed as needed to prevent damage by mechanical shock during handling and transportation. Instruments too heavy or too delicate to be shipped while mounted on the equipment shall be installed, wired up, tested, and then disconnected, removed, packed, and shipped for permanent mounting at the site.
3. Preservatives: Unless otherwise specified or approved by FERMCO, preservatives shall not be

applied. Where preservatives have been approved for use, the preservative identity and the method of removal shall be stated in shipping documents and on a notice attached to the item or unit package. The Seller shall furnish MSDSs for preservatives used.

1.9 PROJECT CONDITIONS

A. Location

- 1. The purchased equipment shall be required to operate at the FEMP site in Fernald, Ohio, outside, under roof.

B. Elevation

- 1. The site elevation is approximately 590 feet above sea level.

C. Duty

- 1. Each system shall be designed for continuous operation, 16 hours per day, 365 days per year.
- 2. Each system shall be designed for outdoor service.

D. Life

- 1. The system shall be designed to have an effective operating life of 20 years.

E. Temperature

- 1. The ambient temperature in which the system will operate will range between -10 degrees F and 110 degrees F.

F. Available Utilities

- 1. Utility services furnished are listed below for information only:

Electrical Power	480 volts preferred, three phase, 60 Hz.
Process Water	40 to 50 psig.
Compressed Air	90 psig.

PART 2 PRODUCTS

2.1 EQUIPMENT

The following are the debris shredder and process shredder systems performance requirements.

A. Debris Shredder System:

1. Shredder System

a. The debris shredder shall be designed to size reduce, in general, solid materials mixed with wet, muddy soils and sludges. It shall be sized to process the following inventory in an 8-hour shift.

- 1) 30 units - 55-gallon drums full of wet soil (20 percent sand, 50 percent silt, 30 percent clay at 35 percent moisture dry basis [db]).
- 2) 40 units - 24-inch by 24-inch by 12-inch steel reinforced concrete blocks (4,000 psi concrete with 3 - 22 inch, No. 4 rebar).
- 3) 200 units - 12-inch diameter agglomerated waste (33 percent clay, 33 percent magnesium fluoride, 33 percent lime, 25 percent moisture content db), 150 lbs/ft³ bulk density.
- 4) 240 units - 12-inch by 12-inch by 12-inch carbon graphite molds.
- 5) 160 units - Wood pallets (48 inches by 48 inches, 1,000-lb load rating).

b. The shredding mechanism shall be designed such that a minimum of 98 percent of the material exiting the shredder system shall not be larger than 4 inches in any two dimensions and 4 feet in the third dimension.

c. The debris shredder will be required to size reduce miscellaneous debris (e.g., light gage [up to 1/4-inch-thick] angles and channels), #10 rebar, and miscellaneous pieces of metal on an occasional basis.

d. The shredder system shall meet performance and acceptance testing requirements set forth

in Article 2.4, Paragraph D, Subparagraph 1;
and Article 3.4, Paragraph B.

- e. The shredder system shall be equipped with variable speed drives. The drives may be hydraulic or electric.
- f. The shredder system shall have automatic reversal capabilities to clear jams, should they occur. Seller shall quote the capabilities to eject nonprocessable items through a rock box to a container at ground level as an option.
- g. All working parts, equipment, and systems shall be arranged for convenient operation, obstruction-free access and passage, inspection, lubrication, maintenance, and ease of replacement.
- h. Shredding mechanism and shredder interior shall be designed to withstand the 7-foot, 0-inch freefall of material (maximum weight 1,000 pounds for any single item) from the grapple loader during each loading operation.
- i. If expected operations will result in equipment surface temperatures in excess of 140 degrees F, the surface shall be insulated for operator protection.

2. Feed System

- a. The debris shredder will be fed by a backhoe with a grapple attachment.
- b. The hopper walls shall have a minimum side slope of 45 degrees.
- c. The hopper shall have an available volume of at least 6 cubic yards to accommodate waste (water level full).
- d. The hopper shall be equipped with side access ports for clearing bridged materials.
- e. A hydraulic feed ram system shall be provided and installed in the hopper to prevent rolling of drums and other items that roll inside the shredder. Ram will be extended to hold drums in place so that cutters can grab and shear rolling objects.

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3. Structural System

- a. Structural Interfaces: The debris shredder, including its drive, shall be mounted on a structural base frame. Hydraulic power units (if applicable) will be mounted on a separate structural frame including valve panel, reservoir, electric motor, pumps, etc.
- b. Materials of construction shall, as a minimum, meet the following requirements:
 - 1) Carbon and Structural Steel: ASTM A36.
 - 2) Bolts, Nuts, and Washers: ASTM A325.
 - 3) Welding Materials: AWS D1.1.

4. Electrical System

- a. Seller shall provide all motors, motor starters, and all electrical equipment and wiring.
- b. The electrical system shall comply with the requirements specified in Section 16052 and Section 15172.
- c. The equipment shall be prewired to the maximum extent possible before shipment. Field wiring shall be kept to a minimum.
- d. Seller shall provide equipment and skid grounding lugs, prewired to a single location for tie-in to facility ground system in accordance with NFPA 70.
- e. Seller shall provide a motor unloading device so that the shredder drive motor is always started unloaded.

5. Control System: The debris shredder control system shall, as a minimum, perform the following control functions.

- a. Local Functions:
 - 1) Shredder start/stop switch.
 - 2) System emergency stop switch with alarm.
 - 3) Dust suppression system on/off switch (option).
 - 4) Local indicators for motor volt/amperage usage.
 - 5) Local indications of hydraulic fluid temperature and pressure, if applicable.
 - 6) Local indication of activated fire suppression system.

- 7) Local alarm to indicate high torque condition for the shredder. 1
- b. Remote Functions: 2
- 1) The shredder control system shall be provided with input/outputs such that alarms and equipment can be stopped from a remote location on a terminal supplied by FERMCO. 3
- 6. Safety Systems 4
- a. The equipment shall be designed to protect the operator from contact with moving parts and loose debris. 5
- b. Maximum noise level from operation of the shredder system shall not exceed 85 dBA at 1 meter distance from the machine at normal hearing height. If this noise level cannot be achieved, then the Seller shall submit with the proposal the noise level that can be achieved. Measures that reduce this noise level without losing system functionality will be evaluated favorably by FERMCO. 6
- 7. Cleaning System 7
- a. It is FERMCO's intent to clean the shredder with water; the Seller shall provide cleaning recommendations with proposal. 8
- b. The Seller shall include in cleaning recommendations an opinion on the effectiveness of steam cleaning of equipment proposed under this specification. 9
- 8. Dust Suppression System (option) 10
- a. The dust suppression system shall be proposed as an option. Equipment and costs for this option shall be separate from the other system components provided under this specification. 11
- b. The debris shredder dust suppression system shall be self-contained, requiring only building utilities for operations. 12
- c. The dust suppression system shall be locally controlled so that an operator can activate it when it is needed. 13

d. The dust suppression system shall minimize release of dust to the building when in operation.

B. Process Shredder System

1. Shredder System

a. The process shredder shall be designed to size reduce wet, muddy soils and sludges mixed with a small amount of tramp materials. It shall be sized to process the following inventory in 16 hours: 850 tons of waste soil (average bulk density 90 P.C.F.) made from 92 percent soil, 3 percent gravel, and 5 percent tramp materials. All percentages given under this paragraph are in weight percent.

1) The soil shall be composed of 25 percent sand, 50 percent silt, and 25 percent clay. Water shall be added to the soil mixture so that a mixture of mud-like consistency is produced:

2) The tramp materials shall be composed of:

5 percent Rebar - No. 4 by 4 inches long.

10 percent Clay balls - 12-inch diameter.

40 percent Terra Cotta Pipe - 4-inch diameter, broken, 12-inch-long shards.

40 percent Concrete block fragments - no rebar, 4,000 psi, size range of 2 inches in diameter to 12 inches in diameter.

5 percent Wood - Oak 2 inches by 4 inches by 12 inches.

In addition, three units 2-1/2-inch by 1/4-inch by 1-foot long angle iron and 40 units of plastic bags (4-mil thick, 12 ft² surface area) will be added to the tramp materials.

- b. The shredding mechanism shall be designed so that 98 percent of the material exiting the shredder system shall not be larger than 4 inches in any dimension. Most of the waste being processed through the shredder will be less than 12 inches in any dimension. 1-6
- c. In case of malfunction of the metal detection system, process shredder may be required to process debris listed in Article 2.1, Paragraph A, Subparagraphs 1.a.2 through 1.a.4 on an occasional basis. 7-11
- d. The shredder system shall meet performance and acceptance testing requirements set forth in Article 2.4, Paragraph D, and in Article 3.4, Paragraph B. 12-15
- e. The shredder system shall be equipped with variable speed drives. The drives may be hydraulic or electric. 16-18
- f. The shredder system shall have automatic reversal capabilities to clear jams, should they occur. Seller shall quote the capabilities to eject nonprocessable items through a rock box to a container at ground level as an option. 19-24
- g. All working parts, equipment, and systems shall be arranged for convenient operation, obstruction-free access and passage, inspection, lubrication, maintenance, and ease of replacement. 25-29
- h. Shredding mechanism and shredder interior shall be designed to withstand the 7-foot, 0-inch freefall of material (maximum weight 1,000 pounds for any single item of tramp material) from the skip hoist bucket during each loading operation. 30-35

2. Feed System

The process shredder shall be fed by a skip hoist (provided by others). The skip hoist shall discharge into the process shredder hopper. 36-39

- a. The skip hoist shall feed waste with an average bulk density of 90 P.C.F. to the process shredder at 70 cubic yards per hour. 40-42

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Cycle time for the skip hoist shall be 3 minutes.

- b. Process Shredder Hopper
 - 1) The minimum hopper feed opening size shall be 8 feet long by 5 feet wide, with additional appropriate apron width in both directions to preclude spillage of feed material during skip hoist loading operation. The skip hoist bucket shall be 8 feet long by 4.5 feet wide by 3.5 feet deep.
 - 2) The hopper walls shall have a minimum side slope of 70 degrees off horizontal and shall be lined with abrasion-resistant material.
 - 3) The hopper volume shall be sized to accept a full charge from the skip hoist without spillage and shall be consistent with the design process rate of 70 cubic yards per hour.
 - 4) The hopper shall be equipped with side access ports for cleaning bridged materials.
- 3. Structural System
 - a. Structural Interfaces: The process shredder, including its drive, shall be supplied on a common base. Hydraulic power units (if applicable) will be mounted on a structural frame (skid) including valve panel, reservoir, electric motor, pumps, etc.
 - b. Materials of construction shall, as a minimum, meet the following requirements:
 - 1) Carbon and Structural Steel: ASTM A36.
 - 2) Bolts, Nuts, and Washers: ASTM A325.
 - 3) Welding Materials: AWS D1.1.
- 4. Electrical System
 - a. Seller shall provide all motors, motor starters, and all electrical equipment and wiring.
 - b. The electrical system shall comply with the requirements specified in Sections 16052 and 15172.

- c. The equipment shall be prewired to the maximum extent possible before shipment. Field wiring shall be kept to a minimum. 1
 - d. Seller shall provide equipment and skid grounding lugs, prewired to a single location for tie-in to facility ground system in accordance with NFPA 70. 2
 - e. Seller shall provide a motor unloading device so that the shredder drive motor is always started unloaded. 3
5. Control Systems: The process shredder control system shall, as a minimum, perform the following control functions. 4
- a. Local Functions: 5
 - 1) Shredder start/stop switch. 6
 - 2) System emergency stop switch with alarm. 7
 - 3) Dust suppression system on/off switch (option). 8
 - 4) Local indicators for motor volt/amperage usage. 9
 - 5) Local indication of hydraulic fluid temperature and pressure, if applicable. 10
 - 6) Local indication of activated fire suppression system. 11
 - 7) Local alarm to indicate high torque condition for the shredder. 12
- b. Remote Functions: 13
- 1) The shredder control system shall be provided with input/outputs so that alarms and equipment can be stopped from a remote location on a terminal supplied by FERMCO. 14
- 2) A 10-inch by 10-inch by 1/4-inch-thick camera mounting plate shall be supplied and attached to the hopper system. The plate shall be positioned so that a mounted camera (supplied by FERMCO) can "see" into the hopper. The position of the camera mounting plate shall not interfere with shredder operations, including skip loading operations. 15

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6. Safety Systems

- a. The equipment shall be designed to protect the operator from contact with moving parts and loose debris.
- b. Maximum noise level from operation of the shredder system shall not exceed 85 dBA at 1 meter distance from the machine at normal hearing height. If 85 dBA cannot be achieved, then the Seller shall submit at the time of the proposal the noise level that can be achieved. Measures that reduce this noise level without losing system functionality will be evaluated favorably by FERMC0.

7. Cleaning System

- a. It is FERMC0's intent to clean the shredder with water; the Seller shall provide cleaning recommendations with the proposal package.
- b. The Seller shall include in cleaning recommendations an opinion on the effectiveness of steam cleaning of equipment proposed under this specification.

8. Dust Suppression System (option)

- a. The dust suppression system shall be bid as an option. Equipment and costs for this option shall be separate from other system components provided under this specification.
- b. The process shredder dust suppression system shall be self-contained, requiring only building utilities for operations.
- c. The dust suppression system shall be locally controlled so that an operator can activate it when it is needed.
- d. The dust suppression system shall minimize release of dust to the building when in operation.

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2.2 MATERIALS

The Seller shall furnish equipment in accordance with the following minimum requirements.

A. Shredder Shafts and Cutters

1. Cutter shafts shall be minimum AISI, No. 4140 alloy steel or equal.
2. Cutters shall be heat treated to Rc 55 or equal.

B. Hydraulic Fluid

1. Nonflammable hydraulic fluid shall be used. The Seller shall notify FERMCO in writing at the time of proposal if flammable hydraulic fluids are required.

C. Bearings

1. Bearing materials shall be selected to provide a minimum life (L-10) of 50,000 hrs per ABMA with the exception of bearings used in motors and gear reducers. Gear reducer bearing materials shall be selected to provide a minimum life (L-10) of 5,000 hrs. See Section 15172 for motor bearing requirements. Applicable sections of the latest ABMA standards at the time of subcontract award shall be used.

D. Gear Reducers

1. Gear reducers shall be designed in accordance with AGMA standards with a minimum service factor of 1.5 on motor nameplate ratings. Applicable sections of the latest AGMA standards at the time of subcontract award shall be used.

E. Hazardous Materials

1. Absolutely no hazardous materials such as lead, mercury, asbestos, PCBs, etc., shall be used in the manufacture of either shredder.

2.3 ACCESSORIES

- A. Each module of the shredders shall be supplied with lifting lugs situated around the center of gravity so

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that straight lifts will be achieved using Seller-recommended rigging.

2.4 FABRICATION

A. Welding

1. Welding shall be performed by qualified welders using qualified weld procedures. Welders and weld procedures shall be qualified in accordance with AWS D1.1.

B. Finish

1. Prefinish Inspection: Prior to the painting of the components but after completion of fabrication, FERMCO shall have an opportunity to inspect each unit at the manufacturer's location. The Seller shall notify FERMCO 7 working days prior to the inspection.
2. Shop Preparation: Steel surfaces that are to be shop painted shall be subjected to "Commercial Blast Cleaning," SP6. All weld spatter shall be removed before blast cleaning.
3. Application:
 - a. All coatings shall be applied in accordance with the manufacturer's published application instructions.
 - b. Coatings shall not be applied when the relative humidity exceeds 85 percent.
 - c. Newly coated surfaces shall be protected from rain, condensation, and contamination until thoroughly dry.
4. Paint System and Schedule:
 - a. All surfaces to be painted shall receive two coats.
 - b. Prime coat shall be a minimum 2-mil thickness, inorganic zinc-rich primer.
 - c. Finish coat shall be at least 4 mils thick.
 - d. Prime and finish coat colors shall be different.
 - e. Requirements stated are a minimum. The Seller shall verify that paint system will be suitable for the intended application.

- f. The Seller shall provide 1 gallon of touch-up paint for each shredder and 1 quart each for the control panel and transformer(s). 1
- g. Paint shall be formulated of ingredients which, when physically stripped from the equipment, shall not cause the discarded paint to be considered a hazardous waste by either RCRA characteristics (ignitability, toxicity, corrosivity, or reactivity) or by virtue of listing (D, K, P, or U lists) as per 40 CFR, Part 261, Subparts C and D. 2
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C. Lubrication 12

- 1. Prior to testing, all components that require lubrication shall be lubricated in accordance with the manufacturer's recommendations. The Seller shall refill the machine with all required lubricant after delivery and installation at the FEMP site. 13
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D. Shop Assembly and Performance Testing 20

- 1. Debris Shredder 21
 - a. The Seller shall completely assemble the system in the Seller's shop and perform tests with a FERMO representative present as outlined in Table 1. 22
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 - b. The Seller shall supply all test materials, including surrogate materials, for the shop performance test. At the conclusion of the performance test, the Seller shall be responsible for test material disposal, including disposal costs. 27
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 - c. The test shall be performed with the shredder operation at full speed. At least one of the items listed in Table 1 shall weigh 1,000 pounds. The 1,000-pound item shall be added to an empty hopper by allowing it to freefall from a height of 7 feet above the hopper directly onto the cutter mechanism. 33
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Table 1 - Debris Shredder Performance Requirement

MATERIAL	PROCESSING RATE	REQUIREMENTS
Two 55-gallon steel drums full of wet soil (20 percent sand, 50 percent silt, 30 percent clay at 35 percent moisture dry weight basis (db)) and five pieces of 4"x 8"x 6' oak	All material shredded in 5 minutes	All material roughly blended and shredded
2 cubic yards of silty clay sized sludge containing five 3-foot-square, 60 mil plastic membrane pieces, and five 3-mil-thick, 5-gallon garbage bags full of sawdust, clay slurry at 50 percent moisture db	Waste material passing through crusher/shredder in 4 minutes	Sludge material lumps destroyed and plastic and wood shredded
Steel reinforced concrete block 24" x 24" x 12" (4000 psi 3 - 22" pieces of #4 rebar	Block crushed in 5 minutes	Unshredded steel segregated from shredded material
Unshreddable 36" steel channel 6" x 4" x 5/16) in a drum full of wet soil (40 percent moisture db)	Drum and shreddable contents size reduced in 2 minutes.	Steel channel may not damage crusher/shredder and must be easily removed or automatically segregated from the shredded material
80 ft ³ of 12" diameter clay balls.	Size reduced in 2 minutes.	Clay balls completely disintegrated without plugging the shredder
Two wood pallets, 4' x 4"	Pallets crushed in 2 minutes	Pallets size reduced

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- 2. Process Shredder
 - a. The Seller shall completely assemble the system in the Seller's shop and perform tests with a FERMCO representative present as outlined below:
 - 1) Test Duration: 2 hours.
 - 2) Material: As specified in Article 2.1, Paragraph B, Subparagraph 1.a.
 - 3) Quantity of material: 285 tons.
 - 4) Test Requirements: Process the complete inventory in 2 hours with 98 percent of the tramp materials size reduced to no larger than 4 inches in any direction.
 - b. The Seller shall supply all test materials, including surrogate materials, for the shop performance test. At the conclusion of the performance test, the Seller shall be responsible for test material disposal, including disposal costs.

E. Seller shall make all necessary modifications to equipment to meet the stated performance requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Seller's Instructions:
 - 1. Packages may be stored temporarily indoors or outdoors at -30 degrees F to 120 degrees F and at any degree of relative humidity.
 - 2. The Seller shall provide a representative to witness FERMCO's receiving inspection. The Seller's representative shall oversee unpacking operations and provide FERMCO written verification that unpacking was performed in accordance with Seller's instructions. FERMCO shall be responsible for offloading equipment from shipping trailers or trucks.

- B. Receiving Inspection:
 - 1. FERMCO will receive and inspect packages containing each shredder system to verify the

contents and to check for possible damage during shipment.

C. Handling and Storage:

1. FERMCO will safely handle and store each shredder component (assembly) in accordance with the Seller's instructions.
2. FERMCO will repackage, as necessary, each shredder component, under supervision of the Seller's representative and in accordance with the Seller's repackaging instructions.
3. Multiple items and miscellaneous hardware shall be stored together in a group lot.

3.2 PREPARATION

- A. The Seller shall prepare and supply to FERMCO a complete list of equipment required for installation.

3.3 INSTALLATION

- A. The shredder systems shall be installed by FERMCO in the plant area designated for each shredder system. The overall plan will be prepared to meet the Seller's design requirements. All the foundations, structural platforms, and building footing for the facility will be in place at the time of each shredder installation.
- B. The Seller shall provide an on-site technical representative(s) to assist with the assembly and installation of each shredder. The technical representative(s) shall certify that the assembly and installation is in accordance with the Seller's drawings and instructions.
- C. Before installation commences, FERMCO will have equipment that connects to or interlocks with each shredder, as well as all necessary installation equipment as specified by the Seller, available on site.

- D. FERMCO will install equipment in accordance with Seller's approved installation instructions. FERMCO will:
 - 1. Set and adjust units level and plumb.
 - 2. Install all equipment that connects to or interlocks with each shredder.
 - 3. Connect to utilities, add lubricant and oils, and make shredder systems operational.

- E. Seller shall conduct an 8-hour training class on FERMCO's site to instruct FERMCO personnel in the operation of both the debris and process shredders.

3.4 FIELD QUALITY ASSURANCE

- A. Configuration Controls
 - 1. After installation, the Seller shall certify that all connections with site utilities, all connections prescribed by the Seller's installation instructions, and all interconnects with FERMCO-supplied equipment have been made correctly.
 - 2. The Seller shall:
 - a. Verify that settings and continuity of circuits are correct per Seller's start-up procedures.
 - b. Verify that all lubrication points have been lubricated as required by the Seller's start-up procedures.

- B. Acceptance Test
 - 1. FERMCO will perform acceptance testing while Seller's representative is present, in accordance with Article 2.4, Paragraph D, Subparagraphs 1 and 2.
 - 2. FERMCO will supply all test materials, including surrogate materials, for the acceptance test. At the conclusion of the acceptance test, FERMCO will be responsible for test materials disposal, including disposal costs.

3.5

ADJUSTING

- A. FERMCO, acting on Seller's representative's instructions, shall make any necessary adjustment to correct deficiencies identified in the acceptance testing.

3.6

CLEANING

- A. FERMCO shall clean equipment after installation, removing all surplus oil and lubricants, debris, and construction materials.
- B. FERMCO shall paint any nicks and scrapes generated during the installation process per Seller's requirements, using Seller-supplied paint.

END OF SECTION

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APPENDIX A

DATA SHEETS

Date: 03/06/96
Rev.: D RE: KM

13652

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/PO-145

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SHREDDER SYSTEM DATA SHEETS

Project Title: _____

Company Name: _____

Preparer: _____ Date: _____

Equipment Name: _____

Note: Separate data sheets are to be completed for the debris shredder and the process shredder system.

1. Motor List (see Section 15172)

2. Total Weight of Shredder _____ lbs
(excluding hydraulic power unit)

2A. Wt. of hydraulic power unit _____ lbs

3. Drive System _____ Hydraulic or Electromechanical

4. Hopper

A. Volume (water level full) _____ ft³

B. Hopper Feed Opening _____ in. x _____ in.

C. Materials of Construction _____

5. Shredder Cutters

A. Configuration _____

B. Diameter/Width _____ in. / _____ in.

C. Materials of Construction _____

D. Hardness _____

E. Cutting Speed _____ rpm

F. Number of Hooks/Cutter _____



6. Cutter Shafts (if applicable)

- A. Diameter _____ inches
- B. Materials of Construction _____
- C. Tensile/Yield Strength of Material _____
- D. Expected Dimensions of Shredded Materials _____

7. Gear Reducers

List for each gear reducer the following information

- A. AGMA Service Factor (based on connected motor HP)
 - 1. Mech. hp Rating (normal running conditions, durability) _____
 - 2. Stall Torque Strength Rating _____
 - 3. Thermal Horsepower Rating _____
- B. Minimum L-10 Bearing Life _____ hrs

8. Bearings

Cutter Shaft Bearings

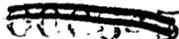
- A. Minimum L-10 Life _____ hrs

9. Couplings

List for each coupling the following information

- A. Type _____ Geared/Flexible
- B. Horsepower Rating _____ hp

10. Provide motor data as listed in Section 15172, Attachment 1.



11. Maximum Expected Noise Level for Operating Shredder _____ dBA @ 1 meter

12. Shredder Drive System Data:

13. Describe equipment furnished to prevent drums from rolling inside the shredder (debris shredder only):

14. Dust Suppression System Data: _____

15. Ancillary Equipment Description: _____

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16. Cleaning Recommendations (per Article 2.1, Paragraph A.8 and B.8: _____

17. Compressed Air Consumption _____ psig _____ scfm

18. Process Water Consumption _____ psig _____ gpm

19. References (for existing similar installations):

Name	Address	Phone
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A. _____

B. _____

C. _____

D. _____

E. _____

APPENDIX B

WASTE MATERIALS TEST DATA

Date: 03/06/96
Rev.: D RE: KM

13652

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/PO-145

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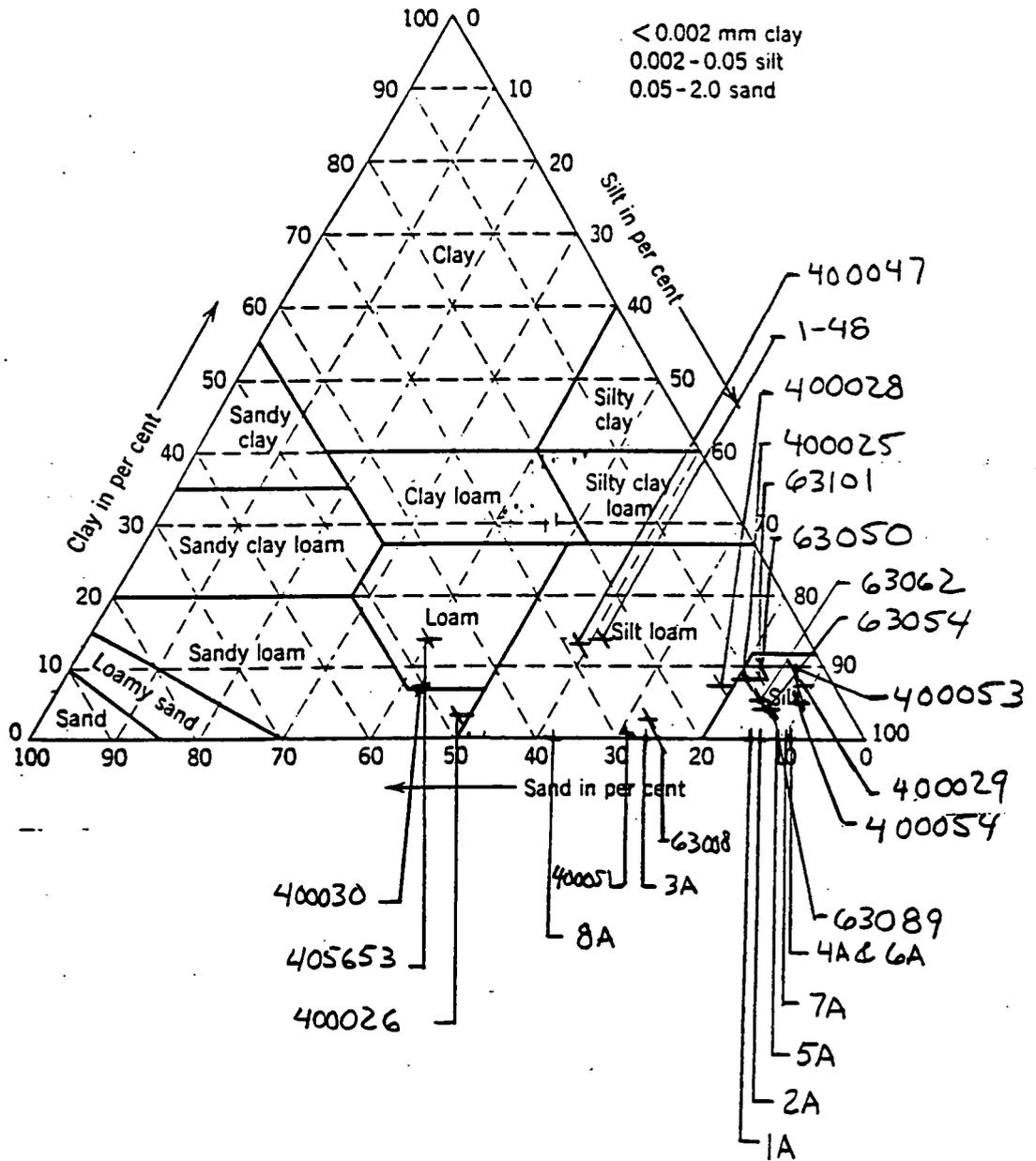
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Grain Size Analysis of Each Pit

Pit No.	Boring No.	Sample Identification		Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (% dry wt.)	Specific Gravity G _s	Grain Size Analysis			Atterberg Limits			USCS Group Symbol	Group Name
		Sample No.	Sample Type						Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL		
1	1765	63089	SI	4.5	7	1	23.8	3.027	0.1	6.6	93.3	4	NP	NP	ML (NP)	Silt (NP)
1	1765	63101	SI	14.0	16.5	1	20.9	2.92	0.0	8.3	91.7	10.0	NP	NP	ML (NP)	Silt (NP)
1	1766	63060	SI	4.5	7	1	18.3	3.042	0.2	8.8	91.2	8	NP	NP	ML (NP)	Silt (NP)
1	1766	63064	SI	8.5	11.0	1	15.9	3.15	0.0	10.0	90.0	4.0	NP	NP	ML (NP)	Silt (NP)
1	1766	63062	SI	14.0	16.5	1	21.8	3.03	0.0	10.2	89.8	5.0	NP	NP	ML (NP)	Silt (NP)
1	1767	63008	SI	3.5	6.0	1	23.3	3.07	3.1	25.8	71.1	3.0	NP	NP	ML (NP)	Silt (NP) with Sand
1	11352	400063	SS	2.0	3.0	2	33.9		0.0	4.0	96.0	10.0	NP	NP	ML (NP)	Silt (NP)
1	11352	400064	SS	5.5	8.0	2	27.7		0.0	6.0	94.0	5.5	NP	NP	ML (NP)	Silt (NP)
1	11352	400025	SI	7.5	10.0	2	19.6	3.09	0.7	10.3	89.0	7.5	NP	NP	ML (NP)	Silt (NP)
1	11352	400028	SI	11.5	14.0	2	44.8	3.06	5.5	49.5	46.0	3.5	NP	NP	SM	Silty Sand
1	11353	400047	SS	4.5	5.5	2	19.3		19.0	28.0	53.0	13.0	NP	NP	ML (NP)	Sandy Silt (NP) with Gravel
1	11353	400028	SI	10.0	12.5	2	18.3	3.05	1.0	15.5	83.5	8.5	NP	NP	ML (NP)	Silt (NP) with Sand
1	11353	400051	SS	13.5	14.0	2	30.9		3.0	28.3	68.7	1.3	NP	NP	ML (NP)	Sandy Silt (NP)
1	11354	400029	SI	7.5	10.0	2	23.1	3.11	0.1	3.6	96.0	7.3	NP	NP	ML (NP)	Silt (NP)
1	11354	400030	SI	11.5	14.0	2	47.3	2.80	2.0	50.0	48.0	6.7	NP	NP	SM	Silty Sand
1	1765	1A	CAN			3	20.3		0.0	14.2	85.8	8.5	NP	NP	ML (NP)	Silt (NP)
1	1765	2A	CAN			3	24.7		0.0	13.2	86.8	8.8	NP	NP	ML (NP)	Silt (NP)
1	1765	3A	CAN			3	26.1		2.9	26.8	70.3	7.3	NP	NP	ML (NP)	Silt (NP) with Sand
1	1766	4A	CAN			3	18.0		0.0	9.0	91.0	9.0	NP	NP	ML (NP)	Silt (NP)
1	1766	5A	CAN			3	20.7	3.02	0.4	10.8	88.8	0.0	NP	NP	ML (NP)	Silt (NP)
1	1766	6A	CAN			3	21.1		0.0	8.0	91.0	8.0	NP	NP	ML (NP)	Silt (NP)
1	1766	7A	CAN			3	20.7		1.1	86.1	86.1	1.1	NP	NP	ML (NP)	Silt (NP)
1	1767	8A	CAN			3	22.7		3.9	37.8	56.5	3.9	NP	NP	ML (NP)	Silt (NP)
1		1-48	COMP	0.0	12.0	4	17.2	2.62	32.5	24.5	43.0	14.0	NP	NP	OC	Clayey Gravel with Sand
	11568	406653	SI	10.5	13.0	5	50.4	2.77	0.6	46.5	52.7	13.3	NP	NP	ML (NP)	Sandy EGBC Silt

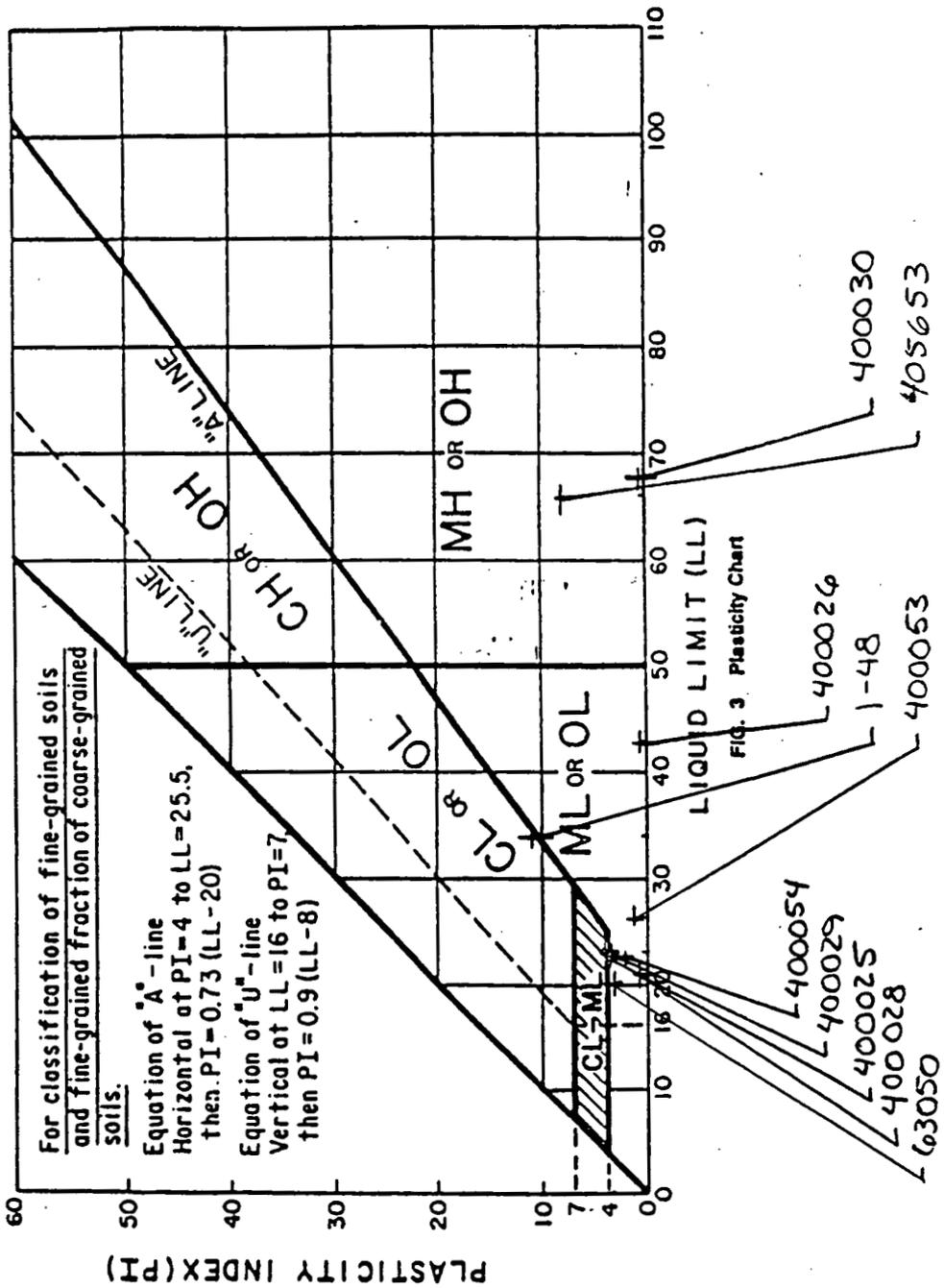
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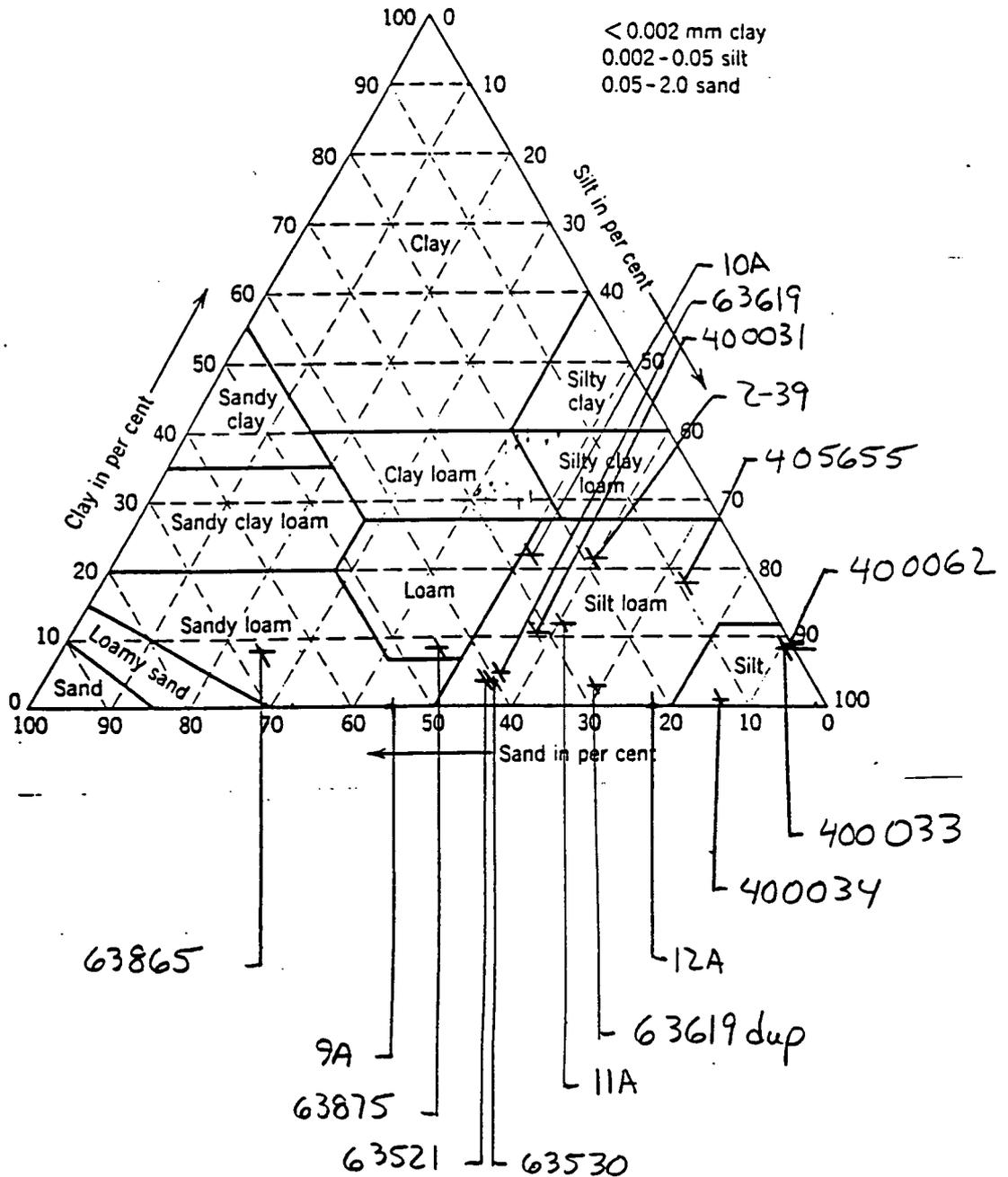
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	63101	63008	3A	6A		400051
	63054	1A	4A	7A		

Grain Size Analysis of Each Pit

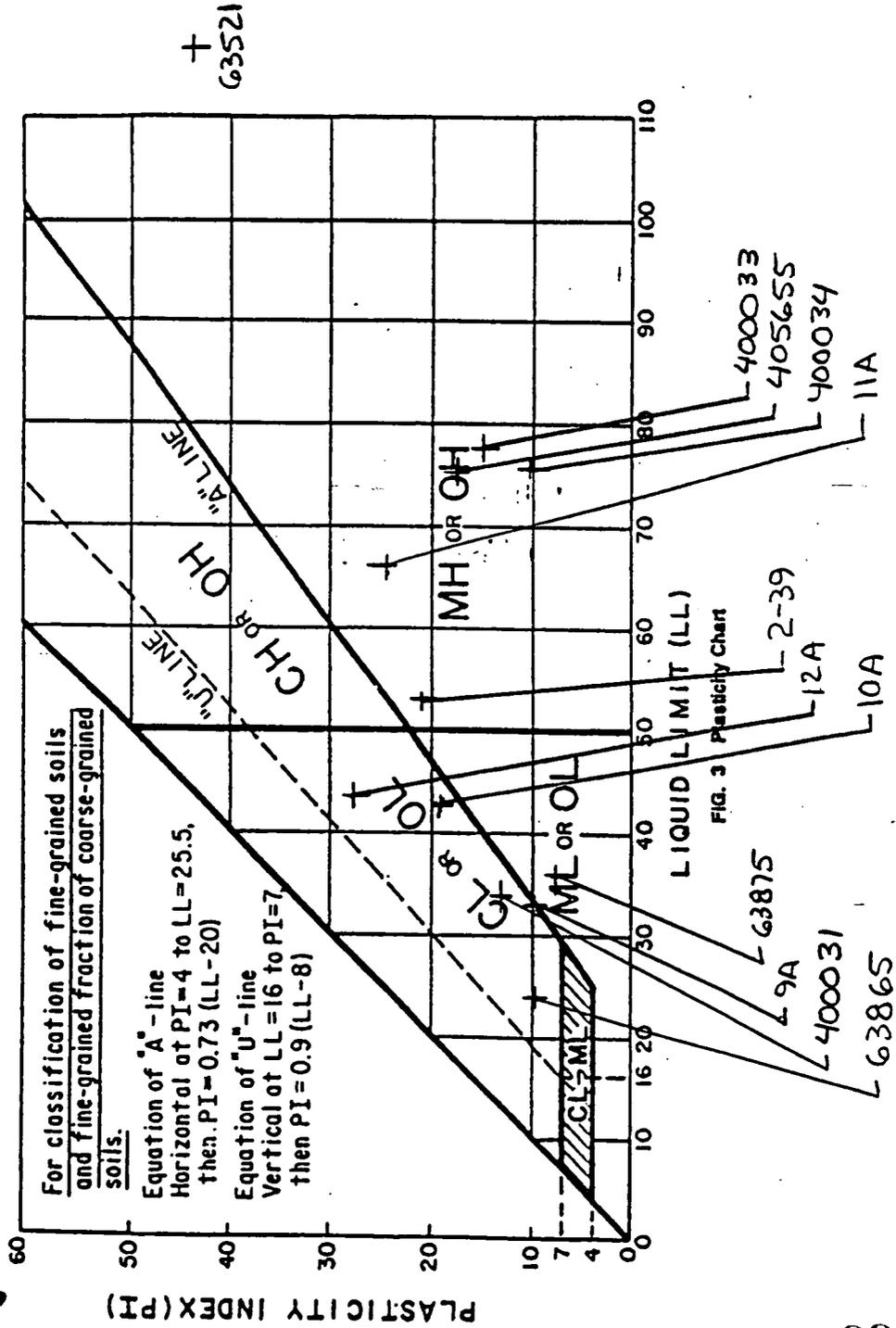
Pit No.	Boring No.	Sample Identification		Bottom Depth		Data Source	Moisture Content (W _o wgt)	Specific Gravity G _s	Grain Size Analysis			Index Property Data			USCS Group Symbol	Group Name
		Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)				Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL		
2	1768	63619	SI	11.0	13.0	1	280.0	2.80	0.0	39.0	61.0	5.0	NP	NP	Sandy Silt (NP)	
2	1768	63620	SI	11.0	13.0	1	316.6	2.79	0.0	28.5	71.5	3.0	NP	NP	Silt (NP) with Sand	
2	1768	63621	SI	12.0	14.0	1	231.2	2.64	0.3	40.2	59.5	4.0	MH	MH	Sandy Elastic Silt	
2	1769	63630	SI	18.0	20.0	1	189.8	2.64	1.8	40.1	58.1	4.0	MH	MH	Sandy Elastic Silt	
2	1817	63875	SI	10.5	12.5	1	32.7	2.65	25.4	45.5	29.1	8.0	SM	SM	Silty Sand with Gravel	
2	1818	63865	SI	5.0	7.5	1	21.4	2.50	18.1	67.3	14.6	8.0	SC	SC	Clayey Sand with Gravel	
2	11356	400001	SI	6.0	8.5	2	24.1	2.69	21.5	32.2	46.3	11.0	SC	SC	Clayey Sand with Gravel	
2	11358	400062	SS	8.5	10.0	2	245.7	3.02	0.0	7.0	100.0	6.8	MH	MH	Elastic Silt	
2	11359	400033	SI	4.5	7.0	2	108.6	2.86	4.7	1.3	98.7	8.0	MH	MH	Elastic Silt with Sand	
2	11359	400034	SI	8.5	11.0	2	88.2	2.86	4.7	14.0	81.3	1.8	MH	MH	Elastic Silt with Sand	
2	1768	BA	CAN			3	36.4		1.0	65.1	43.9	22.2	SH	SH	Silty Sand	
2	1768	10A	CAN			3	38.3	2.72	7.6	26.1	66.3	22.2	SH	SH	Silty Sand	
2	1818	11A	CAN			3	70.5	2.67	5.5	27.8	67.7	11.7	MH	MH	Sandy Elastic Silt	
2	1817	12A	CAN			3	16.7		4.2	22.3	73.5	16.2	CL	CL	Lean Clay with Sand	
2	02-06	2-39	COMP	0.0	10.0	4	31.9	2.59	20.0	19.0	81.0	22.0	MH	MH	Gravelly Elastic Silt with Sand	
2	11569	405655	SI	7.5	10.0	8	138.0	2.88	0.0	8.3	90.7	17.7	MH	MH	Elastic Silt	

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Grain Size Analysis of Each Pit

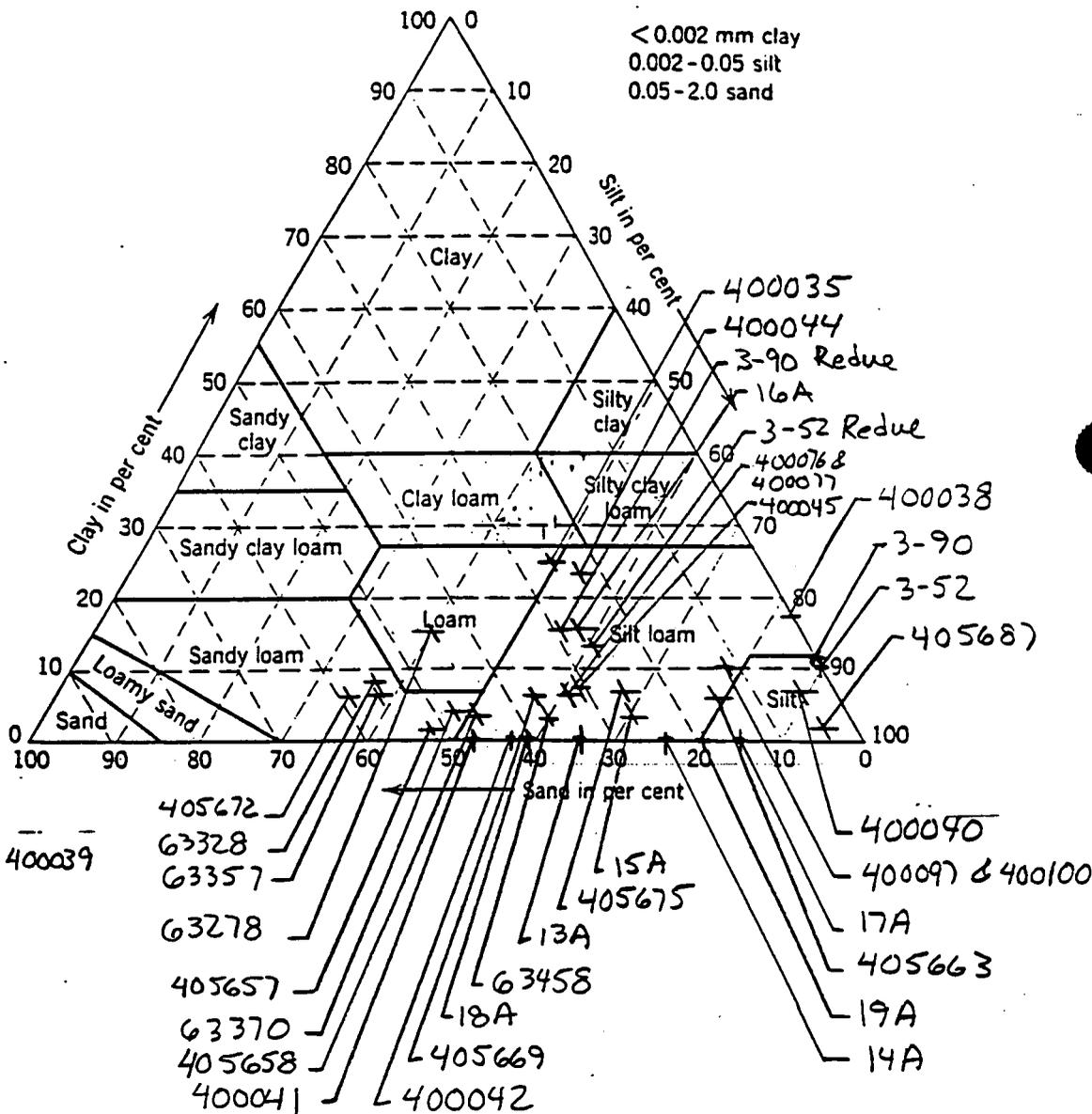
Pit No.	Boring No.	Sample Identification		Bottom Depth (ft)	Data Source	Moisture Content (% dry wt.)	Specific Gravity G _s	Gravel (%)	Grain Size Analysis		Liquid Plasticity Data			USCS Group Symbol	Group Name
		Sample No.	Sample Type						Sand (%)	Silt or Clay (%)	LL	PL	PI		
3	1770	63328	SI	4.0	1	83.7	2.20	0.5	56.0	43.5	8.0	NP	SM	Silty Sand	
3	1770	63357	SI	20.0	1	138.7	2.84	0.2	56.0	43.5	8.0	NP	SM	Silty Sand	
3	1770	63370	SI	28.0	1	131.1	2.77	1.1	48.6	50.3	4.0	MH	MH	Sandy Elastic Silt	
3	1771	63458	SI	32.0	1	55.1	2.84	0.2	37.1	62.7	3.0	MH	MH	Sandy Elastic Silt	
3	1772	63278	SI	19.5	1	35.4	2.15	1.3	45.8	52.8	15.0	NP	ML(NP)	Sandy Silt	
3	11360	400097	SS	13.0	2	54.3	2.84	0.8	11.2	88.0	10.0	ML	ML	Silt	
3	11360	400100	SS	14.0	2	51.3	2.84	0.8	11.2	88.0	10.0	ML	ML	Silt	
3	11360	400085	SI	20.5	2	18.0	2.69	4.0	24.5	71.5	25.3	CI	CI	Lean Clay with Sand	
3	11361	400088	SI	10.5	2	188.9	2.88	0.0	0.0	100.0	17.0	MH	MH	Lean Clay with Sand	
3	11361	400089	SI	21.0	2	102.8	2.88	0.0	4.0	96.0	7.3	ML	ML	Silt	
3	11362	400076	SS	6.0	2	84.8	2.84	7.0	32.7	60.3	6.3	ML(NP)	ML(NP)	Silty Silt (NP)	
3	11362	400077	SS	6.5	2	87.5	2.88	7.0	32.7	60.3	6.3	ML(NP)	ML(NP)	Silty Silt (NP)	
3	11362	400041	SI	18.0	2	173.8	2.60	0.8	42.9	56.5	34.1	MH	MH	Silty Elastic Silt	
3	11363	400042	SI	23.0	2	25.3	2.78	5.3	22.4	72.3	21.0	ML	ML	Silt with Sand	
3	11363	400044	SI	12.0	2	44.7	2.39	2.4	30.7	68.9	7.3	ML(NP)	ML(NP)	Sandy Silt (NP)	
3	11363	400045	SI	19.0	2	145.4	2.54	3.2	33.7	63.1	33.8	MH	MH	Sandy Elastic Silt	
3	1770	13A	CAN	14.0	3	152.7	2.84	3.5	23.8	72.7	58.9	MH	MH	Elastic Silt with Sand	
3	1770	14A	CAN	12.0	3	123.2	2.69	6.5	26.8	67.7	31.7	MH	MH	Elastic Silt with Sand	
3	1770	15A	CAN	13.0	3	98.8	2.72	3.1	27.0	66.7	44.3	MH	MH	Elastic Silt with Sand	
3	1771	16A	CAN	17.0	3	142.0	2.84	1.0	15.3	83.7	16.0	MH	MH	Elastic Silt with Sand	
3	1772	17A	CAN	17.0	3	41.9	2.84	2.3	40.8	58.8	7.7	ML	ML	Sandy Silt	
3	1772	18A	CAN	19.0	3	38.1	2.84	5.0	19.8	74.1	18.9	CL	CL	Lean Clay with Sand	
3	03-05	3-52	COAMP	0.0	4	56.9	2.54	9.0	26.0	66.0	10.0	MH	MH	Sandy Elastic Silt	
3	03-05	3-52 RedLab	COAMP	0.0	4	57.0	2.54	9.0	26.0	66.0	13.0	MH	MH	Sandy Elastic Silt	
3	03-02	3-60	COAMP	0.0	4	43.3	2.65	5.0	29.0	68.0	11.0	ML	ML	Sandy Silt	
3	03-02	3-60 RedLab	COAMP	0.0	4	41.6	2.65	5.0	29.0	68.0	15.0	ML	ML	Sandy Silt	
3	11570	405657	SI	10.5	6	288.7	2.83	0.0	52.1	47.9	1.9	SM	SM	Silty Sand	
3	11570	405658	SI	15.5	6	295.9	1.99	0.0	46.2	53.8	3.4	MH	MH	Sandy Elastic Silt	
3	11570	405659	SI	17.5	6	217.3	2.78	0.0	14.1	85.8	5.9	MH	MH	Elastic Silt	
3	11571	405660	SI	20.0	6	188.5	2.82	0.0	4.0	96.0	3.1	MH	MH	Elastic Silt	
3	11571	405661	SI	23.5	6	186.1	2.77	0.0	38.9	61.0	47.2	MH	MH	Sandy Elastic Silt	
3	11572	405662	SI	15.0	6	184.3	2.76	0.0	58.3	41.6	5.7	SM	SM	Silty Sand	
3	11572	405672	SI	23.0	6	267	2.67	0.0	25.1	74.3	7.8	MH	MH	Elastic Silt with Sand	
3	11572	405675	SI	30.0	6	267	2.67	0.0	25.1	74.3	7.8	MH	MH	Elastic Silt with Sand	

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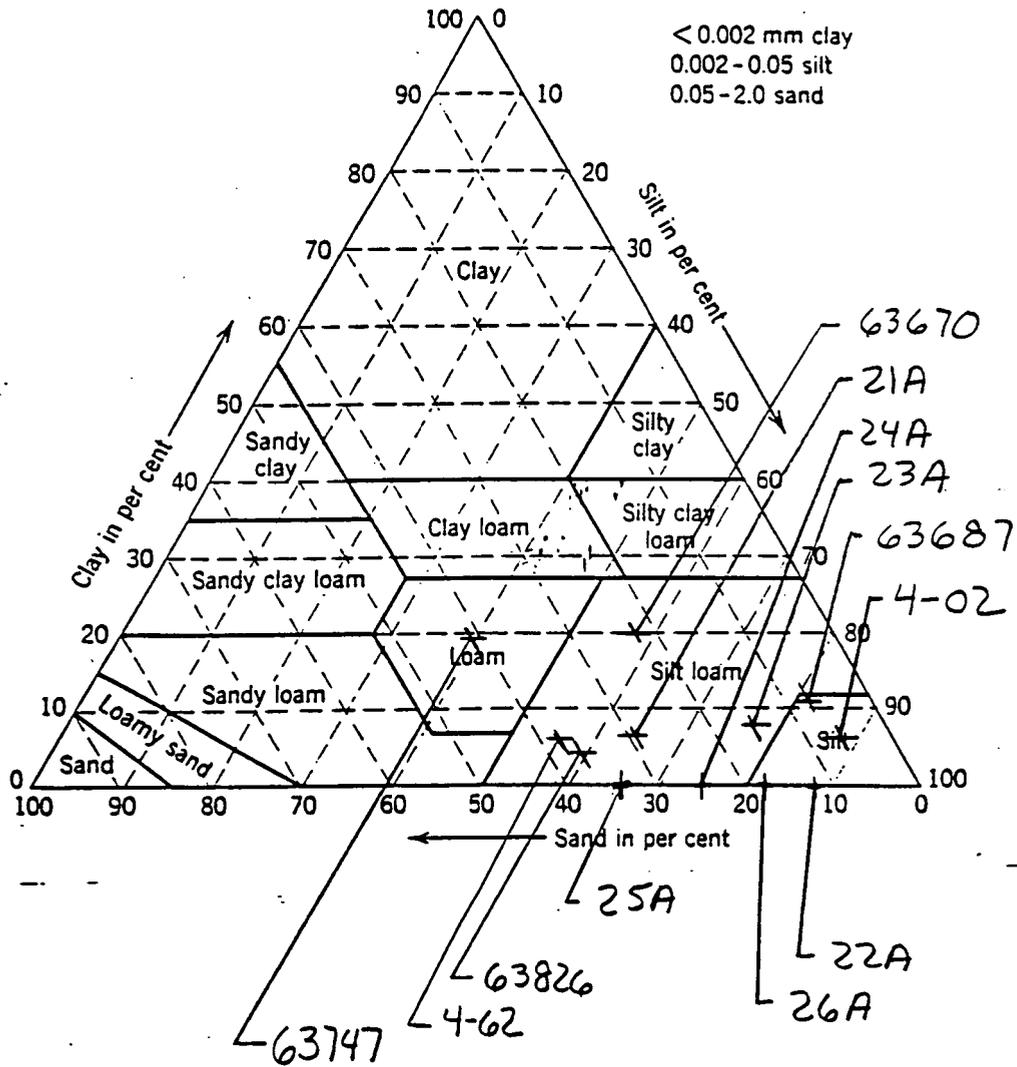
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Grain Size Analysis of Each Pit

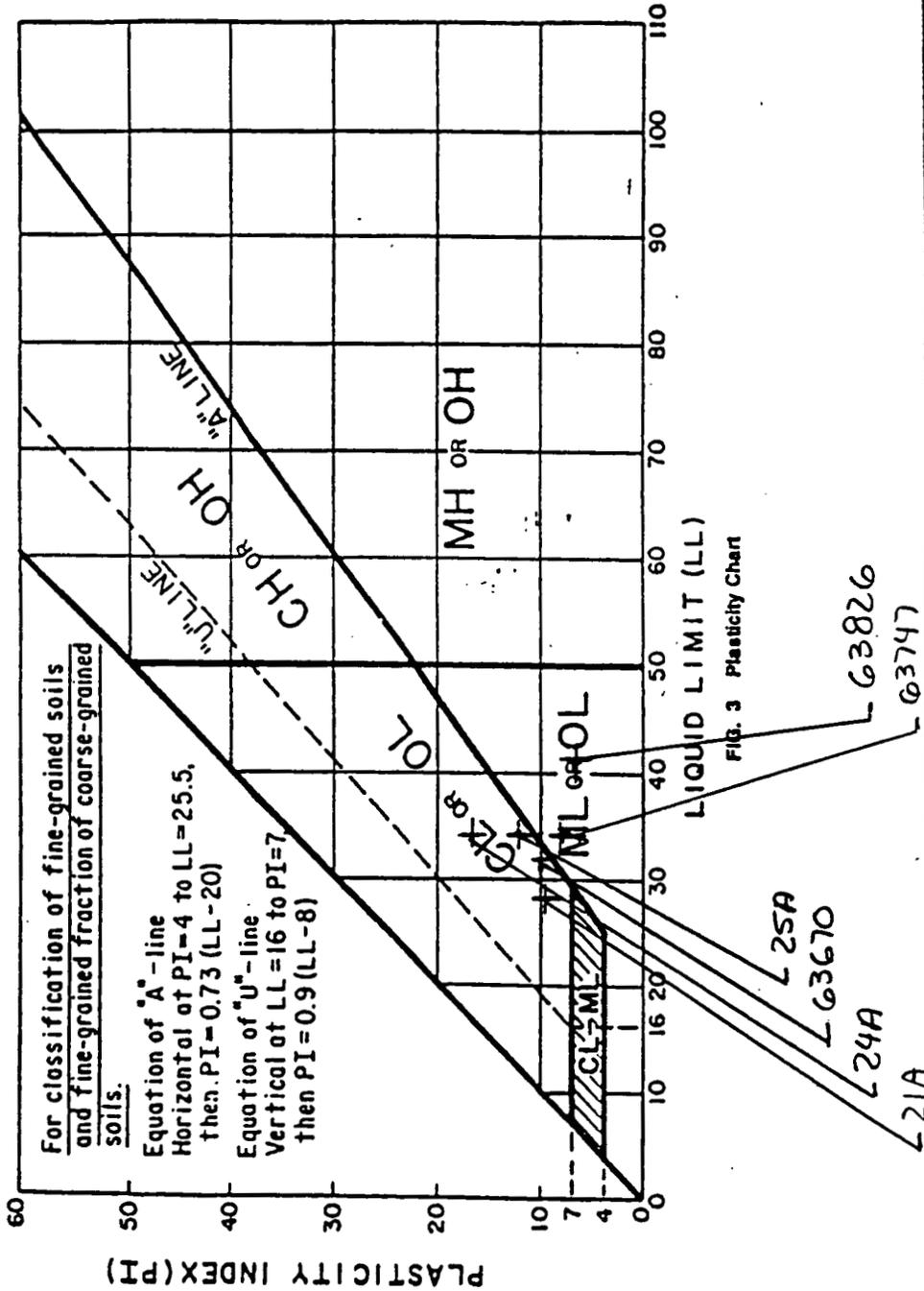
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		Sample No.	Sample Type						Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL			PI
4	1773	63717	SI	11.0	13.0	1	21.4	2.82	2.1	41.4	63.5	19.0	34.0	26.0	6.0	CL	Sandy Lean Clay
4	1774	63670	SI	10.0	12.0	1	19.9	2.79	0.8	22.6	78.6	20.0	32.0	22.0	10.0	CL	Lean Clay with Sand
4	1774	63687	SI	20.0	22.0	1	17.8	3.10	0.3	7.8	92.1	11.0	NP	NP	NP	ML (NP)	Silt (NP)
4	1775	63828	SI	15.0	17.0	1	61.5	3.59	0.1	36.0	63.9	4.0	41.0	34.0	7.0	CL-ML	Sandy Silty Clay
4	1773	21A	CAN			3	18.0	3.25	8.4	29.5	64.1	6.8	28.4	18.5	9.8	CL	Sandy Lean Clay
4	1773	22A	CAN			3	24.3		0.0	12.0	86.0		NP	NP	NP	ML (NP)	Silt (NP)
4	1773	23A	CAN			3	22.2	3.02	0.8	15.2	84.0	8.1	NP	NP	NP	ML (NP)	Silt (NP) with Sand
4	1775	21A	CAN			3	10.1		13.4	21.7	61.9		33.9	16.7	17.2	CL	Sandy Lean Clay
4	1775	25A	CAN			3	28.4		1.2	34.7	64.1		34.1	21.8	12.3	CL	Sandy Lean Clay
4	1775	26A	CAN			3	29.3		1.2	18.0	80.8		NP	NP	NP	ML (NP)	Silt (NP) with Sand
4	04-01	4-02	COMP	0.0	20.0	4	27.0	2.75	0.0	6.0	64.0	6.0	NP	NP	NP	ML (NP)	Silt (NP)
4	04-04	4-82	COMP	0.0	20.0	4	28.8	3.33	7.0	38.0	65.0	8.0	NP	NP	NP	ML (NP)	Sandy Silt (NP)
4	04-04	4-82 Redus	COMP	0.0	20.0	4	28.8	3.83									

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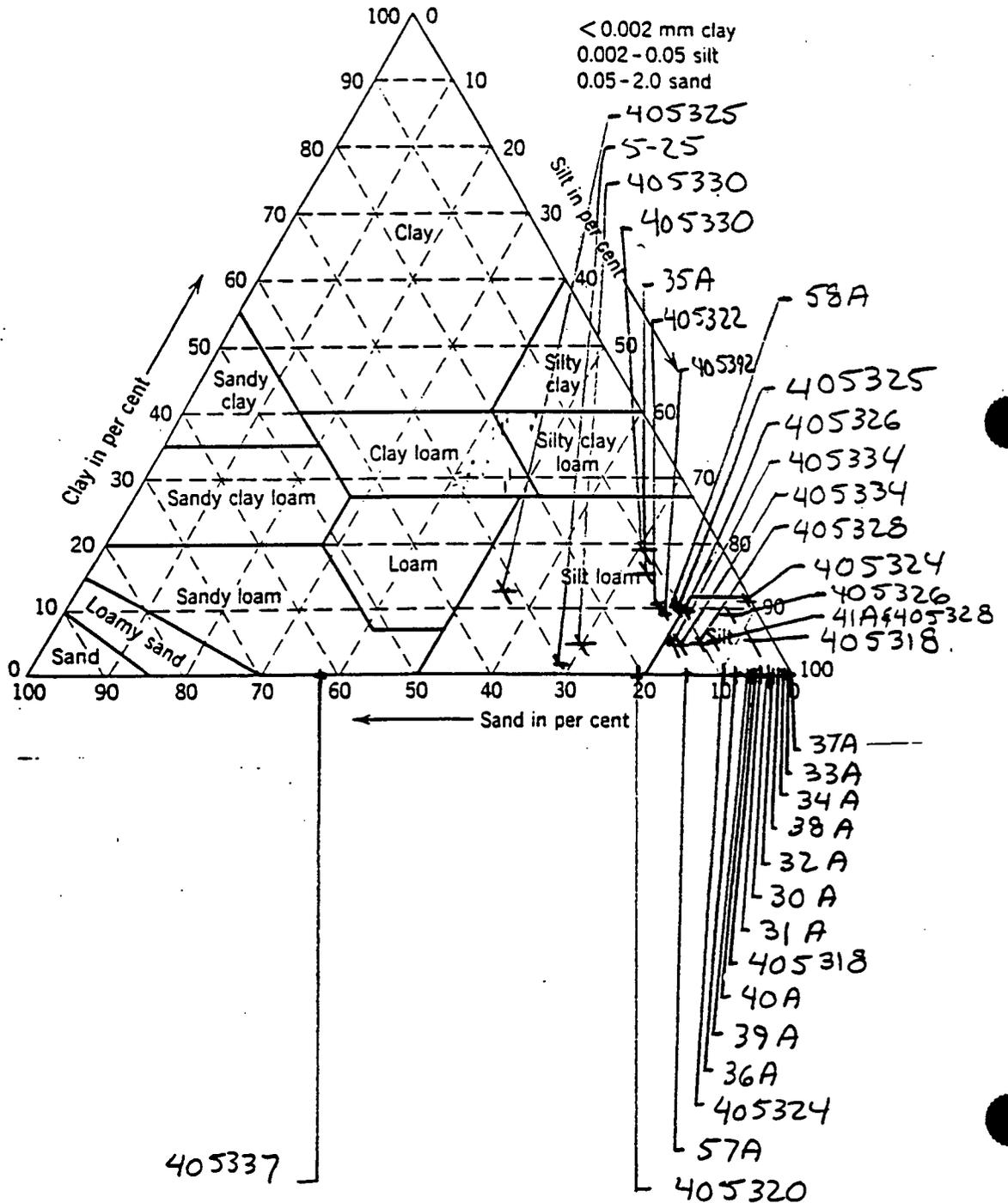
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Grain Size Analysis of Each Pit

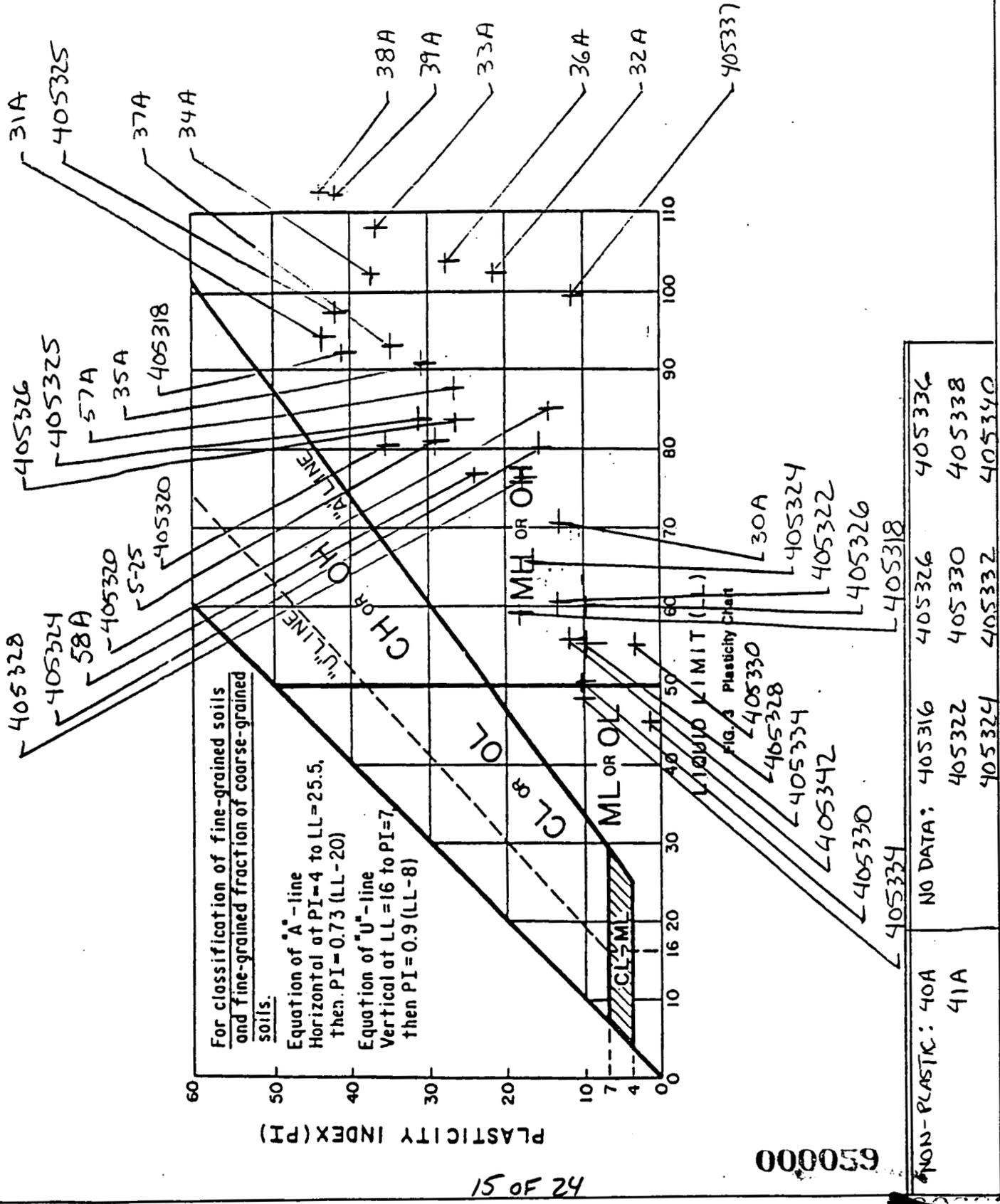
Pit No.	Boiling No.	Sample Identification		Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (% dry wt.)	Specific Gravity	Gravel (%)	Grain Size Analysis		Clay Fract. (%)	Index Property Data			USCS Group Symbol	Group Name
		Sample No.	Sample Type							Sand (%)	Silt or Clay (%)		LL	PL	PI		
5	5	30A	CAN			3	1730		0.0	5.0	86.0		70.7	57.7	13.0	MH	Elastic Silt
5	5	31A	CAN			3	497.5		0.0	5.2	84.8		84.2	50.6	43.6	MH	Elastic Silt
5	5	32A	CAN			3	483.0		0.0	3.4	86.6		102.2	80.5	21.7	MH	Elastic Silt
5	5	33A	CAN			3	507.3		0.0	1.3	88.7		108.4	71.8	36.6	MH	Elastic Silt
5	5	34A	CAN			3	451.7		0.0	1.9	88.1		102.2	64.4	37.8	MH	Elastic Silt
5	5	35A	CAN			3	181.1	2.70	0.0	11.9	88.1	14.5	80.9	60.2	20.7	MH	Elastic Silt
5	5	36A	CAN			3	327.4		0.0	8.7	81.9		103.8	75.6	28.2	MH	Elastic Silt
5	5	37A	CAN			3	629.0		0.0	0.2	89.8		83.0	84.0	35.0	MH	Elastic Silt
5	5	38A	CAN			3	495.7	2.74	0.0	2.7	97.3		122.3	68.1	44.2	MH	Elastic Silt
5	5	39A	CAN			3	448.5		0.0	5.9	84.1		112.0	69.6	42.4	MH	Elastic Silt
5	5	40A	CAN			3	114.5		0.0	5.5	84.5		NP	NP	NP	ML (NP)	Silt (NP)
5	5	41A	CAN			3	109.3	2.71	0.0	6.0	84.0	8.9	NP	NP	NP	ML (NP)	Silt (NP)
5	5	57A	CAN			3	242.3		0.0	14.8	85.4		87.7	60.9	26.8	MH	Elastic Silt
5	5	58A	CAN			3	266.7	2.70	0.0	10.4	86.6	10.2	71.1	52.7	21.4	MH	Elastic Silt
5	05-04	5-25	COMP	10.0	29.0	4	188.5	2.43	0.0	30.0	70.0	2.0	81.0	52.0	29.0	MH	Sandy Elastic Silt
5	WPS-1	405316	VC	14.5	15.0	5											
5	WPS-1	405318	VC	19.5	20.0	5											
5	WPS-1	405318	VC	24.5	25.0	5											
5	WPS-2	405318	VC	8.0	14.0	5	302.8	2.71	0.0	3.4	86.6	5.0	68.2	41.2	18.0	MH	Elastic Silt
5	WPS-3	405318	VC	19.0	24.0	5	56.0	2.66	0.0	5.4	84.8		82.2	50.9	41.3	MH	Elastic Silt
5	WPS-3	405320	VC	13.5	19.0	5	265.0	2.74	0.1	20.3	79.6		85.0	69.8	15.2	MH	Elastic Silt with Sand
5	WPS-4	405322	VC	9.5	14.5	5	1141.2	2.81	0.0	13.3	86.7	10.3	60.7	47.0	13.7	MH	Elastic Silt
5	WPS-4	405322	VC	19.0	19.5	5											
5	WPS-5	405324	VC	10.5	15.5	5	448.4	2.84	0.0	9.8	80.2		66.0	49.1	16.9	MH	Elastic Silt
5	WPS-5	405324	VC	15.5	20.5	5	418.8	2.96	0.0	0.3	86.7	11.1	81.1	65.2	15.9	MH	Elastic Silt
5	WPS-5	405324	VC	25.0	25.5	5											
5	WPS-6	405326	VC	8.0	14.0	5	831.6	2.64	0.0	3.6	88.3	8.9	60.1	50.2	9.9	MH	Elastic Silt
5	WPS-6	405326	VC	14.0	19.0	5	578.7	2.84	0.0	10.0	80.0	9.5	63.5	56.1	27.4	MH	Elastic Silt
5	WPS-7	405328	VC	21.5	27.0	5											
5	WPS-7	405328	VC	18.5	18.5	5	576.2	2.88	0.0	10.5	80.5	4.2	73.3	58.3	18.0	MH	Elastic Silt
5	WPS-7	405328	VC	18.5	24.0	5	185.5	2.80	0.0	8.1	81.9	4.8	52.2	43.3	9.9	MH	Elastic Silt
5	WPS-8	405330	VC	9.0	14.0	5	537.1	2.77	0.1	10.1	89.8	19.0	55.4	51.8	3.5	MH	Elastic Silt
5	WPS-8	405330	VC	14.0	18.5	5	180.4	2.91	0.0	25.5	74.5	4.8	50.4	40.0	10.4	MH	Elastic Silt with Sand
5	WPS-8	405330	VC	18.5	24.0	5											
5	WPS-8	405332	VC	13.5	14.0	5											
5	WPS-8	405332	VC	18.5	19.0	5											
5	WPS-8	405332	VC	24.5	24.0	5	361.1	2.76	0.0	13.1	86.9	5.1	58.0	44.1	11.9	MH	Elastic Silt
5	WPS-10	405334	VC	9.0	14.0	5	73.4	2.62	0.0	13.4	86.8	5.9	48.7	36.7	10.1	ML	Silt
5	WPS-10	405334	VC	18.5	21.0	5											
5	WPS-11	405336	VC	12.0	12.5	5											
5	WPS-11	405336	VC	17.0	17.5	5											
5	WPS-11	405336	VC	22.0	22.5	5											
5	WPS-12	405338	VC	15.5	16.0	5											
5	WPS-13	405340	VC	13.5	14.0	5											
5	WPS-14	405342	VC	18.5	18.0	5											
5	WPS-14	405342	VC	18.5	25.0	5	196.9	2.91	0.0	12.9	87.2	9.7	45.7	46.5	1.2	ML	Silt
5	WPS-14	405342	VC	24.5	24.5	5											
5	WPS-5A	405325	VC	15.0	20.0	6	569.2	2.68	0.0	10.3	89.7	10.3	83.9	53.1	30.9	MH	Elastic Silt
5	WPS-5A	405325	VC	20.0	25.0	6	497.3	2.83	0.0	31.5	68.5	13.4	97.3	56.6	42.1	MH	Sandy Elastic Silt
5	PL15-11A	405337	VC	12.5	17.5	6	306.7	2.71	0.0	62.4	67.6	0.0	69.8	88.0	11.6	MH	Sandy Elastic Silt

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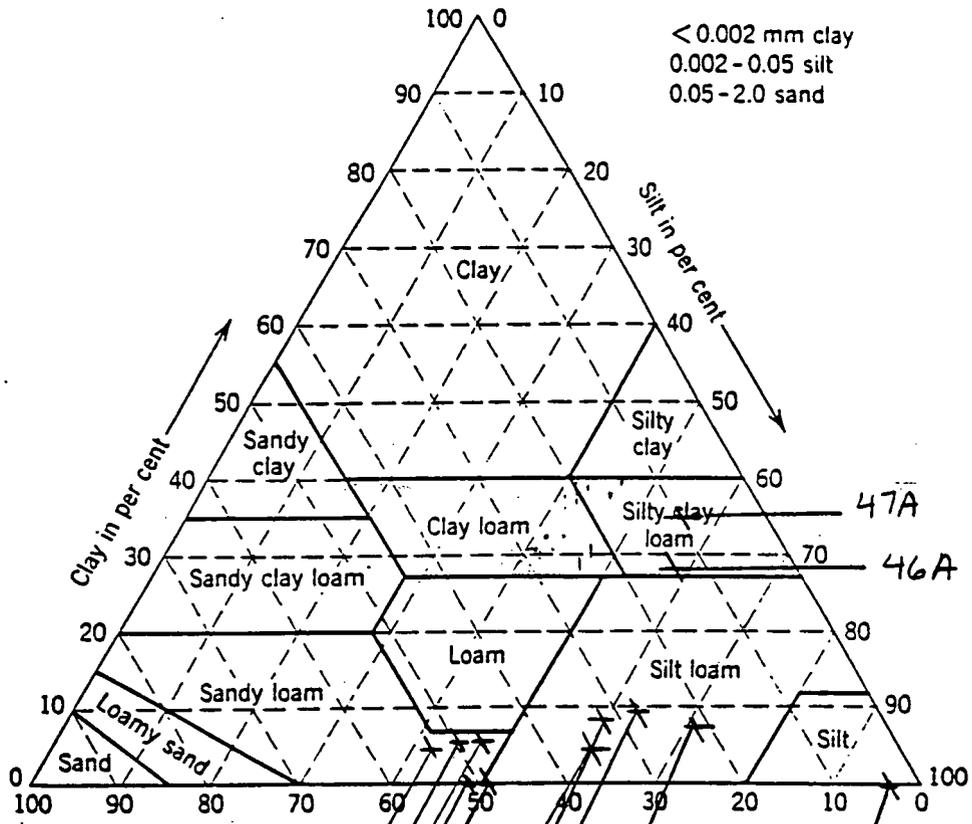


Grain Size Analysis of Each Pit

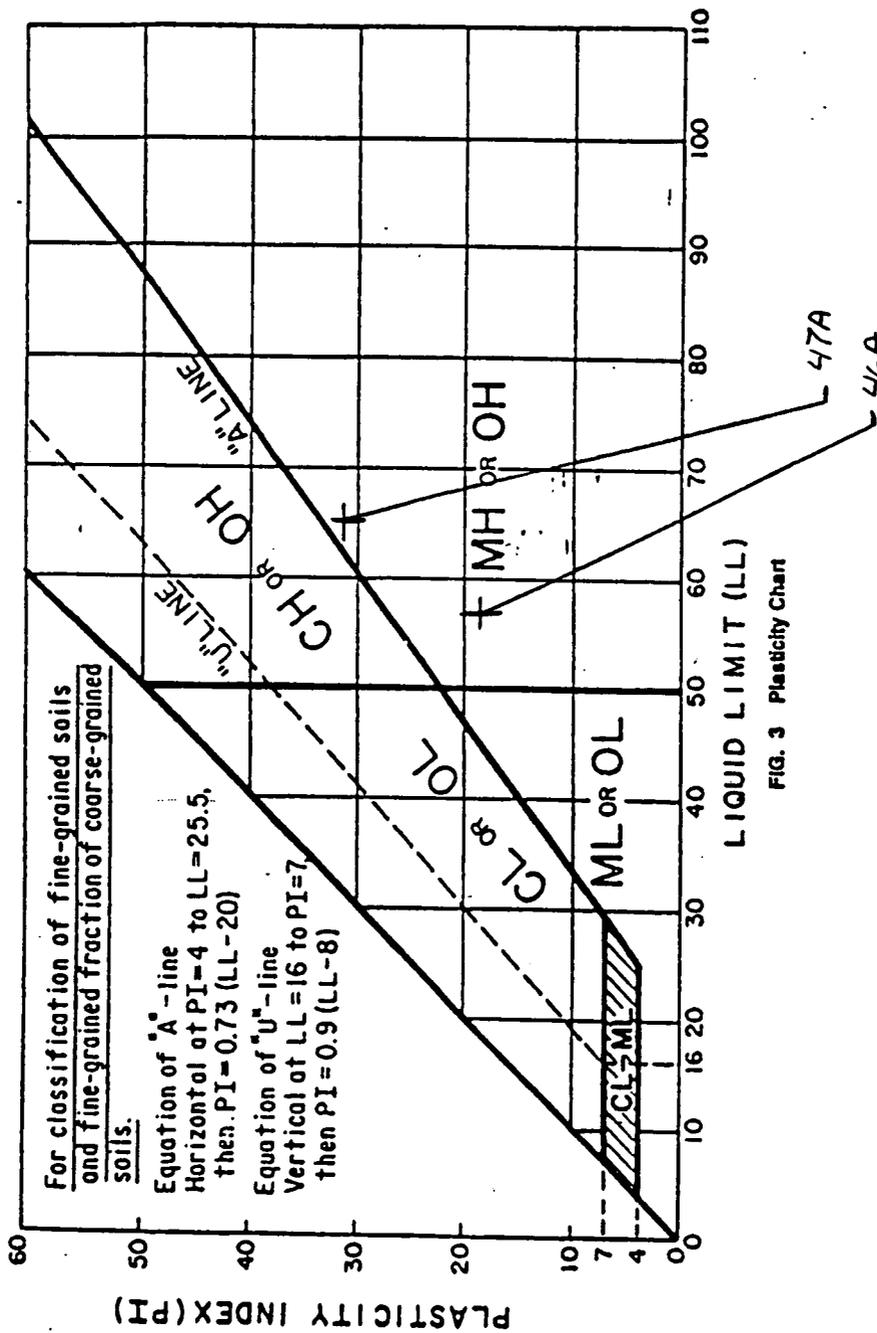
Pit No.	Boing No.	Sample Identification		Top Bottom		Data Source	Moisture Content (dry wt.)	Specific Gravity G _s	Gravel (%)	Grain Size Analysis		Index Property Data			USCS Group Symbol	Group Name
		Sample No.	Sample Type	Depth (ft)	Depth (ft)					Sand (%)	Silt of Clay (%)	LL	PL	PI		
6	WPB-1	405344		8.0	13.0	5	132.8		10.3	35.3	54.4	NP	NP	NP	ML (NP)	Sandy Silt (NP)
6	WPB-2	405346		7.0	12.0	5	23.4		3.0	49.6	47.4	NP	NP	NP	SM	Silty Sand
6	WPB-3	405348		8.5	6.0	5										
6	WPB-4	405348		13.5	14.0	5										
6	WPB-5	405350		10.5	11.0	5										
6	WPB-5	405352		7.5	7.5	5	15.9	3.24	0.0	51.0	48.0	NP	NP	NP	SM	Silty Sand
6	WPB-5	405352		12.5	18.5	5	33.6	3.27	4.7	48.8	48.5	NP	NP	NP	SM	Silty Sand
6	WPB-6	405354		7.5	8.0	5	14.8	3.38	4.2	47.7	48.1	NP	NP	NP	SM	Silty Sand
6	WPB-6	405354		12.5	18.0	5	13.4	3.34				NP	NP	NP		
6	WPB-7	405358		12.5	18.0	5										
6	(1)	43A	CAN			3	425.1		0.0	3.7	66.3	NP	NP	NP	ML (NP)	Silt (NP)
6	(1)	45A	CAN			3	26.8	3.21	0.0	27.6	72.4	NP	NP	NP	ML (NP)	Silt (NP) with Sand
6	(1)	45C	CAN			3	117.6		0.0	51.3	48.7	NP	NP	NP	SM	Silty Sand
6	(1)	46A	CAN			3	107.4	2.86	0.0	14.8	86.2	NP	NP	NP	ML	Silt
6	(1)	47A	CAN			3	111.4	2.85	0.0	8.8	92.2	NP	NP	NP	MH	Elastic Silt
6	06-04	6-10	COMP	0.0	10.0	4	60.4	2.87	0.0	21.0	79.0	NP	NP	NP	ML (NP)	Silt (NP) with Sand
6	08-03	8-22	COMP	0.0	15.0	4	50.5		0.0	32.0	68.0	NP	NP	NP	ML (NP)	Sandy Silt (NP)

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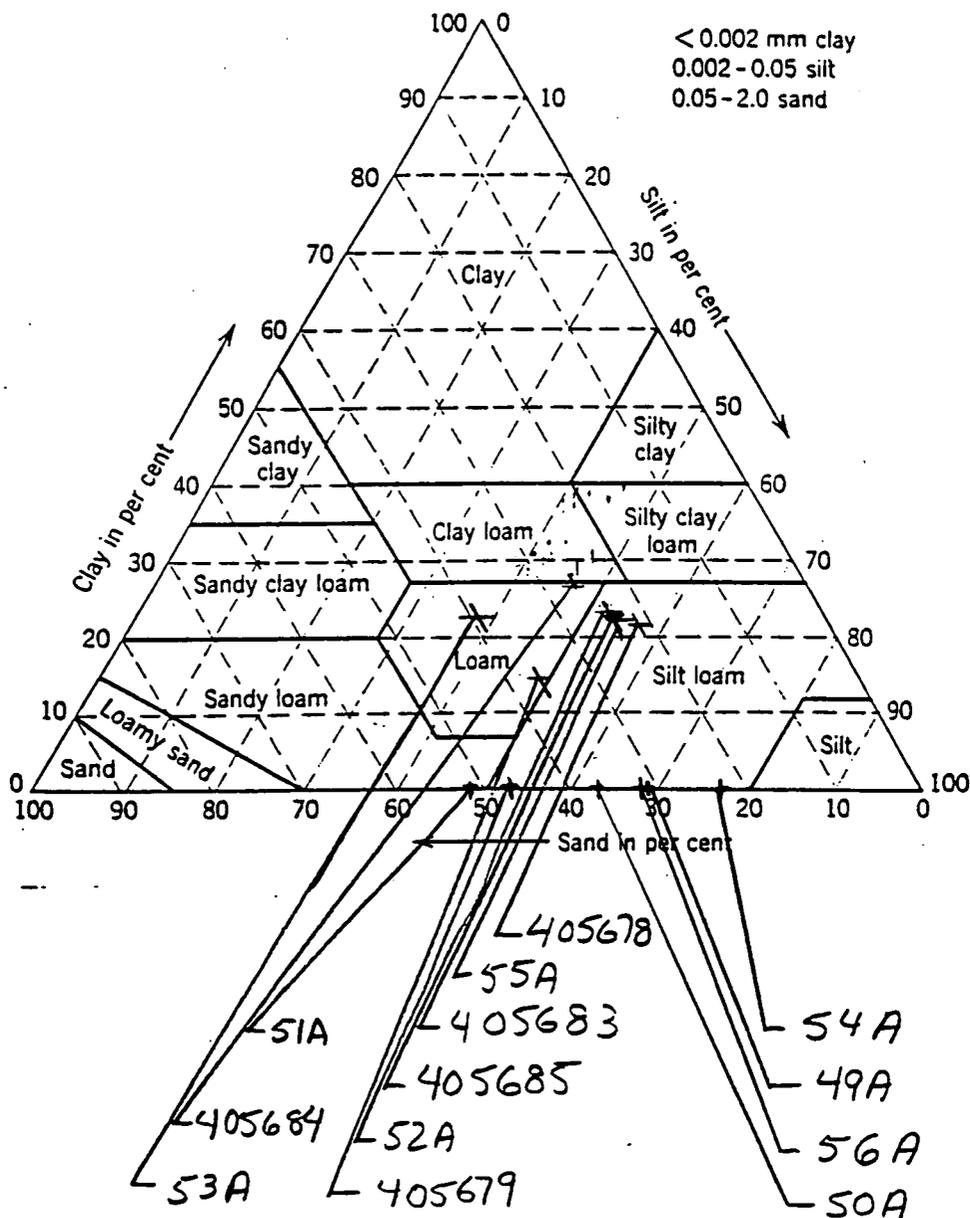
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Grain Size Analysis of Each Pit

Pit No.	Boiling No.	Sample Identification		Top Bottom		Data Source	Moisture Content (% dry wgt)	Specific Gravity G _s	Grain Size Analysis		Index Property Data			USCS Group Symbol	Group Name			
		Sample No.	Sample Type	Depth (ft)	Depth (ft)				Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fact. (%)	LL			PL	FI	
CW	11573	49A	CAN			3	53.4		3.3	31.1	65.6			43.9	25.6	18.3	CL	Sandy Lean Clay
CW	1573	50A	CAN			3	65.1		10.9	28.4	63.7			50.6	32.5	18.1	MH	Sandy Elastic Silt
CW	1573	51A	CAN			3	61.9		0.0	51.5	48.5			45.0	28.0	17.0	SM	Silty Sand
CW	1573	52A	CAN			3	40.2		8.5	47.0	44.3			38.3	21.9	14.1	SM	Silty Sand
CW	1573	53A	CAN			3	35.4	2.69	0.0	35.4	69.8		22.3	38.3	18.9	17.1	CL	Sandy Lean Clay
CW	1573	54A	CAN			3	73.9		0.5	22.5	77.0			24.7	39.2	15.5	MH	Sandy Elastic Silt with Sand
CW	1573	55A	CAN			3	71.7	2.78	1.8	23.7	74.5		23.8	52.4	39.0	14.4	MH	Elastic Silt with Sand
CW	1573	56A	CAN			3	66.5		3.3	31.3	65.4			53.3	40.2	13.1	MH	Sandy Elastic Silt
CW	1573	406678	JA1	7.5	10	6		2.72	5.7	21.7	72.6		21.7	26.8	14.9	13.9	CL	Lean Clay with Sand
CW	1573	406679	JA1	10	11.5	6	16.9	2.65	6.2	24.0	67.8		14.6	31.9	20.2	11.8	CL	Sandy Lean Clay
CW	1573	406680	JA1	20	21.3	6	13.9	2.73	6.1	24.1	67.8		22.6	30.9	13.5	17.4	CL	Sandy Lean Clay
CW	1573	406684	SI	23	25	6		2.72	3.8	26.7	70.7		27.4	37.0	16.1	20.8	CL	Lean Clay with Sand
CW	1573	406685	JA1	25.0	28.5	6	19.5	2.73	4.7	24.4	70.8		24.4	28.9	14.0	15.9	CL	Lean Clay with Sand

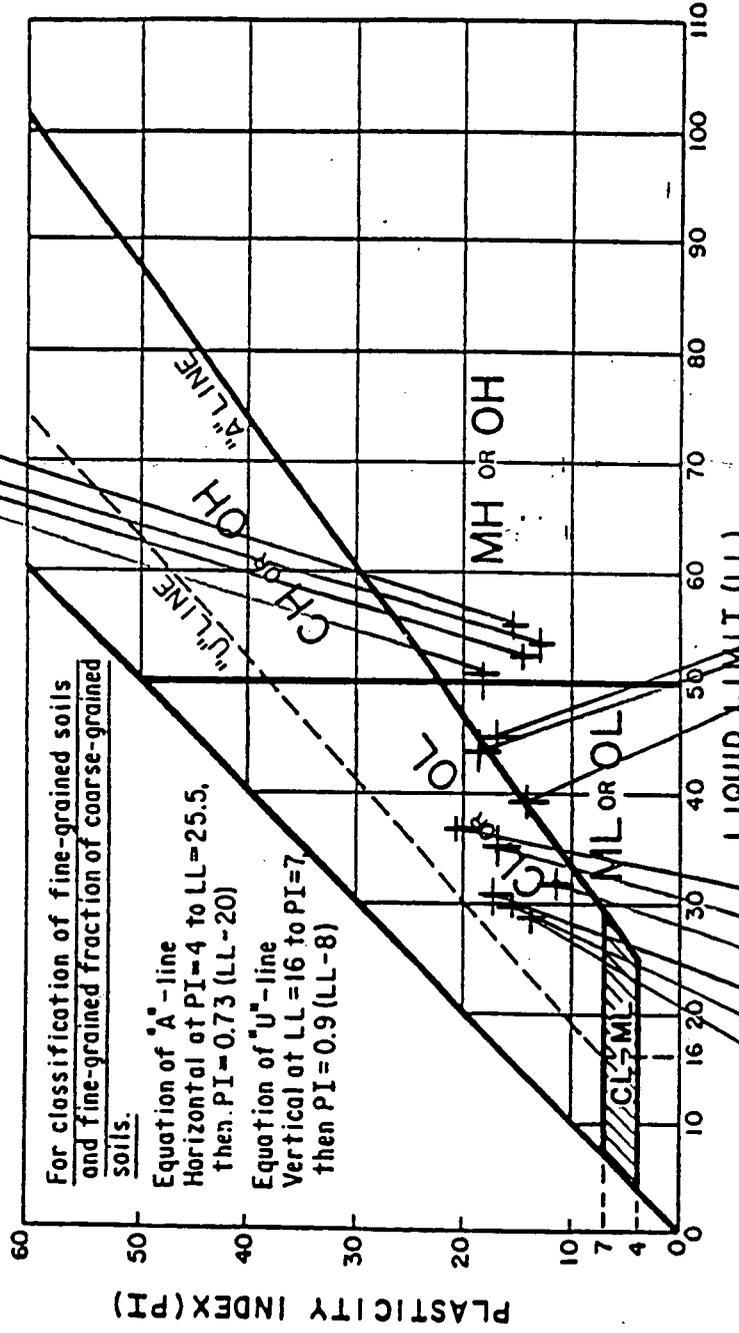
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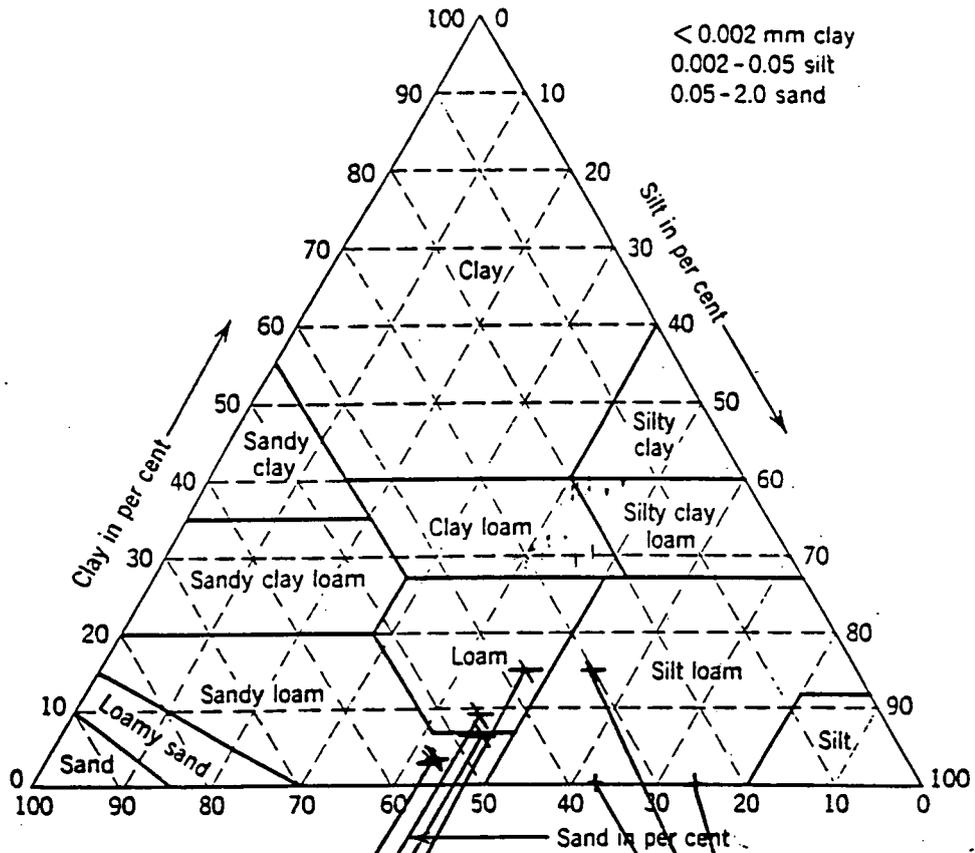
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Grain Size Analysis of Each Pit

Pit No.	Boring No.	Sample Identification		Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (Naty wgt)	Specific Gravity Gs	Gravel (%)	Grain Size Analysis		Clay Fract. (%)	Index Property Data			USCS Group Symbol	Group Name
		Sample No.	Sample Type							Sand (%)	Silt or Clay (%)		LL	PL	PI		
BP	1776	63176	SI	4.5	8.0	1	43.3	3.74	6.9	46.0	47.1	9.0	NP	NP	NP	SM	Silty Sand
BP	1776	27A	CAN			3	25.5		2.6	28.2	71.2		41.3	24.7	18.8	CL	Lean Clay with Sand
BP	1777	26A	CAN			3	25.6		4.4	37.0	64.6		36.1	31.0	4.1	ML	Sandy Silt
BP	1819	26A	CAN			3	30.0		8.5	36.2	53.3	15.0	37.8	26.7	11.1	ML	Silty Silt
BP	07-01	7-09	COMP	0.0	10.0	4	30.1	2.48	10.0	54.0	36.0	4.0	NP	NP	NP	SM	Silty Sand
BP	07-04	7-34	COMP	0.0	18.0	4	30.2		13.0	30.0	57.0	15.0	36.0	34.0	2.0	ML	Sandy Silt
BP	07-04	7-34	COMP	0.0	18.0	4							33.0	30.0	3.0	ML	Sandy Silt
BP	07-08	7-52	COMP	0.0	18.0	4	29.2	2.35	13.0	47.0	40.0	8.0	NP	NP	NP	SM	Silty Sand

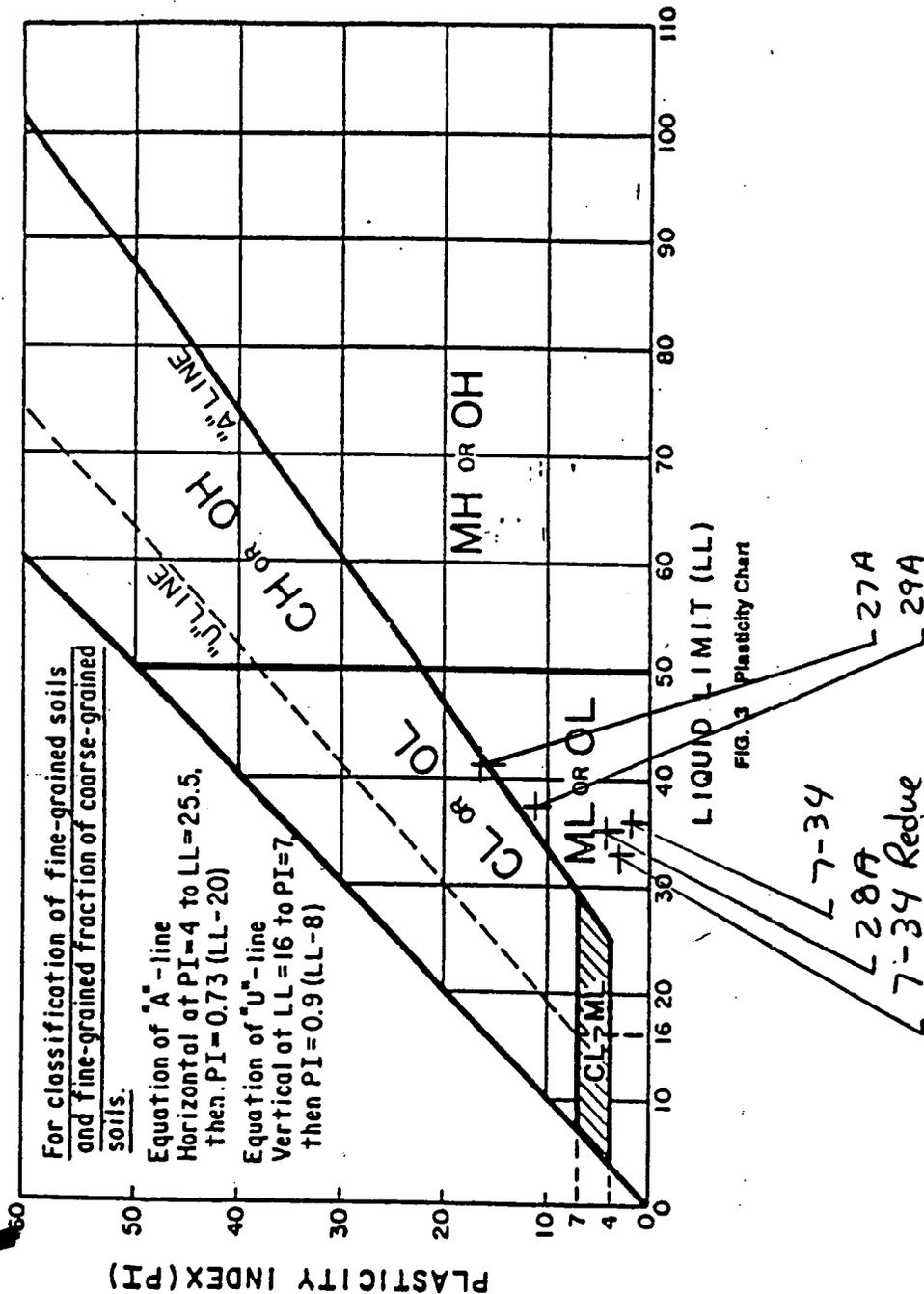
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OU-1 SHREDDER PRICE BREAKDOWN

<u>Item</u>	<u>Description</u>	<u>Unit of Quantity</u>	<u>Unit Measure</u>	<u>Extended Price</u>	<u>Amount</u>
001	Engineering and design of the Debris Shredder	1	Lot		\$ _____
002	Fabrication of the Debris Shredder to include the following:	1	Lot		\$ _____
002a.	Hopper			\$ _____	
002b.	Hydraulic Feed Ram			\$ _____	
002c.	Shredder with Controls			\$ _____	
002d.	Fire Protection System			\$ _____	
003	Debris Shredder Options:				
003a.	Dust Suppression System			\$ _____	\$ _____
003b.	Rock Box			\$ _____	
004	Fabrication of the Process Shredder to include the following:	1	Lot		\$ _____
004a.	Hopper			\$ _____	
004b.	Shredder Stage(s) with Controls			\$ _____	
004c.	Fire Protection System			\$ _____	
005	Process Shredder Options:				
005a.	Dust Suppression System			\$ _____	\$ _____
005b.	Rock Box			\$ _____	
006	Miscellaneous Direct Charges (i.e., travel and per diem)	1	Lot	\$ _____	\$ _____
007	Spare Parts List	1	Lot		\$ _____
008	Preventative Maintenance	12	Months	\$ _____	\$ _____

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ESTIMATED
QUANTITY

009	Technical Services for Site Receiving Inspection	16	Hours	\$ _____	\$ _____
010	Technical Services for Installation	200	Hours	\$ _____	\$ _____
011	Technical Services On-Site Test Observer	200	Hours	\$ _____	\$ _____
012	Technical Services for Operator Training	8	Hours	\$ _____	\$ _____

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POTENTIAL BIDDERS LIST

The following constitutes the potential vendors bidders list for the shredder. Each of the vendors has been contracted (see contact name) and has indicated that the company would welcome an RFP for the OU-1 shredder. In addition, all the vendors listed below have stated that they have experience in the design and manufacturing of low-speed, high-torque shear type waste shredder equipment.

1. American Pulverizer Company
5540 West Park Avenue
St. Louis, MO 63110
Tel: (314) 781-6100, Fax: (314) 781-9209
Contact: Mr. Chris Griesedieck
2. Komar Industries, Inc.
4425 Marketing Place
Groveport, OH 43125
Tel: (614) 836-2366, Fax: (614) 836-9870
Contact: Ms. Dana Ford
3. MAC Corporation/Saturn Shredders
201 East Shady Grove Road
Grand Prairie, TX 75050
Tel: (214) 790-7800, Fax: (214) 790-8733
Contact: Mr. Damon Dedo
4. Shredpax, Inc.
136 W. Commercial Avenue
Wood Dale, IL 60191-1304
Tel: (708) 595-8780, Fax: (708) 595-9187
Contact: Mr. Ken Smith
5. Shred Tech
295 Pinebush
Cambridge, Ontario N1T-1B2
Tel: (800) 465-3214, Fax: (519) 621-0688
Contact: Mr. Ken Lewis
6. SSI, Inc.
28655 S.W. Boones Ferry Rd
Wilsonville, OR 97070
Tel: (503) 682-3633, Fax: (503) 682-1704
Contact: Ms. Joyce Beasley
7. Triple/S Dynamics
1031 S. Haskel Avenue
Dallas, TX 75223
Tel: (800) 527-2116, Fax: (214) 828-8688
Contact: Mr. Jim Sullivan

U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERMCO SUBCONTRACT NO. 2-21487
Division 15 - Mechanical
SHREDDER(S) PERFORMANCE SPECIFICATION

PARSONS

Prepared by: _____

Checked by: _____

Date: 02/06/96
Rev.: B RE: TF

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WBS No.: 1.1.1.1.1.3.1
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SECTION 15172
MOTORS FOR SHREDDER(S)

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Low voltage, three phase induction motors.
- B. Low voltage, single phase induction motors.

1.2 RELATED SECTIONS

- A. Section 13652 - Shredder(s).
- B. Section 16052 - Basic Electrical Materials and Methods for Shredder(s).

1.3 REFERENCES

- A. American Bearing Manufacturers Association (ABMA):
 - 1. ABMA 9-90 Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11-90 Load Ratings and Fatigue Life for Roller Bearings.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE 112-91 Standard Test Procedure for Polyphase Induction Motors and Generators.
- C. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA MG 1-93 Motors and Generators.
 - 2. NEMA MG 13-84 Frame Assignments for Alternating Current Integral-Horsepower Induction Motors.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 70-96 National Electrical Code.

1.4

SYSTEM DESCRIPTION

- A. Provide electric motors as required for the Shredder. Each motor shall be selected especially for its respective driven equipment. Each motor shall be adequate for the full range of the driven equipment's performance.

1.5

SUBMITTALS

- A. Product Data: Provide data for motors, including full load amps, NEMA frame size, and additional standard nameplate data. Provide efficiency and power factor for each of 1/2, 3/4, and full load. Include catalog sheets and drawings showing voltage, ratings, impedances, normal and short circuit current ratings, dimensions, and enclosure details.
- B. Operation and Maintenance Data: Include assembly drawings and bearing data, including replacement sizes and lubrication instructions.
- C. Certificate of Conformance: Provide statement certifying that the materials supplied meet or exceed technical requirements.
- D. Testing Procedures: Submit written procedures for all required testing. Test procedures shall include criteria for acceptable performance.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and commissioning of products.
- F. Recommended Spare Parts Lists: Provide, where applicable.
- G. Material Safety Data Sheet (MSDS): Submit MSDSs for all cutting oils, caulks, sealants, and all similar components.

- H. Test Reports: Indicate satisfactory completion of required tests and inspections. Submit results verifying performance in accordance with IEEE 112. 1
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- I. Motor Data Sheets: Provide completed motor data sheet (Attachment 1) for each motor provided. 5
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1.6 QUALITY ASSURANCE 8

- A. Conform to NFPA 70 and NEMA MG 1. 9
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PART 2 PRODUCTS 12

The listing of equipment suppliers below in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal. It is the offerer's responsibility to propose equipment that is best suited for this project in combined terms of quality and price. 13
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2.1 MANUFACTURERS 23
24

- A. Reliance Electric. 25
26
27
- B. U. S. Motors. 28
29
- C. General Electric. 30
31

2.2 EQUIPMENT 32

- A. General Construction and Requirements 33
34
 - 1. Electrical Service: Refer to related sections of the specifications and the drawings for required characteristics. 35
36
37
 - 2. Motors: Design for continuous operation at a temperature of 40 degrees C ambient, and for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type. Motors to be controlled by 38
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variable frequency drives shall be of a design suitable for this type of operation.

3. Visible Nameplate: Nameplate to indicate motor horsepower, voltage, phase, frequency, rpm, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, serial number, and bearing numbers. Nameplate shall be stainless steel, permanently attached to the motor frame.
4. Electrical Connection: Conduit connection boxes, threaded for conduit and designed to allow for 90 degree step rotation of the conduit entrance. Oversize conduit boxes shall be provided.
5. Motor Service Factor: Furnish motors with service factors required by the table in Paragraph D. Motor size in hp shall be selected to serve the driven equipment over its full performance range as though the service factor is 1.0.
6. Motor voltage shall be 115 V, single-phase for motors 1 hp or less. Other motors shall be 460 V, three-phase.
7. Motors drawing less than 250 W that are intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.

B. Three Phase - Squirrel Cage Induction Motors

1. Motors shall be 460 V, three phase, 60 Hz.
2. The motor connection diagram shall be stainless steel, permanently stamped and attached to the motor either inside the conduit box or on the same side as the conduit box.
3. Starting Torque: To be matched to the driven equipment.
4. Starting Current: Not to exceed six times full-load current.
5. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics or as required by the driven equipment.
6. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
7. Insulation System: Non-hygroscopic NEMA Class F or better.

- 8. Testing Procedure: In accordance with IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and for compliance with performance data. 1
- 9. Motor Frames: NEMA MG 13 standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts. 2
- 10. Bearings: Grease lubricated, anti-friction ball bearings with housings equipped with plugged provision for prelubrication, rated for minimum ABMA 9 and 11, L-10 life of 20,000 hours. 3
- 11. Sound Power Levels: To NEMA MG 1. 4
- 12. Motors shall be high efficiency type. 5
- 13. Motors shall be totally enclosed fan cooled (TEFC). 6
- 14. Nominal Efficiency: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112. 7
- 15. Nominal Power Factor: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112. 8

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C. Performance Schedule: Three Phase - Energy efficient, TEFC.

HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor	
1	1200	145T	81	72	3
1-1/2	1200	182T	83	65	4
2	1200	184T	85	68	5
3	1200	213T	85	63	6
5	1200	215T	86	66	7
7-1/2	1200	254T	89	68	8
10	1200	256T	89	75	9
15	1200	284T	90	72	10
20	1200	286T	90	76	11
25	1200	324T	90	71	12
30	1200	326T	91	79	13
40	1200	364T	92	78	14
50	1200	365T	92	81	15
60	1200	404T	92	83	16
75	1200	405T	92	80	17
100	1200	444T	93	83	18
125	1200	445T	93	85	19
1	1800	143T	82	84	20
1-1/2	1800	145T	84	85	21
2	1800	145T	84	85	22
3	1800	182T	87	83	23
5	1800	184T	88	83	24
7-1/2	1800	213T	89	85	25
10	1800	215T	90	84	26
15	1800	254T	91	86	27
20	1800	256T	91	85	28
25	1800	284T	92	84	29
30	1800	286T	93	86	30
40	1800	324T	93	83	31
50	1800	326T	93	85	32
60	1800	364T	93	87	33

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HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor	
75	1800	365T	93	87	1
					2
100	1800	405T	94	86	3
125	1800	444T	94	87	4
150	1800	445T	94	88	5
200	1800	447T	95	87	6
					7
1-1/2	3600	143T	82	85	8
2	3600	145T	82	87	9
3	3600	182T	82	87	10
					11
5	3600	184T	85	88	12
7-1/2	3600	213T	86	86	13
10	3600	215T	86	86	14
					15
15	3600	254T	88	91	16
20	3600	256T	89	89	17
25	3600	284T	90	92	18
					19
30	3600	286T	91	92	20
40	3600	324T	91	91	21
50	3600	326T	90	92	22
					23
60	3600	364T	91	93	24
75	3600	365T	91	91	25
100	3600	405T	92	92	26
					27

For motors not in schedule, furnish manufacturer's standard high-efficiency motor.

D. Service Factor Schedule

HP	3600 rpm	1800 rpm	1200 rpm	900 rpm	
1/6 - 1/3	1.35	1.35	1.35	1.35	33
					34
1/2	1.25	1.25	1.25	1.15	35
					36
3/4	1.25	1.25	1.15	1.15	36
					37
1	1.25	1.15	1.15	1.15	37
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>1 - 150	1.15	1.15	1.15	1.15	38
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- E. Single phase motors shall conform to the following respective requirements. The driven equipment supplier shall furnish motor starter, motor type, and motor enclosure type suitable for the application.
1. Single Phase Power - Split Phase Motors
 - a. Starting Torque: Less than 150 percent of full load torque.
 - b. Starting Current: Up to seven times full load current.
 - c. Breakdown Torque: Approximately 200 percent of full load torque.
 - d. Drip-Proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
 - e. Enclosed Motors: 1.0 Service Factor, prelubricated ball bearings.
 2. Single Phase Power - Permanent-Split Capacitor Motors
 - a. Starting Torque: Exceeding 1/4 of full load torque.
 - b. Starting Current: Up to six times full load current.
 - c. Multiple Speed: Through tapped windings.
 - d. Open Drip-Proof or Enclosed Air Over Enclosure: Minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.
 3. Single Phase Power - Capacitor Start Motors
 - a. Starting Torque: Three times full load torque.
 - b. Starting Current: Less than five times full load current.
 - c. Pull-Up Torque: Up to 350 percent of full load torque.
 - d. Breakdown Torque: Approximately 250 percent of full load torque.
 - e. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
 - f. Drip-Proof Enclosure: NEMA Service Factor, prelubricated bearings.
 - g. Enclosed Motors: 1.0 service factor, prelubricated ball bearings.

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PART 3 EXECUTION

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END OF SECTION

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ATTACHMENT 1

MOTOR DATA SHEET

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MOTOR DATA SHEET

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Submit for each motor. Mark N/A if not applicable.

- 1. Driven Equipment Number _____
- 2. Driven Equipment Name _____
- 3. Motor Manufacturer _____
- 4. Quantity _____
- 5. Horsepower (hp) _____
- 6. RPM _____
- 7. Voltage _____
- 8. Enclosure Type _____
- 9. Frame _____
- 10. Phase/Frequency _____
- 11. Insulation Class _____
- 12. Service Factor _____
- 13. NEMA Design _____
- 14. Space Heaters _____
- 15. Full Load Amperes (FLA) _____
- 16. Locked Rotor Amperes (LRA) _____
- 17. Efficiency:
 - 1/2 Load _____
 - 3/4 Load _____
 - Full Load _____
- 18. Power Factor:
 - 1/2 Load _____
 - 3/4 Load _____
 - Full Load _____

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U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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FERMCO SUBCONTRACT NO. 2-21487

Division 16 - Electrical

SHREDDER(S) PERFORMANCE SPECIFICATION

PARSONS

Prepared by: _____

Checked by: _____

Date: 03/06/96
Rev.: C RE: TF

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WB: No.: 1.1.1.1.1.3.1
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SECTION 16052
BASIC ELECTRICAL MATERIALS AND METHODS
FOR SHREDDER(S)

PART 1 GENERAL 6

1.1 SECTION INCLUDES 7

A. Electrical equipment, material, and services required for shredder. 10

- 1. Disconnect switches. 12
- 2. Motor starters. 13
- 3. Selector switches. 14
- 4. Enclosures for electrical equipment. 15
- 5. Molded case circuit breakers. 16
- 6. Variable frequency drives. 17
- 7. Conduit. 18
- 8. Wire and cable. 19
- 9. Instrument cable. 20
- 10. Nameplates. 21
- 11. Wire markers and cable tags. 22
- 12. Splicing and termination components. 23

1.2 RELATED SECTIONS 24

- A. Section 13652 - Shredder(s). 27
- B. Section 15172 - Motors for Shredder(s). 29

1.3 REFERENCES 30

- A. National Fire Protection Association (NFPA): 33
 - 1. NFPA 70-96 National Electrical Code. 34
- B. American National Standards Institute (ANSI): 35
 - 1. ANSI C80.1-90 Rigid Steel Conduit-Zinc Coated. 37
- C. Underwriters Laboratories, Inc. (UL): 39
 - 1. UL 360-86 Liquid-Tight Flexible Steel Conduit. 40
 - 2. UL 486A-91 Wire Connectors and Soldering Lugs for Use with Copper Conductors. 42

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3.	UL 510-94	Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.	1
			3
D.	National Electrical Manufacturers Association (NEMA):		4
1.	NEMA AB 1-93	Molded Case Circuit Breakers and Molded Case Switches.	5
2.	NEMA ICS 1-93	Industrial Controls and Systems General Requirements.	6
3.	NEMA ICS 2-93	Industrial Controls and Systems, Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.	7
			8
4.	NEMA ICS 3.1-90	Industrial Controls and Systems, Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.	9
			10
5.	NEMA ICS 6-93	Industrial Controls and Systems Enclosures.	11
			12
6.	NEMA KS 1-90	Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).	13
			14
7.	NEMA 250-91	Enclosures for Electrical Equipment (1000 Volts Maximum).	15
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1.4 SYSTEM DESCRIPTION

- A. Design Conditions: As noted in Section 13652. Ambient shall be 40 degrees C.
- B. Design Criteria: As noted in Section 13652.
- C. Electrical starters, controls, wiring, and conduit required to operate the shredder. Where these electrical items are mounted on the same shipping section, they shall be electrically connected using wire or cable and conduit as specified herein. For items not mounted on the same shipping section, electrical interconnection diagrams shall be furnished, conveying clearly how these items are to be wired. Disregard requirements herein for material or equipment not required for the shredder.

1.5 SUBMITTALS

- A. Product Data: Provide data for all equipment and materials specified. Include catalog sheets and drawings showing voltage, ratings, impedances, normal and short circuit current ratings, dimensions, and enclosure details. 1-6
- B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and commissioning of products. Provide interconnection wiring diagrams indicating actual point-to-point termination of wiring between electrical switches, controls, starters, and other equipment. Wire terminations and individual wires must be labeled with numbers. 8-16
- C. Testing Procedures: Submit written procedures for all required testing. Testing procedures shall include criteria for acceptable performance. 18-20
- D. Certificate of Conformance: Provide statement certifying that the equipment and materials supplied meet or exceed technical requirements. 22-24
- E. Material Safety Data Sheet (MSDS): Submit MSDSs for cutting oils, caulks, sealants, and all other similar components. 26-28
- F. Test Reports: Indicate satisfactory completion of required tests and inspections. 29-31

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: All products and services performed shall conform to the requirements of NFPA 70. 34-36
- B. Certifications: All items shall be tested and listed for the purpose intended by Underwriters Laboratories or Factory Mutual, Inc., with label attached. 37-39

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Disconnect Switches

1. Nonfusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
2. Fusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: FS W-F-870. Designed to accommodate Class R fuses.

B. Motor Starters

1. Magnetic Motor Controllers: NEMA ICS 1 and ICS 2, AC general purpose, circuit breaker, combination, Class A magnetic controller for induction motor. Each controller shall have a control power transformer with two primary fuses, one secondary fuse with other secondary lead grounded.
2. Coil Operating Voltage: 120 volts, 60 hertz.
3. Overload Relay: NEMA ICS 2 bimetal, ambient compensated.
4. Enclosure: NEMA ICS 6, type 4.
5. Selector Switch: Cover mounted, rotary type, on-off.
6. Minimum Size Contactor: Size 1.
7. Circuit Breaker: Instantaneous trip only, minimum 22 kA symmetrical interruption.
8. Pilot Lights: Two push-to-test, industrial type with nameplates, red and green.

C. Selector Switches

1. Stainless steel enclosure, NEMA ICS 6, type 4.
2. Two-position, maintained contact (start/stop).
3. Three-position, maintained contact (hand/off/auto).

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- D. Enclosures for Electrical Equipment
 - 1. All enclosures for electrical equipment shall be type 4, conforming to NEMA ICS 6 or NEMA 250, as appropriate.

- E. Molded Case Circuit Breakers
 - 1. NEMA AB 1 with integral thermal and instantaneous magnetic trip in each pole. Provide common trip handle for all poles with capability of physical lockout. Terminals, minimum 75 degrees C rated.
 - 2. Breaker enclosures shall be type 3R, conforming to NEMA 250.

- F. Variable Speed Drives
 - 1. Manufacturers:
 - a. Cutler Hammer.
 - b. Allen Bradley.
 - c. Westinghouse.
 - d. Substitutions: Submit to the FERMC0 for engineering approval. The listing of equipment suppliers in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal. It is the offerer's responsibility to propose equipment that is best suited for this project in combined terms of quality and price.
 - 2. Provide enclosed variable frequency drive suitable for load intended, conforming to the requirements of NEMA ICS 3.1.
 - 3. Ratings
 - a. Rated Input Voltage: 480 volts, three phase, 60 Hertz.
 - b. Motor Nameplate Voltage: 460 volts, three phase, 60 Hertz.
 - c. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
 - d. Operating Ambient: -10 degrees C to 40 degrees C.
 - e. Humidity: 20-90 percent noncondensing.

4. Design
 - a. Employ microprocessor-based inverter logic, isolated from power circuits.
 - b. Employ pulse width modulated inverter system.
 - c. Employ switching power supply operating off DC link.
 - d. Design for ability to operate drive with motor disconnected from output.
 - e. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.
5. Product Options and Features
 - a. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.
 - b. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
 - c. Volts per Hertz Adjustment: Manufacturer's standard.
 - d. Current Limit: 150 percent of rated for 1 minute.
 - e. Acceleration Rate Adjustment: 0.5-30 seconds.
 - f. Deceleration Rate Adjustment: 1-30 seconds.
 - g. Provide hand-off-automatic selector switch and manual speed control.
 - h. Input Signal: 4-20 mA DC, 250 ohms loop impedance (maximum).
 - i. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic mode.
 - j. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode.
 - k. Manual Bypass: Provide contactor, motor running overload protection, and short circuit protection for full voltage, nonreversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation.
 - l. Disconnecting Means: Include integral circuit breaker on the line side of each drive.

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2.2 MATERIALS

A. Conduit

- 1. Rigid steel, heavy wall, galvanized conduit conforming to ANSI C80.1. Conduit shall be 3/4 inch minimum in diameter. Attachment straps, hangers, and struts shall be galvanized.
- 2. Liquid-tight flexible metal conduit conforming to UL 360. Conduit shall be 3/4 inch minimum in diameter.

B. Wire and Cable

- 1. Single conductor, 600-volt insulated copper conductor. Conductors for power and lighting branch circuits shall not be smaller than No. 12 AWG. Conductors No. 12 AWG and larger shall be stranded. Conductors for control shall not be smaller than No. 14 AWG stranded. Conductors for Class 1 remote-control and signal circuits shall be enclosed in cable and shall comply with NFPA 70. Conductors for solenoid valves and/or limit switches shall be multiconductor No. 16 AWG, as required. Power and lighting conductor insulation shall be Type THW, XHHW, or THWN. Conductors required to be rated 90 degrees C in accordance with NFPA 70 shall be type XHHW-2 or THW-2.
- 2. Any other specialized conductors provided, for which the above requirements are not suited, shall be UL listed for the purpose intended.

C. Instrument Cable

- 1. Instrumentation cable shall be No. 16 AWG stranded tinned copper conductors. Conductors shall be polyethylene insulated and rated 600 volts, 60 degrees C. Conductors shall be twisted with aluminum-polymer shield; No. 18 AWG stranded, tinned copper drain wire. Cable shall have overall-chrome gray FR-PVC jacket.

D. Nameplates

- 1. Nameplates shall be engraved, three-layer laminated plastic, 5/16-inch bold style, black letters on white background.

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E. Wire Markers and Cable Tags

1. Wire markers shall be single-conductor, slip-on, heat-shrinkable sleeve with typed or printed black letters on a white background. Wire markers shall be similar to W. H. Brady Co. computer-printable "Bradysleeve" or approved equal.
2. Cable tags shall be rectangular, flat, non-heat-shrinkable tags with 1/8-inch-high letters. Cable markers shall be similar to Raychem-type TMS or approved equal.

F. Splicing and Termination Components

1. Wire connectors, UL 486A, as applicable.
2. Insulation tape, UL 510.
3. Provide solderless terminal lugs on stranded conductors.
4. Twist-on splicing connectors (wire nuts) are not acceptable for 480-volt splices.

2.3 FABRICATION

A. Conduit

1. Route conduit parallel or at right angles to equipment lines. Provide conduit supports at approximately 8-foot intervals.
2. Cut conduit square using saw or pipecutter. All cut ends of conduit shall be reamed.
3. Install no more than the equivalent of three 90-degree bends between boxes. Use hydraulic one-shot conduit bender or factory elbows for conduit diameter larger than 1-1/2 inch.
4. Use form 8 conduit bodies to make sharp changes in direction. Avoid moisture traps; provide junction box with weep hole.
5. Provide cast metal boxes such as FS or FD.
6. Provide 1/8-inch nylon pull cord in empty conduits.
7. Final conduit connections to motors or other vibrating equipment shall be made with approximately 3-foot liquid-tight flexible metal conduit.

B. Wire and Cable

1. All wire and cable shall be completely enclosed in conduit or in junction boxes, metal raceway, or panels.

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- 2. Swab conduit before installing cable. Remove burrs, dirt, or other debris. 1
- 3. When pulling cable into conduit, use wire pulling compound. 2
- 4. Splices shall be made only in outlet or junction boxes. 3
- 5. Provide equipment grounding conductor along with phase conductors in all conduits. 4
- 6. Multiconductor cables shall contain an integral ground conductor. 5
- 7. Grounding conductors shall be connected to equipment with compression lugs. Grounding connections shall be made to clean, dry surfaces. Scale, rust, grease, and dirt shall be removed from surfaces to which grounding connections are to be made. 6
- 8. Conductors shall be color coded. Conductors No. 6 AWG and larger shall be identified using colored tape at terminals and splice points. Conductors No. 8 AWG and smaller shall be identified using colored insulation or jacket. Color coding shall be as follows: 7

480Y/277V	Phase A	Brown	8
	Phase B	Orange	9
	Phase C	Yellow	10
	Neutral (grounded)	Gray	11
	Ground	Green or bare	12
208Y/120V	Phase A	Black	13
	Phase B	Red	14
	Phase C	Blue	15
	Neutral (grounded)	White	16
	Ground	Green or bare	17
240/120V	Phase	Black	18
	Phase	Red	19
	Neutral (grounded)	White	20
	Ground	Green	21

C. Nameplates.

- 1. Degrease and clean surfaces to receive nameplates. 22
- 2. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using self-tapping screws. 23

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D. Wire and Cable Markers

1. Provide wire markers on each conductor in pull boxes and junction boxes, and at each load connection. Provide cable tags in pull boxes for multiconductor cables.
2. Wire and cable tags shall identify panel and circuit number or control wire number, as required.

E. Motor Starters

1. Install motor controllers with selector switches approximately 54 inches above finished floor.
2. Install overload heater elements in motor controllers to match motor characteristics.
3. Provide engraved nameplate identifying motor served.

F. Selector Switches

1. Mount selector switches at a mounting height of 54 inches above the floor, adjacent to the equipment controlled. Provide unistrut mounting supports.

G. Variable Speed Drives

1. Fabrication
 - a. Wiring Terminations: Match conductor materials and sizes indicated.
 - b. Enclosure: NEMA 250, Type 4.
 - c. Finish: Manufacturer's standard enamel.
2. Do not install drive until building environment can be maintained within the service conditions required by the manufacturer.
3. Select and install overload heater elements in motor drives to match installed motor characteristics.
4. Provide engraved plastic nameplates.
5. Provide neatly typed label inside each motor drive door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

H. Grounding

1. Provide ground conductor termination lugs (minimum two) adequate for 4/0 wire on each shipping section.
2. Bond all electrical enclosures to any conducting structures on which they are mounted and to the ground termination lugs in accordance with NFPA 70.

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2.4 SOURCE QUALITY CONTROL

A. Testing

1. Power and Control Wire: All wires shall be tested for continuity. Wire insulation shall be megger tested between each conductor and ground. A 1000-volt megger shall be used for insulation rated 600 volts. Minimum resistance shall be 50 megohms.
2. Utilization Equipment:
 - a. Make electrical connections to utilization equipment in accordance with manufacturer's instructions.
 - b. Installation shall conform to the requirements of NFPA 70.
 - c. Motor windings shall be checked for continuity.
 - d. Motor windings rated 460 volts nominal shall be megger tested with a 1000-volt megger prior to connection of power leads. Minimum acceptable resistance shall be 50 megohms.
 - e. Motor and phase rotation shall be checked with a phase rotation tester similar to G. Biddle Company (Catalog No. 56060) or equal on equipment which could be damaged by reverse rotation.
 - 1) Motor and phase rotation shall be verified before energizing motors.
 - 2) All motors shall be "bumped" to check for proper direction of rotation prior to performing operational tests on the equipment.

B. Verification of Performance: Record for submittal, the results for testing, Article 2.4, Paragraph A above.

PART 3 EXECUTION

Not used.

END OF SECTION

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Indirect Dryer

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Indirect Dryer Performance Specification

Operable Unit 1
Project Order 145
March 1996
Revision C

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487



25 Merchant Street
Cincinnati, Ohio 45246

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U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERMCO SUBCONTRACT NO. 2-21487

PROJECT ORDER 145
SPECIFICATIONS

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16857	HEATING CABLES AND PANEL FOR INDIRECT DRYER	B	03/01/96

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INDIRECT DRYER PERFORMANCE SPECIFICATION
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APPENDICES

1. Requirements/Instructions for FEMP Suppliers
2. Submittal Requirements
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SECTION 11182
INDIRECT DRYER PERFORMANCE SPECIFICATION

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PART 1 GENERAL

1.1 SCOPE OF WORK

A. Introduction:

Clean-up efforts are currently underway at the Fernald Environmental Management Project (FEMP). The FEMP, formerly known as the Feed Materials Production Center, is a United States Department of Energy (DOE) facility near Fernald, Ohio (northwest of Cincinnati), which was operated from 1952 to 1989 to provide high-purity uranium metal products to support United States defense programs.

Production at the facility was suspended in 1989, and focus was shifted to environmental restoration and waste management activities. The site is currently operated by the Fernald Environmental Restoration Management Corporation (FERMCO). The entire FEMP site has been divided into five operable units (operable unit is a term employed to provide physical groupings of environmental areas of concern at a site). The contents of eight separate waste pits (Pits 1 through 6, the Burn Pit, and the Clearwell) and the associated caps, clay liners, and surrounding soils, have been designated as Operable Unit 1 (OU1). The pit contents, caps, liners, and soils are the materials of interest for this specification, although performance and acceptance will be tested on surrogate materials described in Article 3.6.

A Remedial Investigation/Feasibility Study, several Treatability Studies, and other supporting tests have been performed on the OU1 materials. Based on the information developed during these studies, a preferred alternative for remediation of the waste pits was determined. This alternative involves retrieving the materials from the pits, drying them to appropriate moisture levels, then packaging the dried materials for shipment and disposal at a low-level radioactive waste

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disposal facility. The OUI Overall Process Block Flow Diagram is attached in Appendix 4. It shows an overview of the preparation of the pit wastes before shipment off site. It is for information only (please note that the slurry pump line shown to the dryer will be used intermittently, and will only "dribble" slurry into the feeder/conveyor system on an as-needed basis). No sole slurry feeding of the dryer is planned for operations. The indirect rotary dryer described in this specification will be used to dry the pit waste materials (the dryer will first be tested on surrogate materials and accepted as described in Article 3.6).

B. Scope of Work:

This specification defines the overall engineering, design, fabrication/manufacturing, shop testing, packaging, delivery, and field testing of the indirect dryer system, complete with all necessary equipment, controls, and instrumentation. Design to meet the performance requirements is the full responsibility of the SELLER.

It also defines the requirements for providing technical assistance for installation and acceptance testing.

This specification is prepared to be used as a support document with the Request for Proposal (RFP) Package.

1.2 **DESIGN**

A. General:

Equipment and materials of construction shall conform to the requirements of this specification and to the SELLER's standard or recommended design for the intended service. Equipment shall also conform to accepted industry standards of engineering, design, and workmanship.

The intent of this specification is to define the performance requirements to design, manufacture, and supply the entire indirect dryer system for bidding purposes. It is not the intent of this specification

to restrict the design of the indirect rotary dryer system and its components.

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This specification was written for one dryer train; however, it is permissible to include alternate proposals for two dryers, provided they can be justified from the standpoint of better performance, manufacturing limitations, or lower operating costs. These alternate proposals shall be submitted in accordance with Article 1.5 entitled "SELLER's Stated Deviations and Substitutions."

B. Reference Specifications (Sections) and Documents:

Specifications and documents listed below are part of this specification.

1. Piping Specifications, Sections 15060, 15090, and 15250, and Electric Motor Specification, Section 15171 (Division 15).
2. Electrical Specifications, Sections 16051 and 16857 (Division 16).
3. Requirements/instructions for FEMP suppliers:
 - a. "Standard Requirements for FEMP Suppliers," Form FS-F-2672, Pages 1 through 4 (Appendix 1).
 - b. "Explanation of Standard Requirements for FEMP Suppliers," Form FS-F-2672-1, Pages 1 through 3 (Appendix 1).
4. Submittal requirements:
 - a. "SELLER Drawing and Data Submittal Requirements," Pages 1 through 4, Specification No. E-212-A (Appendix 2).
 - b. "SELLER Drawing and Data Commitment," Form E-212 (Appendix 2).
5. Data sheets:
 - a. Centrifugal fan data sheet (Appendix 3).
 - b. Dryer data sheet (Appendix 3).
 - c. Burner data sheet (Appendix 3).
6. Drawings and sketches:
 - a. Indirect rotary dryer system diagram (Appendix 4).
 - b. General arrangement (Appendix 4).
 - c. Instrumentation and control interfaces (Appendix 4).

d.	Overall Process Block Flow Diagram (Appendix 4).	1
7.	Supporting information:	3
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b.	Pit Waste Characterization Data (Appendix 5).	5
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C.	Codes and Standards:	7
	SELLER shall comply with the codes and standards referenced in this paragraph. The SELLER shall state exceptions to these standards in accordance with the requirements of Article 1.5.	8 9 10 11
1.	Air Movement and Control Association (AMCA):	12
a.	AMCA 99 Standards Handbook.	13
b.	AMCA 210 Test Code for Air Moving Devices.	14
2.	American Bearing Manufacturers Association (ABMA).	15
3.	American Gear Manufacturers Association (AGMA):	16
a.	AGMA 2000-A-88 Gear Classification and Inspection Handbook.	17 18
b.	AGMA 2004-B-89 Gear Materials and Heat Treatment Manual.	19 20
4.	American Institute of Steel Construction (AISC):	21
a.	AISC M016-89 Manual of Steel Construction - Allowable Stress Design (ASD) (Ninth Edition).	22 24
b.	AISC S329-85 Specification for Structural Joints using ASTM A325 or A490 Bolts - Allowable Stress Design.	25 26 27 28
5.	American Society of Civil Engineers (ASCE):	29
a.	ASCE 7-93 Minimum Design Loads for Buildings and Other Structures.	30 31 32
6.	American Society of Mechanical Engineers (ASME) ¹ :	33
a.	ASME Boiler and Pressure Vessel Codes, 1992	34 35

¹ Specific ASME Code sections are referenced in the body of this specification for certain weld and inspection requirements. No code stamp is required. An approved code shop is preferable, but not mandatory. A pre-qualification inspection process will be used to approve a non-code shop (see Article 1.4, Paragraph A, Item 1).

- b. ASME (USAS) B4.1-67. Preferred Limit and Fits for Cylindrical Parts. 1 2 3
- 7. American Society for Testing and Materials (ASTM): 4
 - a. ASTM A36/A36M-94 Structural Steel. 5 6
 - b. ASTM A148/A148M, Rev. B-93 Steel Castings, High Strength for Structural Purposes. 7 8 9
 - c. ASTM A325-94 Structural Bolts, Steel, Heat Treated. 10 11
 - d. ASTM A500-93 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes. 12 13 14
- 8. American Welding Society, Inc. (AWS): 15
 - a. AWS A2.4-93 Standard Symbols for Welding, Brazing, and Nondestructive Examination. 16 17 18
 - b. AWS D1.1-94 Structural Welding Code-Steel. 19 20
 - c. AWS QC1-88 Standard for AWS Certification of Welding Inspectors, Fourteenth Edition. 21 22 23
- 9. International Conference of Building Officials (ICBO): 24
 - a. Uniform Building Code - 1994. 25 26
- 10. International Society for Measurement and Control (ISA): 27
 - a. ISA S5.1-84 Symbols and Identification. 28 29 30
- 11. National Electrical Manufacturers Association (NEMA): 31
 - a. NEMA 250-91 Enclosures for Electrical Equipment. 32 33 34
- 12. National Fire Prevention Association (NFPA): 35
 - a. NFPA 54-92 National Fuel Gas Code. 36 37
 - b. NFPA 68-94 Guide for Venting of Deflagrations. 38 39
 - c. NFPA 70-96 National Electrical Code. 40 41
 - d. NFPA 80-95 Standard for Fire Doors and Fire Windows. 42 43

- e. NFPA-85C-91
Standards for the Prevention of Furnace
Explosions/Implosions in Multiple Burner
Boiler-Furnaces.
 - f. NFPA 86-95
Standard for Ovens and Furnaces.
 - g. NFPA 101-94
Code for Safety to Life and from Fire in
Buildings and Structures.
13. Occupational Safety and Health Administration
(OSHA):
- a. 29 CFR 1910
Occupational Safety and Health Standards.
14. Ohio Basic Building Code (OBBC), 1995

1.3 SUBMITTALS

A. Requirements:

SELLER's records, data, drawings, and documentation
submittal shall be performed as requested and scheduled
in accordance with the requirements specified by FERMC0
"SELLER Drawing and Data Submittal
Requirements," Specification No. E-212-A, and "SELLER
Drawing and Data Commitment Form, E-212," attached in
Appendix 2. The SELLER shall maintain documents
attesting to this procurement as records. The records
shall be retrievable and protected against damage or
loss.

All records generated as a result of this order, but
not required to be submitted, must be stored and
maintained in accordance with the SELLER's QA Program.
FERMCO reserves the right to have access to the files
for the retention time specified by the SELLER in the
SELLER's QA Program.

The SELLER shall prepare a documentation inventory
transmittal sheet (listing all documents and number of
pages) and attach this sheet to each set of
documentation. Each set of documentation shall list
FERMCO's purchase order number, project number, and
equipment piece number, and be consecutively numbered.

The SELLER shall comply with all the requirements as specified by FERMC0 in documents including "Explanation of Standard Requirements for FEMP Suppliers" and form FS-F-2672, "Standard Requirements for FEMP Suppliers," attached in Appendix 1.

B. Submittals Required with Bid Package:

1. Dimensioned outline drawings for the equipment and systems (footprints and elevations). Major component weights and space requirements (for all SELLER-provided equipment) shall be identified. Interfaces, as defined in Article 2.2, Paragraph H, shall be indicated.
2. Materials of construction on major components and associated design criteria and features of the major components (see Article 2.1, Paragraph B) of the indirect dryer system shall be identified.
3. A weekly schedule (bar chart) of SELLER activities from date of award to delivery of the indirect dryer system shall be provided. Activities shall include design review/approval processes, inspection of fabrication, shop testing, and delivery. The schedule shall indicate specific hold points which will be placed in the SELLER's production process, design, and fabrication to allow FERMC0 to review, approve design, and witness fabrication, inspections, and tests. FERMC0 shall be given 2 weeks to review and respond to SELLER's design deliverables. Eight weeks shall be given to the SELLER from date of award to delivery of drawings specified in Article 1.3, Paragraph C. There may be a delay of about 2 months between design and authority to fabricate. Twenty-six weeks shall be given to the SELLER for fabrication of the dryer package. In preparation of the above schedule, the following shall be incorporated: FERMC0 shall be notified a minimum of 1 week in advance of the designated hold point dates for the above activities (see Requirements, Appendix 1). The inspections of fabrication will include examination of the structure, dimensions, and

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workmanship; operation of moveable components; and review of shipping instructions.

The SELLER shall complete the Submittal Requirement Form, Column IV (Appendix 2).

4. A brief system description of drying process control and operation, covering the entire range of operating parameters (feed moisture, feed rate, plasticity, product dryness, etc.) as specified in Article 2.2 shall be provided.
5. Major equipment list (see Article 2.1, Paragraph B) with process duty outline specification, electric motor list, major instruments with control loops provided by SELLER, and equipment sizes (catalog cuts).
6. Conceptual Process Block Flow Diagram, with overall heat and material balances based on drying surrogate solids, and SELLER data required for acceptance testing in Table A of Article 3.6 shall be provided (refer to Appendix 5 for surrogate material properties).
7. Utility requirements:
 - a. Power (kw).
 - b. Natural Gas (scfm, psig) (note availability in Article 2.2, Paragraph C, Subparagraph 1.p).
 - c. Water (gpm).
 - d. Plant air (scfm, psig).
8. All pertinent major design data (outline data sheets) or information required to assemble and operate the system shall be provided. Data sheets provided in Section 15171 and Appendix 3 are to be filled out to the extent indicated and submitted by the SELLER with the bid package.
9. QA Program:

The SELLER shall submit the QA Program as specified in Article 1.4, Paragraph A.
10. The SELLER shall provide the terms and conditions of the SELLER's warranty for workmanship and materials.

C. Deliverables Required After Award, During Execution, 2039 and at Project Closeout:

1. Engineering drawings:

The SELLER shall prepare engineering drawings that illustrate the salient features of the indirect dryer. The drawings shall include the information and specifications, relating to the assembly and secondary assemblies, necessary to inspect, assemble, and install the indirect dryer unit. The drawings shall specify the dimensions, tolerances, fits, anchor bolt settings, and operating weights. These drawings shall have a list of components with a reference to shop drawings and bill of materials needed for installation of that assembly. They shall delineate weld and inspection requirements, material specifications, and surface and heat treatments. Drawings may be supplemented by specifications and/or data sheets which are cross-referenced.

In addition, the drawings shall be in sufficient detail so that the indirect dryer system may be interfaced with required utilities and mating assemblies and equipment.

Shop drawings shall be provided for the dryer assembly base frames and for the main frame.

These drawings shall:

- a. Indicate sizes, spacing, and locations of components and structural members, bolted connections, and welded connections.
- b. Indicate welded connections with AWS A2.4 welding symbols.
- c. Indicate net weld lengths.
- d. State the vertical loads and lateral forces (wind and seismic) used in the design.

These drawings shall be submitted to FERMC0 for approval. After approval by FERMC0, the SELLER shall submit two sets of reproducible drawings identified as "Certified for Construction." These drawings shall be submitted on dry erasable Mylar, 30-inch by 42-inch maximum size.

2. Spare parts list:

The SELLER shall provide a final parts list and a recommended spare parts list. The spare parts list shall be identified on the drawings' bill of material section. This spare parts list shall be confirmed and updated by the SELLER at the time of project close-out to reflect any additions or changes in spare parts. The spare parts shall identify the supplier, the supplier's part number, and the sales office responsible for the Cincinnati, Ohio, area.

3. Installation, Operations, and Maintenance (IOM) Manuals:

The SELLER shall prepare bound IOM manuals which, as a minimum, contain:

- a. Installation instruction for all assemblies and subassemblies as specified by corresponding drawings
- b. Operating procedures, including start-up and emergency shutdown (see operating modes under Article 2.2, Paragraph C, Subparagraph 2)
- c. Instructions for maintenance
- d. Troubleshooting guide
- e. Maintenance schedule and service guide
- f. Instrument maintenance and calibration procedures, along with recommended operating parameters.

The manuals shall be submitted to FERMCO for review and approval a minimum of 6 weeks prior to the shipment of each assembly of the entire package. The SELLER shall furnish 10 bound copies and one reproducible copy of the approved manuals to FERMCO to be included with the shipment.

4. Material Safety Data Sheets (MSDSs) on all finishing products. This includes paints, primers, and coatings, along with all information requested in Article 3.3.

5. Acceptance Test Plan and Procedures:

The SELLER shall prepare Acceptance Test Procedures and an Acceptance Test Plan that will

cover the requirements for acceptance testing specified in Article 3.6. The plan and procedures must be approved by FERMC0 prior to application.

6. Engineering Calculations:
The SELLER shall submit complete calculations for structural design. The calculations and related drawings will be reviewed and stamped by a professional engineer (licensed in the State of Ohio) provided by FERMC0.

1.4 QUALITY ASSURANCE

A. Quality Assurance Program Requirements:

- 1. The SELLER shall submit the existing QA Program with the bid for review. In the event that no formal QA Program is in place or the existing program does not address the elements listed in Item 2, FERMC0 may substitute the QA Program requirements with all or any of the following:
 - a. Facility inspection and shop certifications.
 - b. Review of manufacturing procedures.
 - c. Review of in-house inspection procedures.
 - d. Review of procedures for nonconforming items.
 - e. Review of welder certifications and welding procedures.
 - f. Review of documentation controls.

FERMC0 may perform in-process assessments during the term of the contract, as applicable.

- 2. The SELLER shall maintain a Quality Assurance Program that, as a minimum, addresses the elements below and checked in Q-1 of the "Standard Requirements for FEMP Suppliers," Form FS-F-2672 (see Appendix 1).

- a. Design Control:
Provide a program to identify control measures used to ensure that design requirements, including quality standards, are defined and verified as applicable and are accurately represented in drawings, specifications, and procedures.

- b. Instructions, Procedures, and Drawings:
The SELLER's activities affecting quality shall be prescribed by and performed in accordance with documented instructions, procedures, or drawings. These documents include criteria for acceptance. 3
- c. Document Control:
Control the preparation, issue, and exchange of documents that specify quality requirements or prescribe activities affecting quality to ensure that correct documents are employed. 4
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- d. Inspection:
Plan and execute inspections to verify conformance to purchase order quality and technical requirements. These inspections shall be documented and provided as required by Form FS-F-2672 (Appendix 1). Notification of FERMCO is required at least 1 week prior to the performance of the inspection. 8
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- e. Test Control:
Plan and execute tests verifying conformance of an item or process according to written procedures which contain the test requirements and acceptance limits. These tests shall be documented and provided as required by the attached Form FS-F-2672. Notification of FERMCO is required at least 1 week prior to the performance of the test. 14
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- f. Control of Test and Measuring Equipment:
Control and calibrate all tools, gauges, instruments, and other devices used for activities affecting quality. 22
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- g. Inspection, Test, and Operating Status:
Provide for the identification of acceptance status of items procured by tagging or marking, or documents traceable to the items required by the specifications. 30
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- h. Control of Nonconforming Items:
Provide for control of items or processes that do not conform to procurement document requirements. Nonconformances shall be 39
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controlled to prevent inadvertent installation or use, and shall be documented 2039

- i. Quality Assurance Records:
 - Generate, compile, and maintain all program records that furnish documentary evidence of quality and shall provide records as specified by the procurement document or Form FS-F-2672.
- j. Handling, Storage, and Shipping:
 - Provide procedures to control requirements specified in Article 3.4.
- k. Corrective Action:
 - Provide procedures to implement corrective actions.
- l. Identification and Control of Items:
 - Controls shall be established to ensure that only correct and accepted items are used or installed. Identification shall be maintained on the items or in documents traceable to the items, or in a manner which ensures that identification is established and maintained.
- m. Control of Processes:
 - Processes affecting quality of items or services shall be controlled. Special processes that control or verify quality, such as those used in welding, heat treating, and nondestructive examination, shall be performed by qualified personnel using qualified procedures in accordance with specified requirements.

B. Standard Requirements List:

- 1. The SELLER shall provide the elements checked in Section Q-2 of the "Standard Requirements for FEMP Suppliers," Form FS-F-2672 (see Appendix 1).

C. Source Inspections/Test:

Control equipment shall be tested to ensure all indirect dryer component assemblies and sub-assemblies

are functioning safely and according to operating parameters.

1. All shop testing requirements shall be handled according to Article 3.1.
2. Successful completion of testing (both attended and unattended by FERMCO) shall be confirmed by issuing certified copies of the test results to FERMCO.
3. Acceptance testing at site:
Final inspection and acceptance at the FEMP will be in accordance with this specification and the following:
 - a. Acceptance testing and inspection shall take place at the FEMP site with FERMCO and the SELLER present in accordance with the requirements specified in Article 3.6.
 - b. The successful completion of the inspections and acceptance tests and surveillances will be FERMCO's method of final acceptance of the purchased system, as specified in Article 3.6.

1.5 SELLER'S STATED DEVIATIONS AND SUBSTITUTIONS

A. SELLER's Responsibility:

The SELLER is to submit in writing to FERMCO exceptions or proposed changes to this specification as alternates in the bid package. This includes proposing two half-size dryers. Each exception or proposed change shall:

1. Identify the item (component within the dryer) as specified in this specification.
2. Identify the reason for the proposed alternate.
3. Present the proposal or alternate (e.g., different components, two dryers).

B. FERMCO's Responsibility:

All deviations from this specification or substitutions offered by the SELLER will be evaluated during bid technical evaluation by FERMCO. However, these deviations and substitutions will not be evaluated if they are not properly presented in the bid package as required by this article. In addition, approved

exceptions will ultimately result in revision to the specification to incorporate the exception.

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PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Responsibilities for Materials and Equipment:

- 1. All deliverable materials and equipment as identified in Paragraph B, shall be the responsibility of the SELLER. The SELLER is also responsible for the quality and compliance of the work of the SELLER's suppliers.
- 2. The SELLER shall be responsible for all engineering, design, fabrication, inspection, testing, checkout technical assistance, and delivery of all deliverable materials and equipment.

B. Materials and Equipment to be Provided by SELLER:

Equipment

<u>Number (EN)</u>	<u>Description</u>	<u>Quantity</u>
1.	Indirect rotary dryer system including furnace with burners (per Article 2.2, Paragraph D, Items 1 and 2)	1
2.	Burner piping and instrumentation skid complete with supply pipeline headers (air and gas), manifolds with instrumentation, and controls per set of burners per zone, fittings, structural frame, and supports (per Article 2.2, Paragraph D, Item 3)	1
3.	Local instrumentation, controls, alarms, control panels, electrical wiring, and connections for safe and efficient operation of all equipment and controls (per Article 2.2, Paragraph E)	1 lot
4.	Combustion-air supply fan (per Article 2.2, Paragraph D, Item 4)	1
5.	Electric motors (per Divisions 15 and 16):	
	a. Rotary dryer drive motor	1
	b. Rotary dryer auxiliary drive motor	1
	c. Combustion-air supply fan drive motor	1

6. d. Other motors as specified by SELLER TBD
Maintenance platforms, walkways, TBD by
structures SELLER

C. Services to be Provided by SELLER:

1. Technical assistance and monitoring for compliance with site installation requirements for all items specified in Article 2.1, Paragraph B.
2. Technical assistance for start-up and a readily available question-answering service.
3. Technical assistance and monitoring for compliance with requirements for acceptance testing, as specified in Article 3.1 and Article 3.6.
4. Instrument inspection, testing, calibration, and tuning:
 - a. SELLER shop checkout.
 - b. Software checkout.
 - c. Installation supervision.
 - d. Field system checkout and start-up.

D. Items to be Provided by FERMCO:

1. All utilities and piping to the indirect rotary dryer burner piping and instrumentation skid (air, natural gas, water, drain).
2. Dryer feeder/conveyor system (a separate RFP will be issued for competitive bid at a later date).
3. Product discharge chute from the indirect rotary dryer product discharge flange.
4. Combustion gas ductwork and support between the combustion gas exhaust manifold and the stack.
5. Process off-gas treatment system, ductwork, and support from the indirect rotary dryer discharge head to the stack.
6. Electrical power supplies and field wiring.
7. Unloading and storage of assemblies and sub-assemblies, installation of indirect dryer system.
8. Concrete foundations and support pillars for the items listed in Paragraph B.
9. Control Room, located within 100 feet of the dryer.
10. Enclosed process areas at feed and discharge ends of drying system.

11. Air exhaust system and connection to seal shrouds at feed and discharge ends. 1
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E. Fasteners: 4

1. All structural bolts shall be ASTM A325 high strength bolts and shall be delivered to the site in the original labeled containers and, once on site, shall not be transferred into unlabeled containers. The label information shall include the type of bolt, purchase order number, and the name of the supplier. All bolts shall be made in the U.S.A. 5
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2.2 TECHNICAL REQUIREMENTS 13
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A. General: 15
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The SELLER shall furnish all deliverable items identified in Article 2.1, Paragraphs B and C, to conform with the design requirements specified in this section. 17
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The SELLER shall propose a proven design, including modifications, as required, to provide all concepts defined in the specification. All piping and flanges and fittings supplied with this equipment shall conform to requirements stipulated in the piping specification sections provided in Division 15. All structural components shall be provided in accordance with the structural requirements specified in Article 2.2, Paragraph G. All components, platforms, walkways, stairs, and guards (for rotating equipment) supplied by the SELLER shall conform to the applicable OSHA standards. 21
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B. System Description: 34
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The surrogate and pit wastes will be dried in an indirect rotary dryer system. This system will consist of (1) an externally heated rotating cylinder (rotary dryer) to receive and dry wastes while advancing material from the feed head toward the discharge, (2) a multiple-zone furnace surrounding the rotary cylinder to generate heating gases by combusting natural gas, (3) a fuel and air supply system to the burners, and 36
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(4) burner management and dryer process control. The combustion gases produced in each zone of the furnace by a set of burners will be controlled to set the rotary dryer shell at a temperature to be specified by the SELLER to meet thermal performance requirements. The SELLER shall provide materials of construction of the rotary shell with the bid package, along with the corresponding heat duty requirements.

The indirect dryer system shall be designed to receive and process wet material of various moisture contents and consistencies depending on the type of feed. Feed waste material will be received from the following sources: (1) screened waste, and (2) intermittent waste slurry. Screened material and intermittent waste slurry will be fed into the rotary dryer through a feeder/conveyor system. This system will be purchased by FERMCO and specified to meet dryer requirements.

The rotary dryer system shall consist of a cylindrical shell rotated with a variable speed drive. The rotating cylinder shall be heated externally by a furnace, enclosing the rotary cylinder, with adequate length to satisfy heat transfer requirements. Heat energy for the indirect drying shall be produced in the multiple furnace zones by a set of burners located in each zone, using natural gas as fuel for combustion. Burners shall be operated with adjustable primary air/fuel ratio, and secondary air to control the flame temperature so the rotating cylinder does not exceed its allowable shell temperature as specified by the SELLER. Exit gases from each furnace zone shall be collected into a header, from where they will be transferred to a combustion gas discharge system provided by FERMCO.

Heat energy from each furnace zone shall be indirectly transferred into the material advancing inside the rotating shell. This heat transfer from the furnace will take place through convection, conduction, and radiation. Hot process off-gas shall be swept from the dryer with a controlled flow of preheated sweep air in

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a cocurrent fashion, and it shall be discharged at the discharge end of the dryer.

Material continuously fed into the dryer will advance through the heated section, where it will be heated up to an average of 200-270 degrees F. The instantaneous maximum temperatures encountered due to high rotary shell temperatures should not be a major concern. Due to the heat transferred into the material, water will be evaporated, and small amounts of organics contained in the waste will be vaporized. Preheated sweep air flowing cocurrently with the advancing waste will carry off the vapors. An estimate of the actual waste off-gas composition is included in Appendix 5, based on an assumption of 80 mol% water vapor load. A heat and material balance shall be supplied by the SELLER based on drying surrogates only. Refer to Appendix 5 for surrogate material properties.

Dried material with the 10 percent average moisture content (dry basis) shall leave the heated section. Dried material shall fall by gravity through the discharge head chute for further handling by FERMCO.

C. Operating Conditions and Requirements:

SELLER shall design equipment to meet the following minimum criteria:

1. Process Design Criteria:

- a. Particle size distribution: 100 percent < 4 inches (see Appendix 5, Section 5.3).
- b. Feed moisture content: 17 to 150 percent (all moisture contents expressed on a dry basis [lbs water/lbs dry solids] x 100 percent).
- c. Loose bulk density: 84 lbs/ft³ at 150 percent moisture content, 140 lbs/ft³ at 17 percent moisture content.
- d. Specific gravity of dried solids: 2.5 to 3.25, average of 2.9.
- e. Feed composition: For details of pit waste composition, see Appendix 5, Sections 5.1 and 5.2.

- f. Feed rate: SELLER shall determine processing rates for feed containing 17 to 150 percent dry basis moisture content. Product moisture content will have an anticipated range of 1 to 25 percent, with a design of 10 percent. Maximum required processing rate shall be 22 tph feed.
- g. Feed temperature: ambient (see Subparagraph 2, Item a).
- h. Dryer product average temperature: 200-270 degrees F at discharge.
- i. Heat transfer: Indirect.
- j. Process off-gas: Temperature, maximum = 350 degrees F; entrained solids lbs/hr = TBD by SELLER.
- k. Sweep air: The SELLER shall specify the maximum required volume which still minimizes solids carryover. FERMO will provide a fan capable of a 4:1 turndown ratio from this maximum. The sweep air will be preheated by FERMO to a maximum temperature of 600 degrees F. Refer to Appendix 5 for an estimated off-gas composition based on actual wastes, assuming 80 mol% water vapor load.
- l. Rotary dryer shell temperature, maximum: TBD by SELLER.
- m. Temperature of outer furnace shell, maximum: 120 degrees F.
- n. Combustion gas outlet temperature: SELLER shall determine and include in the required heat and material balance. Temperatures shall be measured at each zone and in the combined header.
- o. Combustion air temperature, inlet to burner manifold: ambient (see Subparagraph 2, Item a).
- p. Natural gas characteristics: higher heating value = 1,027 Btu/scf; pressure = 60 psig; standard temperature = 60 degrees F; availability = 168,000 acfh in 6-inch pipeline; composition = CH₄ - 96 percent, C₂H₆ - 1.9 percent, N₂ - 0.036 percent, C_nH_n - 2.064 percent.

2. General:

The indirect dryer will be located under a lean-to roofed structure with partial siding and subject to weather-related temperature variations, wind, wind-driven rain, and earthquake loading criteria. The feed head of the rotary dryer and the discharge head shall be enclosed in process areas with maintained temperatures.

Insulation shall be provided on hot generation equipment, ductwork, piping, flues or breeching, using a material, thickness, and surface treatment that will prevent surface temperatures above 140 degrees F where contact would be inadvertent and 120 degrees F where contact is likely or necessary for equipment operation. Insulation shall be in accordance with the SELLER's recommendations.

The SELLER shall specify any special environmental conditions, including temperature and moisture protection, that must be provided for any equipment, instrumentation (hardware and software), or material. The following are the environmental and operating conditions:

a. Ambient conditions outside (summer, winter):

Summer:

Dry bulb temperature: 92 degrees F.

Wet bulb temperature: 73 degrees F.

Winter:

Dry bulb temperature: -1 degree F.

b. Ambient conditions for enclosed process areas:

Dry bulb temperature: 55 - 104 degrees F.

c. Plant elevation: 578 feet above sea level.

d. Operating schedule:

Operating days/week - 7.

Operating shifts/day - 3.

Operating hours/shift - 8.

e. Operating modes:

1) Normal:

The facility is operated at the normal flow rate as specified in Article 2.2, Paragraph C, Subparagraph 1.f.

- 2) Hot idle:
The facility is idled below operating temperatures, and not drying feed. All burners either shut off or set to low fire mode.
- 3) Heat-up:
The facility is started by heating up the system, from cold status to the thermal conditions of normal operations.
- 4) Cool down:
The facility is cooled down from any of the above operating modes to ambient conditions.
- 5) Normal shutdown.
- 6) Emergency shutdown.
- 7) Restart after normal shutdown.
- 8) Restart after emergency shutdown.
- f. Fire protection:
The indirect dryer system shall comply with the applicable NFPA codes and standards listed in Article 1.2, Paragraph C. In addition, the SELLER shall identify any special fire protection requirements needed by any purchased item (equipment, instruments, hardware, software, material).

D. Mechanical Requirements:

1. Indirect rotary dryer:

The indirect rotary dryer assembly shall include the following sub-assemblies and components.

a. Rotary Dryer Shell:

Rotary dryer cylindrical shell material of construction shall be selected by SELLER. It shall be a heat- and corrosion-resistant steel alloy to withstand operating conditions, and be of rolled steel plate, welded construction. Thickness of the shell shall be determined by the SELLER based on the mechanical/structural requirements to ensure a minimum design life of 15 years for the rotary shell operated at the design conditions. Proper safety factors shall be applied calculating the working combined

stresses to ensure that, over the 15-year design life: (1) under operating conditions, tension and shear stresses will never exceed the material strength (yield stress, with the applied safety factors); (2) proper allowance is provided for oxidizing, carburizing, and sulfidizing environments; (3) under operating conditions, deflection shall not exceed industrially accepted values for similar equipment at the point of maximum moment between the supports. The SELLER shall provide calculations supporting thickness selection.

The rotary dryer shell shall accommodate two support riding rings, one at the feed end and one at the discharge end. It shall also accommodate one driving system and seal assemblies at both ends. SELLER shall describe the complete design of the shell, riding rings, and driving system. All applicable AGMA standards shall be adhered to.

The rotary shell shall have cylindrical tolerances on radius per ASME B4.1. The SELLER shall state the maximum section length, and shall note if the entire length of the shell can be manufactured and delivered in one piece.

The following rotary shell internals shall be considered:

- 1) Dropping surrogate materials directly onto a hot surface was found to preclude the need for chains or feed spirals; however, the SELLER shall design provisions for using chains at a future date, with the chain arrangement to be determined by the SELLER. Good results were experienced in tests with shallow-type flow disturbers placed in V-shaped arrangements with spacing between pairs,

- along the entire heated length of the pilot dryer.
- 2) Inside feed spirals to carry feed from the feed end into the furnace covered "Hot Zone" of the dryer shall be considered. It shall be noted that the dryer feeder will be specified by FERMCO to be capable of feeding the waste directly into the "Hot Zone" or as close as the SELLER's design requires. SELLER shall determine the need for a retainer ring on the feed end to prevent backspill into the feed head.
 - 3) Inside flow disturbers (not lifters) shall be supplied through the entire heated length of the rotary dryer. SELLER shall design the disturbers to maximize heat transfer into the waste, and minimize caking of waste onto the rotary shell and dusting.

The rotary shell welding shall comply with referenced parts of ASME code Section VIII, with the exception that no code stamp is required (see requirements in Article 2.4, Paragraph B).

Materials of construction, grade, and hardness for the following components shall be determined by the SELLER per applicable ASTM standards:

- 1) Shell plate: heat- and corrosion-resistant alloy
- 2) Riding rings
- 3) Rollers
- 4) Roller shafts, if applicable
- 5) Feed head
- 6) Discharge head
- 7) Drive system components

b. Support stations assemblies: 1
 Rotating cylinder shall be supported at two 2
 locations through the riding rings, riding on 3
 the support rollers assembly. The entire 4
 support rollers assembly shall be mounted on 5
 a rigid structural steel frame with base 6
 plates and adjusting screws for proper 7
 alignment. 8
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The support rollers next to the drive 10
 assembly shall be designed to limit the 11
 longitudinal movement of the rotating 12
 cylinder. 13
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c. Drive assembly: 15
 Rotary shell shall be driven through a drive 16
 mechanism by a variable speed motor. The 17
 variable speed motor shall be suitable for 18
 starting a fully-loaded rotary shell. 19
 Maximum rpm of the cylinder shall be designed 20
 not to exceed a resultant tangential velocity 21
 of 100 ft/min, with a 10:1 turndown. The 22
 variable speed motor shall be coupled to the 23
 drive assembly. The drive assembly shall 24
 accommodate a second electric motor, backed 25
 up with a diesel generator provided by 26
 FERMCO. The auxiliary drive shall be 27
 designed in case of power outage to rotate 28
 the dryer at the minimum rpm. In addition, a 29
 hand-operated inching mechanism shall be 30
 supplied and mounted on the gear reducer low 31
 rpm output shaft. 32
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The drive assembly components shall be 34
 mounted on a common steel frame equipped with 35
 adjusting screws for proper alignment of the 36
 respective components. 37
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The drive assembly to rotate the cylindrical 39
 shell shall be located at the feed end. The 40
 SELLER has the option of locating the drive 41
 behind the support station toward the 42
 discharge end, providing the mechanical 43

design allows for this arrangement. Such an arrangement would shorten the length of the feeder at the feed end. The SELLER also may offer a different drive option such as a hydraulic drive, provided its application is justified (operability, maintenance, life expectancy, etc.).

d. Rotary dryer feed head:

The feed end head shall be of steel plate welded construction. The feed end head shall be aligned with the rotating cylinder. It also shall support the stationary flange for the rotary dryer seal system.

The feed head shall be designed to support and accommodate the dryer feeder provided by FERMCO (through a sealed/flanged connection), the sweep air connections, the visual inspection window, and the high pressure wash spray inlet connections. Feed end housing shall be designed to be removable on rail tracks and equipped with locking blocks.

The feed head shall accommodate the sweep air intake nozzle(s). The sweep air shall be introduced at inlet point(s) located in the feed head. The SELLER shall furnish piping connecting the sweep air inlet nozzle(s) to an overhead header. Each connecting pipe shall be equipped with a manually adjustable butterfly valve.

The feed head shall be insulated to prevent the temperature of the outer metal surfaces from rising above 120 degrees F, for personnel protection.

e. Rotary dryer discharge head:

The discharge head shall be of steel welded construction. The discharge housing shall mate with the rotating cylinder through a circular opening. This opening shall be

designed to support the stationary part of
the rotary dryer seal system. 1
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Moisture content and temperature of both the 3
product bed and the process off-gas shall be 4
measured inside the rotary shell at the exit 5
point of the final heating zone. Product 6
temperature shall be measured at three 7
points: (1) where the solids exit the shell, 8
(2) where the solids exit the final heating 9
zone, and (3) where the solids exit the next 10
to last heating zone. The SELLER shall 11
determine the type of instrumentation 12
required, along with the size and location of 13
flanges required on the discharge head. The 14
SELLER shall also specify the expected amount 15
of entrained solids in the process off-gas 16
for the various types of surrogate feed shown 17
in Table A of Article 3.6 The dried product 18
discharge outlet located at the bottom of the 19
discharge housing shall be designed so that 20
the product from the dryer drops through it 21
vertically by gravity. 22
23

The discharge head shall be insulated to 24
prevent the temperature of the outer metal 25
surfaces from rising above 120 degrees F, for 26
personnel protection. This will also prevent 27
steam and HF from condensing on the inside 28
surfaces and causing corrosion. 29
30

The discharge bottom shall be supplied with a 31
flange to ensure an airtight bolted 32
connection. All flanged connections shall be 33
sized and located by the SELLER, except for 34
the process off-gas line, which will be sized 35
final by FERMC0 at the time of award. 36
37
38
39

The dryer discharge head shall have the following openings for flanged connections:

<u>Description</u>	<u>Quantity</u>
Process Off-Gas	1
On-Line Humidity Probes	TBD
Product outlet	1
Manhole	1
TV camera	1
Sight port	1
Thermocouples	TBD
Grab sampler	1

f. Rotary dryer seals:

The rotating dryer seals are to be provided at both the feed and the discharge ends to minimize gas leakage into or out of the dryer. The seals shall be designed by the SELLER. The contact section of the seal assembly shall consist of a fixed part connected to the feed end head and the discharge head of the dryer, respectively, and a rotating part connected to the dryer cylinder.

A seal ring with spring loading may be considered to compensate for normal seal wear, heat up, and cool down. The seal must have easy access for adjustment and replacement.

The SELLER shall furnish dryer seals of a type that has been proven in the field by at least 3 years of satisfactory service. Each feed and discharge end seal shall be designed not to allow more than 250 scfm of air inleakage, measured across the seals at differential pressures of 0.5 and 2.0 inches W.C., respectively. Seal performance shall be confirmed by SELLER calculations, and approved by FERMC0.

Each seal shall be enclosed in a shroud to be designed by the SELLER that extends completely around the periphery of the seal. The shroud shall be attached to and supported from the fixed head of the rotary dryer and shall be airtight except for necessary clearance at the dryer cylinder. An exhaust system connecting to the shroud will be supplied by FERMCO to maintain a negative pressure so that air flow is always from the ambient to the shroud through the clearance. The shroud shall be removable for seal maintenance and shall have an access port for seal inspection. Seals shall also be provided at both ends of the furnace between the fixed furnace and the rotating shell. These seals should not require shrouds.

g. Main support frame:

The entire indirect dryer assembly consisting of the support roller assemblies and the drive assemblies, as well as the entire furnace, shall be located and anchored on an integrated structural base frame, designed and supplied by the SELLER. This structure will be located and anchored on concrete pillars to be provided by FERMCO. The foundation requirements for anchoring the main support frame shall be provided by the SELLER.

2. Furnace:

a. The rotary dryer shall be supplied with a furnace surrounding the rotary cylinder. The function of this furnace is to generate high temperature flue gases by combustion of natural gas as fuel.

The furnace shell housing the rotating cylinder shall be designed and constructed to accommodate and support refractory lining. The furnace shall be designed and built in sections (zones) along the length of the

dryer. Each zone shall be equipped with its own designated set of burners to supply the heat required for drying. The SELLER shall specify the thermal duty required for each zone, and shall consider placing baffles between furnace zones for better thermal control. Drying shall be accomplished through indirect heat transfer between the hot gases and the feed, which is fed into the rotating cylinder and advances from the feed end toward the discharge end.

The furnace shell shall be carbon steel plate welded construction and shall be designed in sections with joining flanges. Each furnace section shall be supplied in halves, the upper and lower parts to be fitted together with joints and secured with bolts and nuts.

The furnace sections shall be flanged together. The furnace shall be designed with all necessary stiffening and structurally clamped together, as required. Each section (zone) of the furnace shall be supplied with, but not limited to, the following openings:

<u>Opening</u>	<u>Quantity/Zone</u>
Burner(s)	TBD
Exit gas nozzle	1
Sight port(s)	TBD
Instrumentation	
— thermocouples	TBD
— pressure gauge	1
— outer furnace shell surface temperature measuring device	1

The SELLER shall determine furnace outline dimensions, refractory lining (thickness and type), annular spacing between the refractory hot surface and the outside surface of the rotating shell, number of burners and sight ports per zone, and the quantity and location

of thermocouples placed inside each zone. These thermocouples shall measure rotary shell and annular headspace temperatures at various locations. As a minimum, the furnace annular headspace temperature shall be measured in each zone at the first and last burner. A combined furnace off-gas temperature measurement in the off-gas header shall be included. At least one rotary shell temperature measurement per burner shall be required, with the location to be determined by the SELLER.

Physical dimensions and thermal capacity of the furnace shall be determined by the SELLER to meet technical requirements as specified in Article 2.2, Paragraph C, Subparagraphs 1 and 2.

b. Refractories:

The furnace shall be refractory lined to withstand heat. Use of refractory bricks and/or ceramic fiber may be proposed with proper backing insulation to ensure that the temperature will not exceed 120 degrees F on the furnace external metallic surfaces. The SELLER may propose the option of using pre-installed "soft" refractories.

c. Burners:

The burners shall be a high velocity type of gas burner. The burners shall be designed (1) to burn natural gas, (2) to ensure a low NOx production, (3) to achieve furnace temperature required to maintain dryer shell temperature below its maximum, and (4) to be capable of operating with a turndown ratio of 10:1. In addition, the burner shall be operable in low and high fire with ambient air and with electronic direct spark ignition. In burner selection, to achieve a low NOx concentration in the combustion gases, two-stage combustion may be

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considered. This burner shall have the capacity to be operated over 1,400 degrees F with primary and secondary combustion air supply. The burner shall be supplied with UV flame detectors for flame supervision and be operable with a cross-connected ratio control.

The number of burners per zone and the spacing between burners shall be specified by the SELLER. The SELLER shall select the burners and their thermal duty per zone based on the thermal design requirements specified in Article 2.2 of this specification.

3. Burner piping and instrumentation skid:
The SELLER shall provide all necessary equipment and instrumentation for each set of burners provided independently for each zone of the furnace (fuel and air headers, interconnecting pipes, fittings, valves, control and safety valves fitting and support) on an integrated skid. For general piping requirements, see piping specifications, Sections 15060, 15090, and 15250.

Components to be installed on the skid shall include, but are not limited to, the following:

- a. Gas supply header with independent manifold for each set of burners per zone. The manifold shall include the high and low gas pressure switches, pressure gauge, manual reset shutoff valve, automatic shutoff valve, automatic gas blocking valve, shutoff valves (inlet and outlet), two leak test cocks and interconnecting piping, automatic vent valve, and proof-of-closure switch.
- b. The main air supply header shall be supplied with flow control valves to each zone of the burners.
- c. The piping and valving for each individual burner shall include the interconnecting

piping (burner gas supply) with manual shutoff valve, gas metering orifice, gas ratio regulator, gas limiting orifice valve, flexible pipe connection to the burner, interconnecting piping (gas lighting) with solenoid valve, gas regulator, and limiting gas valve.

Installed instruments, valves, etc., shall be located on the skid to allow easy access for maintenance and replacement. Interconnecting piping within the skid and between the skid and the burners as well as the air supply piping to the air header, located on the skid, shall be supplied by the SELLER. The fuel supply (natural gas) to the main gas header located on the skid will be provided by FERMCO.

The skid shall be designed to have a structural frame for support and routing of valves, pipes, manifolds, etc., and base plate to anchor skid. Any support structure for the skid needed by arrangement shall be supplied by the SELLER. The concrete slab (foundation) will be provided by FERMCO.

4. Combustion-air supply fan:

The duty of the combustion air supply fan is to provide combustion air directly to all sets of burners installed in parallel, for each zone of the dryer furnace. Intake air to the fan will be from ambient. The combustion air fan shall be sized by the SELLER to:

- a. Have adequate pressure in the air header located on the burner piping and instrumentation skid to provide the required air pressure (identical) for each burner per zone.
- b. Supply all of the combustion air (including required excess air) at burner rated capacity and over the range of 10:1 operational turn-down ratio.

- c. The fan static pressure rating shall be determined by the SELLER.
 - d. The fan shall be designed to deliver 15 percent excess volume against a 30 percent static pressure overload.
 - e. The fan shall be supplied with a variable speed motor with controls to accommodate operation as defined by turndown ratio above. The proper means of adjusting the fan and system characteristics must be provided.
 - f. The fan shall be designed as AMCA Class III non-overloading centrifugal type. The fan shall be furnished as a complete unit, including motor, guard, and mounting base. The fan shall conform to AMCA 99 and AMCA 210. The foundation will be supplied by FERMCO per SELLER's requirements.
5. Dryer caked-on feed removal:
- a. Means shall be provided to remove caked-on feed from the inside of the rotary section for a distance from the start of the heated section to be specified by the SELLER. Cake removal shall be accomplished by the application of high pressure water, or by a different method proposed by the SELLER. If a high-pressure water or steam system is chosen, the inlet end of each pipe must terminate outside the dryer with a globe valve and a quick-connect coupling. All components of this system, whether water, steam, or mechanical scraping, must be stainless steel.
6. Arrangement requirements:
- The location of the dryer and all equipment supplied by the SELLER (Article 2.1, Paragraph B) shall be clearly indicated on a general arrangement drawing. All walkways, platforms, stairs, and support structures associated with the equipment shall be included. The major dimensions for major items and equipment assemblies shall be provided to give locations in both plan view and

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elevation. Preliminary arrangement drawings shall be part of the bid package described in Article 1.3, Paragraph B. The location of the dryer shall be subject to the following requirements:

a. Both the feed and discharge housings shall be located in enclosed process areas (to be provided by FERMCO; see Article 2.2, Paragraph H, Item 3).

b. The length of the rotating cylinder not covered by the furnace shall be determined by the SELLER according to the following requirements:

- 1) At the feed end, accommodate one support roller assembly and the drive assembly.
- 2) At the discharge end, accommodate one support roller assembly.
- 3) The SELLER shall consider placing the drive assembly on the discharge end to keep the feed end as short as possible due to the cantilevered feed conveyer.

c. At the discharge end, the elevation shall be set to provide a minimum 5-foot clearance between the floor and the discharge point of the discharge head. The elevation at the feed end shall be determined by the required slope.

d. The entire assembly shall be supported on concrete pillars (provided by FERMCO) as required and specified by the SELLER.

E. Control and Instrumentation Requirements:

1. Specific requirements:

The instrumentation and control philosophy of the operation of the indirect dryer system shall be determined and supplied by the SELLER (per Article 1.3, Paragraph B, Item 4). The SELLER shall also specify and furnish the instrumentation, sensors, and controls for the equipment with local controls and remote control input requirements clearly delineated. The indirect dryer will be monitored and controlled remotely from a control room provided by FERMCO.

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~~Each furnace zone shall be set up to have its own~~
temperature control, independent of the other
zones. Each zone shall have a dedicated set of
burners which shall be automatically or remotely
controllable as a set for rough control. In
addition, each burner shall then be manually
adjustable by the operator for fine-tune of
combustion as required.

The dryer system shall be furnished with a
separate control console (panel) for local
monitoring and operation (including burner
operation described above). The panel will be
wired to the dryer monitoring and control
instruments via an interconnection
cabinet/enclosure. The interconnection
cabinet/enclosure shall be positioned on the dryer
for ease of installation of conductors from the
panel. Wiring connection points shall be clearly
identified for point-to-point wiring at the job
site. See Paragraph E.4.

Interconnection wiring will be supplied and
installed by FERMCO. It shall be the
responsibility of the SELLER to provide
interconnection diagrams to connect the dryer to
the panel.

In addition, the SELLER shall make certain
operating parameters and/or control functions
available as inputs to and/or outputs from a data
acquisition system provided by FERMCO. A listing
of recommended parameters for data acquisition and
controls of interest will be provided by the
SELLER as part of the package submittal after
award.

The indirect dryer control system shall perform,
but not be limited to, the following functions:

- 1) Supervise burner ignition: Prior to warm-up,
initiation of control logic shall verify that

the following limits are satisfied:

- a) Furnace temperatures are within operating limits. 1 2 3
- b) Furnace pressure is within operating limits. 4 5
- c) Combustion air supply fan is operating. 6
- d) Combustion gas exhaust fan is operating. 7
- e) Process off-gas fan is operating. 8
- f) Natural gas pressure is adequate. 9
- g) Dryer is rotating. 10
- 2) Once operating, the following limits will shut down the burners: 11 12
 - a) Furnace temperature is out of limits. 13
 - b) Furnace pressure is out of limits. 14
 - c) Combustion air flow is inadequate. 15
 - d) Natural gas flow is inadequate. 16
 - e) Dryer is not rotating. 17
 - f) Rotary shell temperature exceeds high limit. 18 19

A flame safeguard programming control system (Honeywell Model R4140L or approved equal) shall be provided to control each burner lightoff sequence. The supervised burner ignition system shall follow the start-up sequence as outlined by the SELLER (per Article 1.3, Paragraph C, Item 3) in accordance with NFPA standards. 20 21 22 23 24 25 26 27

- 3) Control burners: Burners/zone shall be controlled (capable of 10:1 turndown ratio) to maintain selected shell temperature. Shell temperature shall be set by the operator. 28 29 30 31 32
- 4) Measure, control, and display inside furnace temperatures and the temperature of the outer surface of the rotating cylinder in each zone. 33 34 35 36
- 5) Measure, control, and display furnace exit gas temperature for each zone. 37 38
- 6) Measure, control, and display temperature and flow of combustion air. 39 40
- 7) For fuel/air ratio control of all sets of burners/zone and each individual burner within each zone, a pressure- balanced 41 42 43

regulator control system is acceptable. The SELLER may quote, as an alternative, a fully metered electronic fuel/air ratio control for each set of burners per zone integrated with a programmable microprocessor.

2. General Requirements:

- a. Locally mounted transmitters shall be two-wire, loop powered configuration, with 4 to 20 mA_{dc} output signal. Accuracy ± 1.5 percent of full scale.
- b. Remote instruments used to provide operator information shall be equipped with digital readouts, 3-1/2 digits minimum.
- c. Direct reading instruments (i.e., pressure gauges, thermometers, etc.) shall be analog display, 4-1/2-inch dial, black letters on white background, phenolic case and polycarbonate lens. Accuracy ± 5 percent of full scale.
- d. Temperature sensors shall be thermocouples selected based on the estimated operating/process temperature to be measured. All thermocouples shall be installed with protecting wells, unless the intended use is the monitoring of surface temperatures.
- e. Materials of construction shall be chosen to provide the optimum resistance to corrosion and wear, while maintaining economic value for the duration of the project.

3. Installation Requirements:

- a. Process sensing instrumentation shall be directly installed on the dryer or the dryer's utility piping whenever conditions permit. Remote installation of field instruments is acceptable to avoid environmental limitations as specified by the instrument manufacturer.
- b. Differential pressure transmitters and switches may, at the option of the installer, be installed remotely from the dryer utilizing instrument stands and racks, as

- well as stainless steel impulse lines between the process and the transducer/transmitter. 1
 - Horizontal runs of instrument impulse lines shall be sloped at 1/4 inch per foot. 2
 - Installations sensing liquids and condensing gases and vapors shall have impulse lines sloping down to the instrument. All other installations shall have lines sloping up to the instrument. 3
 - Instruments directly connected to the process by impulse lines shall be installed with process isolation valves to facilitate maintenance and calibration of the instruments without shutdown of the dryer or its support utilities. 4
 - All instruments and sensors will have affixed a permanent stainless steel tag with the vendor's identification number (loop number) engraved in 1/8-inch-high letters (minimum). The tag may be affixed to the instrument by adhesive, screws or stainless steel wire. 5
 - Sight ports shall be installed on the sidewall of the indirect dryer system to observe burner operation. The SELLER shall design and recommend the sight port dimensions, type of mounting, heat resistant glass suitable for the operating temperature, type of stainless steel shutter, and type of purging. 6
4. Operator Controls: 7
- Information and data for the operation of the dryer will be displayed on a local control panel, along with manual controls to operate the dryer. Controls and displays may be supplied as part of the control software or as discrete components wired to more conventional control/indicating devices. 8
 - The operator control station will be NEMA 4 rating. This will allow the control station to be located outside in a potentially damp area. 9

c. All instruments and controls will be positioned such that viewing, operation, calibration, and maintenance functions may be performed without physically dismantling the instruments and controls.

5. Codes and Standards:

SELLER shall comply with the applicable codes and standards listed in Article 1.2, Paragraph C including, but not limited to, ISA S5.1.

F. Electrical Requirements:

1. See electrical sections in Divisions 15 and 16.

G. Structural Requirements:

1. The rotary dryer support stations will be supported and anchored on concrete foundations (provided by FERMC0) which are capable of resisting all vertical and unbalanced horizontal loads and forces emanating from the dryer. The SELLER shall be responsible for providing information concerning the location, magnitude, and direction of all equipment forces with verifiable calculations. These calculations will be reviewed and stamped by a professional engineer licensed in the State of Ohio, provided by FERMC0. This information shall be furnished with the general arrangement design drawing submittals (per Article 1.3, Paragraph C, Items 1 and 6).
2. Information shall be provided (per Article 1.3, Paragraph C, Item 1) indicating the expected amount (in inches) and direction of thermal expansion for all specified equipment, including proposed location of expansion joints, expansion devices, support lugs, lateral guides, or spring mounts where needed.
3. Equipment/structural design shall provide for loads as specified below:
 - a. Roof, live load: 20 psf.
 - b. Platforms and walkways, live load: 60 psf.
 - c. Wind load: Velocity pressure shall be calculated using equation 3 of ASCE 7-93, using $V = 80$ mph basic wind speed and $I =$

- 1.07. Design wind pressures and forces shall be in accordance with ASCE 7-93, Table 4.
- d. Seismic load: Use provisions of the Uniform Building Code, using $Z = 0.13$, $c = 2.75$, $I = 1.25$, and $R_w =$ reduction factors from Table 16-P. W (total seismic load) shall include all normal operating contents, piping, and attachments.
- e. Shop drawings shall state the vertical loads and lateral forces used (wind and seismic) in the design.
- 4. Materials of construction shall meet the following requirements:
 - a. Carbon and Structural Steel: ASTM A36.
 - b. Structural Tubing: ASTM A500, Grade B.
 - c. Bolts, Nuts, and Washers: ASTM A325.
 - d. Anchor Bolts: ASTM A36; Washers: to be determined by SELLER; Nuts: to be determined by SELLER.
 - e. Welding Materials: AWS D1.1; E70XX.
- 5. Welding requirements are specified in Article 2.4, Paragraph B.
- 6. Finish and painting requirements are specified in Article 3.3.
- 7. Additional Codes and Standards:
SELLER shall also comply with the applicable codes and standards listed in Article 1.2, Paragraph C.

H. Design Interfaces:

This section identifies the interface, interaction, or interconnection points expected for the indirect rotary dryer system. Additional interfaces required by the SELLER's design must be clearly identified within the SELLER's proposal.

- 1. Mechanical interfaces:
Mechanical interfaces required within the indirect dryer system shall be provided in accordance with the requirements of this specification.
 - a. Combustion-air supply fan, inlet flange.
 - b. Gas supply line header on the burner pipe skid, inlet flange.
 - c. Combustion gas exhaust header, discharge flange.

- d. Feed end head, dryer feed conveyor, inlet flange.
- e. Discharge head, product discharge flange.
- f. Discharge head, process off-gas discharge flange.
- g. Feed end head, high-pressure water inlets, quick-connect couplings.
- h. Feed end head, sweep air, inlet flange.

2. Structural Interfaces:

The indirect dryer assembly and its supporting base frame shall be supplied by the SELLER. To support this assembly, reinforced concrete foundations and pillars will be supplied by FERMCO. Structural support for platforms, equipment, piping, etc., included in the system shall also be supplied by the SELLER. The SELLER shall supply drawings (per Article 1.3, Paragraph C, Item 1) indicating the dimensions and location of mounting requirements as well as structural loads, vibrational loads, and deflections that will be used by FERMCO to design and specify the support foundation.

- a. Indirect rotary dryer system, main support frame with anchor bolts.
- b. Burner piping and instrumentation skid, support structure with anchor bolts.
- c. Combustion-air supply fan, base frame with anchor bolts.
- d. Maintenance platforms, walkways and structures; with anchor bolts.
- e. Feed and discharge ends, support structures with anchor bolts.

3. Ventilation:

Feed end head and discharge head of the indirect dryer will be located in enclosed process areas to be provided and ventilated by FERMCO per space requirements provided by the SELLER. Each end of the rotating cylinder will penetrate into a process area. The SELLER shall specify the required dimensions for the openings. The seals

for these building openings at both ends will be provided by FERMCO.

A separate shroud and seal system for the rotary cylinder penetrations of the feed and discharge heads shall be provided by the SELLER. The shrouds surrounding the mechanical seals of the indirect rotary dryer at both feed and discharge ends shall be designed and supplied by the SELLER as specified in Article 2.2, Paragraph D, Subparagraph 1.f. Shrouds will be vented to the plant HVAC system by FERMCO to ensure a minimum vacuum of -0.3 inches W.C. relative to atmosphere.

The indirect rotary dryer shall operate at a minimum vacuum of -0.5 inches W.C. relative to atmosphere at the feed end. The process off-gas acfm will be specified by FERMCO at time of award. The SELLER shall specify pressure drop across the dryer system.

- 4. Electrical Interfaces:
Interfaces between FERMCO and SELLER responsibilities are delineated in the electrical sections 15171, 16051, and 16857.
- 5. Instrumentation and Controls:
All instrumentation sensors mounted on the indirect dryer system are the responsibility of the SELLER.

2.3 MATERIALS OF CONSTRUCTION

All materials shall be new and, unless otherwise specified in this specification, shall be in accordance with the following:

- A. Carbon and Structural Steel: ASTM A36.
- B. Controls and Instrumentation: Per Article 2.2, Paragraph E.
- C. Electrical: Per Divisions 15 and 16.

D. Structural: Per Article 2.2, Paragraph G.

E. Piping: Per Sections 15060, 15090, and 15250 in Division 15.

F. Other materials: As recommended and specified by SELLER.

2.4 FABRICATION REQUIREMENTS

A. General:

The indirect dryer system shall be fabricated with materials, welding processes, and refractory fabrication techniques listed herein, and machined and assembled in conformance with approved SELLER drawings.

B. Welding:

Prior to fabrication, welding procedures and welder qualifications shall be submitted to FERMCO for approval. Welding procedures for the dryer rotating cylinder (shell) shall be qualified to conform with the requirements of ASME, Section VIII, Subsection B, Parts UW-26, UW-27 and UW-28.

1. Welder Qualification:

Within the previous 12 months, welders and welding operators shall be qualified to the actual procedures used in fabrication. For carbon steel, welders shall be qualified per AWS D1.1.

2. Fabrication:

The edges and surfaces of the parts to be welded may be cut to shape and size by mechanical means such as machining, shearing, or grinding, or by oxygen or arc cutting. After oxygen or arc cutting, all slag and molten material shall be removed by mechanically grinding the edge back a minimum of 1/16 inch of parent material before welding. All groove welds shall have complete penetration and all welds shall have complete fusion with the base metal.

3. Equipment and Tools: 1
 All tools and equipment used on carbon steel shall 2
 be free of contamination and foreign matter that 3
 would be detrimental to fabrication. Wire brush 4
 material shall be compatible with the base metal. 5
 Grinding wheels shall be resin bonded. 6

4. Filler Metal: 8
 Filler metals for structural steel shall conform 9
 to AWS D1.1, Table 4.1.1, E70 Series. Filler 10
 metals for alloy steel shall be specified in 11
 accordance with the steel alloy manufacturer's 12
 instructions. 13

Controlled storage and handling of electrodes, 14
 fluxes, and other welding materials shall be 15
 maintained. Coated electrodes that have been open 16
 or unheated in excess of 8 hours shall be used 17
 only if they are oven heated in accordance with 18
 electrode manufacturer's recommendations. The 19
 heat and time shall be maintained and recorded by 20
 a recording instrument. 21
 22

C. Refractories: 23
 The refractories shall be installed at the site. The 24
 SELLER may utilize a subcontractor for refractory 25
 installation, but must retain responsibility. The 26
 SELLER shall provide a refractory design and 27
 installation plan for FERMCO review and approval. The 28
 SELLER may propose the option of using pre-installed, 29
 "soft" refractories. 30
 31

PART 3 EXECUTION 32

3.1 TESTING AND INSPECTION 33

A. General: 34
 The SELLER's quality control department shall be 35
 responsible for ensuring that the equipment components 36
 and accessories are shop inspected during fabrication 37
 and sub-assemblies functionally tested prior to 38
 shipment to prove compliance with the requirements of 39
 40
 41
 42

445 this specification. Inspection and test reports shall be submitted to FERMCO.

B. Integrated Plan:

The SELLER shall submit and maintain a detailed plan with schedule for manufacturing, inspection, and testing. The plan shall be submitted to FERMCO for approval prior to fabrication. FERMCO reserves the right to designate "source inspection hold points" which shall be incorporated into the plan at no cost. The hold points shall define the specific operations in the fabrication or inspection sequence that are to be witnessed by FERMCO or their authorized representative.

C. Witnessing and Notification:

FERMCO reserves the right to witness the shop inspection and tests and, therefore, shall have access to the SELLER's facilities during fabrication, inspection, and testing of equipment or components. The SELLER shall notify FERMCO at least 7 calendar days prior to dates on which inspection or tests at the SELLER's plant, or at the site during installation, are to be performed to maintain the SELLER's manufacturing or shipping schedule.

D. Proposed Procedures:

The SELLER shall submit proposed inspection and acceptance test procedures to FERMCO for approval.

E. Weld Inspection:

Weld inspection procedures and Non-destructive Examination (NDE) welding inspector qualifications shall be submitted to FERMCO for approval.

1. Steel and Alloys:

All NDE shall be per AWS D1.1 with acceptance criteria per either Section 8 or Section 10, if applied to tubular products. All welds shall be 100 percent visual and either magnetic particle or liquid penetrant tested. Ten percent of each welder's welds shall be radiographed for the full length. All shell weld intersections shall be radiographed to clearly show at least 2 inches

each side of the intersection. Inspection reports shall be traceable to each weld joint.

2. Dryer rotating cylinder (shell):
The SELLER shall ensure that the methods of inspection meet the steel suppliers' special instructions given for welding on components that will be subjected to cyclic temperature conditions. All NDE shall be performed in accordance with the requirements of ASME Section VIII, Subsection B, Part UW, "Inspection and Tests," and referred part of Subsections A and C. All welds shall be 100 percent visual and either magnetic particle (MT) or liquid penetrant (PT) tested according to the requirements of ASME Section VIII, Appendix 6, for MT and Appendix 8 for PT. Applied procedure must be performed in accordance with the requirements of T-150 of ASME Section V.

3. NDE Welding Inspector Qualifications:
The NDE inspectors shall be qualified to actual NDE procedures used in accordance with AWS QC1.

F. Weld Repair Procedures:
All weld defects shall be repaired in accordance with repair procedures submitted by SELLER and approved by FERMC0 prior to use. The welds shall then be rewelded and the repaired welds shall be completely retested in conformance with the approved testing method.

G. Tolerances:
Cylindrical tolerances and metal fits shall be in accordance with ASME B4.1. The mating parts described with a class of fit shall be machined to the limits specified therein.

3.2 EQUIPMENT IDENTIFICATION

Equipment shall be identified with a 16-gage stainless steel tag measuring not less than 2 inches by 4 inches, stamped with the equipment tag number. Letters and numbers shall be a minimum of 1/4-inch high for readability. The tag shall be prominently displayed and shall be welded to the equipment. The equipment

numbers shall be indicated on the equipment list to be developed by the SELLER.

3.3 FINISH AND PAINTING

- A. SELLER shall furnish all information, procedures, and requirements with regard to painting and special coatings of the equipment included in this specification. Work shall include surface preparation, primer, and special coat applied in the shop, and field touch-up of shop-applied primer. The SELLER shall specify a minimum dry film thickness per coat according to applicable standards. The SELLER shall also specify different colors for each top coat.

- B. Before commencing work, SELLER shall select the proper coating for the anticipated surface temperatures and shall submit to FERMCO for approval a complete list of special coating materials to be used. SELLER shall also submit printed manufacturer's data (including MSDS sheets) and recommendations of the special coatings relating to the requirements for surface preparation, thinning, mixing, handling application, and storage of material.

- C. Unless otherwise specified by the SELLER, the following surfaces shall be excluded from receiving special coatings:
 - 1. Stainless steel.
 - 2. Glass.
 - 3. Exposed carbon steel and alloys subject to wear, flexure, or close fits (e.g., wheel treads, wheel track, cams, bearings, bearing shafts and housings, retaining rings and grooves, cylinder rods, chains, sprockets, pins, gears, pulley grooves, screw threads, springs, etc.)

3.4 PRODUCT DELIVERY AND ACCEPTANCE

- A. Packaging:
 - 1. Preparation for Packaging:
All materials shall be cleaned to remove all chips, slag, weld spatter, and all visible oil and

grease prior to shipment. After completion of
 equipment preparation and inspection at the
 SELLER's site, the SELLER shall ensure secure
 packaging to prevent shifting and damage during
 transport.

2. Packaging and Shipping:
 Boxes, crates, and packages containing the
 equipment shall be clearly labeled with the name
 of the equipment, tag number, weight, pick-up
 points, and any other information required to
 properly identify and safely handle the items
 during shipping and storage. The components shall
 be packaged and protected to prevent corrosion,
 entrance of foreign matter, damage, and loss
 during shipment. All openings (including the
 rotary shell) shall be covered, capped, or plugged
 to prevent ingress of foreign material during
 shipment and storage. Exposed screw threads shall
 be protected with plastic caps or plugs. Vapor
 phase inhibitors (VPI paper) shall be used in
 boxes or crates. The vapor phase inhibitors shall
 not be used internal to the equipment. All
 shipments shall be accompanied with an itemized
 packing list attached to each shipping container.

B. SELLER's Instructions:
 The SELLER shall submit to FERMCO for approval
 procedures for cleaning, handling, inspecting,
 repackaging, and storing the components at FERMCO's
 site before installation. Packages may be stored
 temporarily indoors or outdoors at -30 degrees F to 120
 degrees F and at any degree of relative humidity.

C. Receiving Inspection:
 FERMCO will receive and inspect packages containing the
 indirect dryer system components to verify the contents
 and to check for possible damage during shipment.

D. Handling and Storage:
 FERMCO will be responsible for safe handling and
 storage of the indirect dryer components (assemblies)
 in accordance with the supplier's instructions.
 Multiples shall be stored together in a group lot.

3.5 ERECTION AND INSTALLATION

The indirect dryer system, with the exception of the refractories, shall be installed by FERMCO in the plant area designated for the dryer system (see the General Arrangement Drawing in Appendix 4). The overall site plan will be prepared to meet the SELLER's design requirements. All the foundations and building footings for the facility will be in place at the time of the indirect dryer installation.

A. The indirect dryer system installation shall be in accordance with the following paragraphs:

1. All components of the indirect dryer system shall be assembled under the responsibility of the SELLER at the site in accordance with the schedule and the performance plan included with the terms and conditions.
2. FERMCO shall be responsible for all transport, cranes, and equipment for installation and erection of the dryer system.
3. FERMCO is responsible for coordinating the erection and installation to correspond with other facility construction and to notify the SELLER 30 days in advance of scheduled indirect dryer installation.
4. FERMCO is responsible for structural concrete supports and coordination with the SELLER for the interfaces before and during erection.
5. The SELLER shall be responsible for the installation of all refractories and proper refractory curing.

3.6 FINAL ACCEPTANCE METHODS

A. Preconditions:

Final acceptance of the installed drying equipment shall be determined by subjecting it to an acceptance test. The acceptance test is to take place at the site after the following preconditions are satisfied:

1. All inspections and mechanical/functional (shop) tests shall have been completed per specified requirements (Article 3.1).

- 2. A system operational readiness check shall have been performed, and it has been determined that the system is ready for start-up. All safety features shall be functional. 1-4
- 3. The dryer surrogate feeds will be supplied by FERMCO using the following weight parameters: 5-6

<u>Feed</u>	<u>wt%</u>	
Al ₂ O ₃	40	8-9
Ca(OH) ₂	3.5	10
MgO	10.5	11
Kaolin	30	12
Bentonite	16	13-14

This corresponds to Feed ID 3-5 of Table 4 from the Report on Execution of Surrogate Waste Drying Tests, OUI, PO-19, August 1994, Revision A, attached. Purchase requisitions for each chemical are attached in Appendix 5 of this specification. 15-19

FERMCO is responsible for adding and mixing the required amount of water to this surrogate. Moisture content in feed and the product as well as the required evaporation rate shall be in accordance with the requirements specified in Table A. The surrogate feed may contain 4-inch tramp material at 1 wt%, due to FERMCO's acceptance testing requirements specified for the dryer feeder/conveyor system. 21-29

- 4. Adequate utility supplies (electric, air, fuel) are available. 30-31
- 5. The process off-gas treatment system shall be ready to maintain the proper pressure (vacuum) in the dryer. 32-34
- 6. The Acceptance Test Plan and Acceptance Test Procedures have been prepared and agreed to by the SELLER and approved by FERMCO. 35-37
- 7. The SELLER shall provide calculations to confirm that the amount of air inleakage across the feed and discharge end seals at differential pressures of 0.5 and 2 inches W.C. will not exceed 250 scfm each. 38-43

Table A - Feed and Product Moisture Contents and Evaporation Rates for Acceptance Testing

Test Runs	Feed		Product	Off-Gas	
	Moisture Content (dry basis)	Rate (tons/hr)	Moisture Content	Maximum Entrained Solids (wt% of feed)	Evaporated Water (tons/hr)
1	55%	per SELLER	10%	per SELLER	4.2
2	55%	22	>10%	per SELLER	per SELLER

B. Methods of Acceptance:

Acceptance of the equipment shall be based on its ability to successfully perform the acceptance tests at the specified conditions within the specified ranges and limits. The methods shall include the following:

1. Demonstrate that the equipment is capable of drying the feed from the specified feed moisture content to the specified product moisture content at the specified evaporation rate (see Table A).
2. Demonstrate at the conclusion of each test run that the dryer can handle a variable feed rate, residence time, and heat transfer rate.
3. Demonstrate continuous 3 hours of steady-state operation for each test run. If the steady-state condition is interrupted due to a mechanical or other problem, the test shall be restarted and run at steady-state for a continuous 3 hours after correction of the problem. (Note: Steady-state is achieved when the rate of solids fed to the dryer equals the rate of solids leaving the dryer, and targeted product moisture content is achieved.)
4. Demonstrate control of (1) furnace temperatures (each zone if applicable) and (2) residence time.
5. Demonstrate the mechanical performance of each component of the drying equipment to prove that the components and materials of construction will withstand the conditions at the specified design parameters (e.g., temperatures, pressures, thermal

loads, mechanical loads, processing rates). As part of this demonstration, the parameters listed in Table B will be measured. The acceptable limits for those parameters, if applicable, are also listed in Table B. The SELLER shall be responsible for meeting the acceptance limits within the tolerance limits of the feed. FERMCO shall be responsible for meeting the feed moisture contents in Table A ± 2.5 percent, and for ensuring the SELLER-specified feed rate in Table A ± 5 percent.

Table B - Acceptance Limits for Dryer Parameters

Parameter	Limits
Furnace Skin Temperature	≤ 120 °F (entire test period)
Moisture Content of Product	Table A value $\pm 2.5\%$
Entrained Solids in Process Off-Gas (to be measured by FERMCO)	Not to exceed SELLER maximum

END OF SECTION

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APPENDIX 1

REQUIREMENTS/INSTRUCTIONS FOR FEMP SUPPLIERS

Date: 03/01/96
Rev.: C RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/145/DRYER 00154

~~000154~~

STANDARD REQUIREMENTS FOR FEMP SUPPLIERS (FS-F-2672)

SECTION I	
Project/Item Name: <u>OU-1 Indirect Dryer Specification</u>	PO/Subcontract No.
Requisition No. _____ GWA _____	
Drawing(s) No. _____	
Specification(s) _____	
Remarks _____	Originated By _____

SECTION II																			
Standard Requirement Number Q-1	<p>SUPPLIER'S QUALITY PROGRAM REQUIREMENTS</p> <table style="width:100%; border: none;"> <tr> <td><input type="checkbox"/> 1) Organization</td> <td><input type="checkbox"/> 7) Control of Purchase Items</td> <td><input checked="" type="checkbox"/> 13) Handling, Storage & Shipping</td> </tr> <tr> <td><input type="checkbox"/> 2) Q Program</td> <td><input checked="" type="checkbox"/> 8) Identification & Control</td> <td><input checked="" type="checkbox"/> 14) Inspection, Test & Operating Status</td> </tr> <tr> <td><input checked="" type="checkbox"/> 3) Design Control</td> <td><input checked="" type="checkbox"/> 9) Control of Processes</td> <td><input checked="" type="checkbox"/> 15) Control of Nonconforming Items</td> </tr> <tr> <td><input type="checkbox"/> 4) Procurement Document Control</td> <td><input checked="" type="checkbox"/> 10) Inspection</td> <td><input checked="" type="checkbox"/> 16) Corrective Action</td> </tr> <tr> <td><input checked="" type="checkbox"/> 5) Instructions, Procedure & Drawings</td> <td><input checked="" type="checkbox"/> 11) Test Control</td> <td><input checked="" type="checkbox"/> 17) Q Records</td> </tr> <tr> <td><input checked="" type="checkbox"/> 6) Documentation Control</td> <td><input checked="" type="checkbox"/> 12) Control of Test Equipment</td> <td><input type="checkbox"/> 18) Audits</td> </tr> </table> <p>Supplier's Quality Program must be approved before contract can be awarded and shall, as a minimum, address the elements checked above.</p>	<input type="checkbox"/> 1) Organization	<input type="checkbox"/> 7) Control of Purchase Items	<input checked="" type="checkbox"/> 13) Handling, Storage & Shipping	<input type="checkbox"/> 2) Q Program	<input checked="" type="checkbox"/> 8) Identification & Control	<input checked="" type="checkbox"/> 14) Inspection, Test & Operating Status	<input checked="" type="checkbox"/> 3) Design Control	<input checked="" type="checkbox"/> 9) Control of Processes	<input checked="" type="checkbox"/> 15) Control of Nonconforming Items	<input type="checkbox"/> 4) Procurement Document Control	<input checked="" type="checkbox"/> 10) Inspection	<input checked="" type="checkbox"/> 16) Corrective Action	<input checked="" type="checkbox"/> 5) Instructions, Procedure & Drawings	<input checked="" type="checkbox"/> 11) Test Control	<input checked="" type="checkbox"/> 17) Q Records	<input checked="" type="checkbox"/> 6) Documentation Control	<input checked="" type="checkbox"/> 12) Control of Test Equipment	<input type="checkbox"/> 18) Audits
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<input checked="" type="checkbox"/> 3) Design Control	<input checked="" type="checkbox"/> 9) Control of Processes	<input checked="" type="checkbox"/> 15) Control of Nonconforming Items																	
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<input checked="" type="checkbox"/> 6) Documentation Control	<input checked="" type="checkbox"/> 12) Control of Test Equipment	<input type="checkbox"/> 18) Audits																	

Q-2	STANDARD REQUIREMENTS LIST	CHECK (/) IF REQ'D	WHEN REQ'D (1)	NO. OF COPIES REQ'D (2)	DRAWINGS SPECIFICATIONS REFERENCE	REQUIRED FOR (3)
Special Processing Procedures & Personnel Certifications						
A	Cleaning Procedure	X	BU	2		A-QE
B	Heat Treat Procedure	X	BU	2		A-QE
C	Helium/Halogen Leak Procedure		BU			A-QE
D	Hydrostatic Test Procedure	X	BU	2		A-QE
E	Pneumatic Test Procedure		BU			A-QE
F	Liquid Penetrant Test Procedure	X	BFR	2		A-QE
G	Liquid Penetrant Personnel Certification	X	BFR	2		A-QE
H	Magnetic Particle Test Procedure	X	BFR	2		A-QE
I	Magnetic Particle Personnel Certification	X	BFR	2		A-QE
J	Radiographic Procedure	X	BFR	2		A-QE
K	Radiographic Personnel Certification	X	BFR	2		A-QE
L	Ultrasonic Test Procedure	X	BFR	2		A-QE
M	Ultrasonic Test Personnel Certification	X	BFR	2		A-QE
N	Visual Examination Procedure	X	BFR	2		A-QE
O	Weld Procedure & Procedure Qualification	X	BU	2		A-QE
P	Welder Performance Personnel Certification	X	BU	2		A-QE
Q	Insulation Resistance Test Procedure	X	BU	2		A-QE
R	Continuity/Resistance Test Procedure	X	BU	2		A-QE
S	Free Iron Test Procedure		BU			A-QE

LEGEND		
(1)	BC = Before Contract Can Be Awarded PS = Prior to Shipment	BFR = Before Fabrication Release WS = With Shipment BU = Before Use
(2)	One Copy Must Be Suitable For Reproduction By Electrostatic Means (e.g., Xerox)	
(3)	A-QE = Approval By Quality Engineering A-PE = Approval By Project Engineer	A-I = Acceptance By Inspection INF = For Information & Comment

STANDARD REQUIREMENTS FOR FEMP SUPPLIERS (Cont'd)

Standard Requirement Number	STANDARD REQUIREMENTS LIST	CHECK (/) IF REQ'D	WHEN REQ'D (1)	NO. OF COPIES REQ'D (2)	DRAWINGS SPECIFICATIONS REFERENCE	REQUIRED FOR (3)
Q-3	Integrated Manufacturing Inspection/Test Plan	X	BFR	2		A-QE
Q-4	Traceability Procedure		BC			A-QE
Q-5	Special Pkg./Ship./Rig. Requirements		BU			A-QE
Q-6	Source Inspection/Test (By FERMCO)	X	PS	N/A		
Q-7	Supplier's Disposition Request (SDR)	X	PS	2		A-QE
Q-8	Assembly & Parts-List Traceability		PS			A1/INF
Q-9	Design Controlled Products (Catalog Data)		WS			INF
Q-10	Inspection/Test Data	X	WS	2		A-QE
Q-11	Radiography Quality Requirements	X		2		A-I
Q-12	Chemical/Physical Test Reports					
A	Raw Material - Mill Chemical Reports		BU			A-I/A-QE
B	Raw Material - Mill Physical Reports		BU			A-I/A-QE
Q-13	Weld Joint Test Specimens		WS			A-QE
Q-14	Identification of Shelf-Life Materials		PS			INF
Q-15	Identification of Shelf-Life Materials Installed in Assembly		PS			INF
Q-16	Serialization		PS			INF
Q-17	Supplier Quality Assurance Release	X	WS	2		A-I
Q-18	Special Processing Certifications	X	PS	2		A-I
Q-19	FERMCO-ICPP Supplied Items - Certification		PS			A-I
Q-20	Detailed Inspection/Test Procedure	X	BU	2		A-QE
Q-21	Certification of Materials to ASME Code		PS			INF
Q-22	Calibration Procedures		PS			A-QE
Q-23	Supplier Certification	X	PS	2		A-QE
Q-24	Other					



Quality Engineer

Date 000156

STANDARD REQUIREMENTS FOR FEMP SUPPLIERS (Cont'd)

Standard Requirement Number	STANDARD REQUIREMENTS LIST	CHECK (✓) IF REQ'D	WHEN REQ'D (1)	NO. OF COPIES REQ'D (2)	DRAWINGS SPECIFICATIONS REFERENCE	REQUIRED FOR (3)
E-1	Engineering Drawings					
A	Schematics		BC	1		
B	Block Diagram Conceptual PFDs		BC	1		
C	Piping Plan		BFR	4		
D	Piping Elevation		BFR	4		
E	Foundation Plan		BFR	4		
F	Elevation Drawing		BFR	4		
G	General Arrangement Drawing/Conceptual		BFR/BC	4		
H	Structural Detail Drawings		BFR	4		
I	Assembly Drawing		BFR	4		
J	Interface Drawings		BFR	4		
K	Flow Diagrams (P&IDs)		BFR	4		
L	Panel Cutout Drawings		BFR	4		
M	Weld Map		BFR	4		
N	Original As-Built Tracings (Sepia)		WS	2		
O	Weight of Unit		BC	1		
P	Descriptive Data		BC	1		
Q	Connection Drawing		BFR	4		
E-2	Curves & Calculations					
A	Characteristic Curves		PS	4		A-PE
B	Performance Curves		PS	4		A-PE
C	Test Result Curves		PS	4		A-PE
D	Calibration Curves		PS	4		A-PE
E	Operating Curves		PS	4		A-PE
F	Correction Curves		PS	4		A-PE
G	Design Analysis					
H	Single Failure Analysis					
I	Failure Mode Analysis		BFR	4		A-PE
J	Fault Tree Analysis					

EXPLANATION OF STANDARD REQUIREMENTS FOR FEMP SUPPLIERS

STANDARD FERMCO QUALITY REQUIREMENTS

The item numbers herein correspond to the numbers on Form FS-F-2672. The narrative under each number provides amplification of the standard quality requirements set forth in this form.

Require-
ment

No. Quality Requirements

Q-1 SUPPLIER'S QUALITY PROGRAM

The supplier must document and maintain a quality program which addresses the elements identified. The supplier's program will be reviewed against ANSI/ASME NQA-1-1989, "Quality Assurance Program Requirements for Nuclear Facilities." When required, the supplier's quality system procedures, operating instructions, and subsequent changes thereto must be made available to the buyer.

Q-2 SPECIAL PROCESSING PROCEDURES AND PERSONNEL CERTIFICATIONS

Special processing procedures and personnel certifications, as required by Form FS-F-2672 must be submitted to the buyer for approval. Special processing procedures and personnel certifications of sub-tier suppliers must also receive buyer's prior approval.

NOTE: Special processes are defined as follows

- a. Those such as welding, heat treating, plating, etc., which are controlled by a quality standard, or other governing specification, and for which the results cannot be readily determined without either disfiguration of the product, or utilization of nondestructive examination or special inspection/tests, or
- b. Those nondestructive examinations or special inspections/tests which are conducted in accordance with requirements of applicable quality standards or other governing specifications, and which are used to detect product discrepancies without destroying the usefulness of the product. This shall include all nonoperating electrical tests, when applicable.

Q-3 INTEGRATED MANUFACTURING/INSPECTION/TEST PLAN

The supplier must prepare, maintain, and use an integrated plan which itemizes the manufacturing, inspection and/or test steps associated with initial material preparation through and including end item delivery. The plan must be submitted to FERMCO. As applicable, FERMCO may designate "source inspection hold points" which will be incorporated in the inspection/test plan at no additional cost to FERMCO.

Q-4 TRACEABILITY PROCEDURE

All items purchased under this procurement package (except as specifically otherwise noted in the contract) must be traceable to the raw material heat/melt/lot from which they were fabricated. A description of the method by which the supplier will achieve and maintain traceability must be submitted to FERMCO. This description must include the identification of all documents/forms used for traceability and a description of how they relate to one another. The submittal of an example would be helpful.

Q-5 SPECIAL PACKAGING, SHIPPING, AND RIGGING REQUIREMENTS

The supplier must prepare and submit a packaging, shipping, and rigging procedure. As a minimum, this procedure must contain the following:

- a. Measures taken to prevent damage in transit;
- b. A detailed description of the design of the container;
- c. Overall dimensions of container and approximate weight;
- d. Recommended method for off-loading (e.g., forklift);
- e. Special off-loading devices (e.g., special slings);
- f. Special instructions to assure proper packaging for storage at buyer's facility;
- g. Special instructions for marking, if applicable.

Q-6 SOURCE INSPECTION/TEST (FERMCO)

Items covered by this procurement must be source inspected/tested by FERMCO. The characteristics to be inspected/tested may be shown in the documentation of Number Q-3 above. Evidence of source inspection/test shall be shown on the supplier's processing records. The supplier must notify FERMCO at least 5 working days in advance of the time the product will be ready for source inspection/test. Source inspection/test does not constitute FERMCO acceptance of the end item. "Source" refers to the supplier's plant, or any sub-tier supplier's plant, or wherever such inspection is necessary.

Q-7 SUPPLIER'S DISPOSITION REQUEST (SDR)

Request for consideration by FERMCO of any departures from drawings, specifications, or other procurement package requirements must be recorded on FERMCO's Supplier Disposition Request (SDR) form FS-F-2672. Do not ship until disposition is made by FERMCO.

Q-8 ASSEMBLY AND PARTS LISTS - TRACEABILITY

The supplier must furnish for each assembly or other end item a reproducible copy of the assembly parts list identifying each major part/component and subassembly by part number, drawing change letter/number, and serial or lot control number, as applicable. When specified, traceability (no. Q-4) and shelf life date (No. Q-14 and/or Q-15) shall also be tabulated.

Q-9 SUPPLIER DESIGN CONTROLLED PRODUCTS (CATALOG DATA)

Reproducible copies of applicable specifications, drawings, and descriptive catalog sheets must be submitted to FERMCO with the shipment under this procurement package. The supplier must not change the design in any way without changing the part number, unless authorized by FERMCO Buyer or Subcontract Administrator.

Q-10 INSPECTION/TEST DATA

All actual inspection/tests are to be submitted by the supplier to FERMCO on any suitable form. The inspection/test required may be dimensioned inspection data, functional test data, and/or nondestructive test data. In each case, the data must be correlatable to the material/items being supplied. The data must include the following information, as applicable:

- a. Part number;
- b. Drawing number/specification number;
- c. Serial numbers;
- d. Lot identification number;
- e. Heat/melt number;
- f. Subcontract/purchase order number, 000159

- g. Each characteristic inspected/tested and the inspection/test sequence;
- h. Each characteristic requirement, including drawing or specification paragraph reference;
- i. Inspection/test Results (attributes or variables data, as specified on Form FS-F).
- j. Inspection/test equipment used;
- k. Inspection/test set-up employed;
- l. Inspection/test environment;
- m. Inspector's/tester's/interpreter's name/number;
- n. Supervisor's signature.

Q-11 RADIOGRAPHY QUALITY REQUIREMENTS

Required radiographic examinations must be performed using the "double film" technique. Both films must be of the same speed and exposed in the same film holder. Each film must meet the quality requirements of the applicable specification, code, or standard. A system of identification must provide traceability of each radiograph to the specific item and to a positive location on the item to which the radiograph pertains. Radiographs of weld repairs must be sequentially identifiable for each repair. Indications revealed by radiography which exceed 50% of the allowable must be recorded on a radiographic interpretation report. Radiographic film including repair exposures and interpretation reports must be submitted to FERMCO and will become the property of FERMCO.

Q-12 CHEMICAL/PHYSICAL TEST REPORTS

The supplier must furnish:

- a. Copies of chemical reports for each heat of the raw material obtained from the original mill source of the material (Ladle analysis).
- b. Copies of physical reports for each heat of the raw material obtained from the original mill source of the raw material.
- c. Copies of chemical reports applicable to the end item and prepared from chemical analyses conducted by direct supplier or by an independent laboratory after the end item has been appropriately processed.
- d. Copies of physical test reports applicable to the end item and prepared from tests conducted by FERMCO's direct supplier or by an independent test agency after the end item has been appropriately processed.

Reports must be clearly identified with, and traceable to, the raw material and/or end item(s) submitted. They must also contain the purchase order number, the applicable specification, and the heat or lot number they represent.

Q-13 WELD JOINT TEST SPECIMENS

For each weld configuration, the supplier must prepare and furnish two typical weld joint specimens in addition to the weld qualification specimens suitable for metallurgical and physical testing, using the same material and procedures as will be used for the finished item.

Q-14 IDENTIFICATION OF SHELF-LIFE MATERIALS

The supplier must identify each item, package, or container of limited shelf-life material with its cure or manufacture date, shelf-life expiration data, storage temperature and humidity, and special handling conditions, in addition to the usual identification requirements of name, part or code number, specification number, type, size, quantity, etc. This identification, including special handling conditions, must be recorded on certifications and shipment documents for the material.

Q-15 IDENTIFICATION OF SHELF-LIFE MATERIALS INSTALLED IN AN ASSEMBLY

- a. The supplier must furnish cure date, assembly date, part name and number, compound number, and manufacturer identification (if different from part number) for parts (synthetic or natural) installed in assemblies delivered under this procurement package. This information must be identifiable with the assembly, and when applicable, with parts within the assembly to which it applies.

Q-16 SERIALIZATION

The supplier must serialize parts, components, subassemblies, and assemblies, as required by drawings, specifications, and/or procurement package. The serial numbers must be as given elsewhere in the contract. When two or more serialized parts are joined in an assembly, a list of each assembly serial number with part numbers, change letters, and component serial numbers must be submitted.

Q-17 SUPPLIER QUALITY RELEASE - FERMCO

The supplier must withhold shipment of items covered by this contract until the "Supplier Quality Release" (Form FS-F-2643) is approved by the cognizant FERMCO Quality Representative or a designee. A copy of the Release must be submitted to FERMCO.

NOTE: This release is to confirm completion of source inspection/test and does not indicate final acceptance or authority to ship material.

Q-18 SPECIAL PROCESSING CERTIFICATIONS

For each item check-marked in Requirement No. Q-2 of Form FS-F-2672, the supplier must submit a written certification stating the specification title and number used to perform the process, the applicable specification revision letters or numbers, the name of the agency which performed the processing, the date, and the signature of a responsible representative of the supplier. When parts are serialized, serial numbers must also appear on the certification.

Q-19 FERMCO-SUPPLIED ITEMS - CERTIFICATION

The supplier must submit a certification stating that the items furnished were produced using materials/items furnished by FERMCO.

Q-20 DETAILED INSPECTION/TEST PROCEDURE

The supplier must prepare, maintain, and use an inspection/test procedure. The procedure must include the following information, as applicable:

- a. Part number;
- b. Drawing and/or specification number;
- c. Subcontract or purchase order number;
- d. Each characteristic to be inspected/tested and the inspection/test sequence;
- e. The corresponding requirement for each characteristic, including drawing and/or specification paragraph references;
- f. The data to be recorded for each characteristic and the form of this data (i.e., attributes or variables);
- g. Inspection/test equipment to be used;
- h. Inspection/test setup to be used;
- i. Inspection/test environment;
- j. Special qualifications certification required of inspection/test personnel.

Q-21 CERTIFICATION OF MATERIALS TO ASME CODE

The supplier must submit a certification stating that materials are in accordance with ASME Boiler and Pressure Vessel Code, Section II, "Materials Specifications." The certification must identify each item fabricated and reference the materials used to the ASME Section material designations. Each certification must contain the signature of a responsible representative of the supplier.

Q-22 CALIBRATION PROCEDURE

The supplier shall submit a calibration procedure that demonstrates traceability to National Bureau of Standards. It shall be applicable to all inspection, test, and measuring equipment used by the supplier in conjunction with work performed under this contract.

Q-23 SUPPLIER CERTIFICATION

The supplier shall submit written certification of compliance with specifications and contractual requirements. The certification must reference the following (a. through f.):

- a. The certificate shall identify the purchased material or equipment, purchase order or subcontract number;
- b. The certificate shall identify the purchased material or equipment specification, specification changes, waivers or deviations applicable to the subject material or equipment;
- c. The certificate shall identify any procurement requirements that have not been met, together with an explanation and the means for resolving the nonconformance;
- d. The certificate shall be attested to by a person responsible for the quality assurance function;
- e. The certificate system, including the procedure to be followed in filling out a Supplier Certificate, shall be described in the supplier's quality assurance program;
- f. The supplier's quality assurance program shall provide means to verify the validity of the Supplier Certificate, such as performance of audits of the supplier or independent inspection or test of the item.

Q-24 OTHER

STANDARD ENGINEERING REQUIREMENTS

Require-
ment
No.

Engineering Requirements

E-1 ENGINEERING DRAWINGS

Engineering drawings, diagrams, plans, and specifications as required by applicable subcontract/purchase order on Form FS-F-2672, "Standard Requirements for FEMP Suppliers" must be submitted to the purchaser in accordance with schedule and for purpose indicated in applicable form. Documents required must be identified in a manner that provides positive correlation with materials, items, or services specified in this purchase contract.

E-2 CURVES AND CALCULATIONS

The supplier must provide to the purchaser:

- a. Graphs indicating characteristic curves, performance/test curves, operating curves, or corrective curves in accordance with schedule and for the purpose shown on applicable Form FS-F-2672, "Standard Requirements for FEMP Suppliers."
- b. Engineering calculations and analyses (i.e., design analysis, stress analysis, single failure analysis, and failure mode analysis) in accordance with schedule and for the purpose shown on the applicable form.

Documents described in Items a. and b. above must be identified to provide positive correlation with applicable materials, items, or services specified in this contract.

E-3 PARTS LISTS AND MANUALS

The supplier must provide to the purchaser:

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- a. Special tool list or recommended spare parts list as indicated on applicable Form FS-F-2672, "Standard Requirements for FEMP Suppliers."
- b. Manuals related to installation, maintenance, or operation of items/systems specified in this purchase contract.

E-4 OTHER

APPENDIX 2

SUBMITTAL REQUIREMENTS

Date: 03/01/96
Rev.: C RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/145/DRYER

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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

FERNALD, OHIO

Specification No. E-212-A

SELLER DRAWING AND DATA SUBMITTAL REQUIREMENTS

Prepared by:

FERMCO

Prepared By _____ Date _____

Project Engineer _____ Date _____

Engineering Manager _____ Date _____

Project Director _____ Date _____

Rev. No. By Revisions Date Checked

Approved

A	SAH	Issued for Review	6/8/93	
B	SAH	Issued for Approval	6/11/93	

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Project Spec. E-212-A
11June93
Page 1 of 4

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SELLER DRAWING AND DATA SUBMITTAL REQUIREMENTS

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SELLER DRAWING AND DATA SUBMITTAL REQUIREMENTS

1.0 SUBMITTAL INSTRUCTIONS

- 1.1 Drawings, documentation and instruction manuals shall be submitted in accordance with the requirements of this specification, the equipment specification, Seller Drawing and Data Commitment Form, and Purchase Order/Contract requirements.
- 1.2 Drawing and documentation submittals shall be accompanied by a transmittal letter. The transmittal letter shall show the following:
 - 1.2.1 Project Name .
 - 1.2.2 Project Number
 - 1.2.3 Purchase Order or Requisition Number (whichever is applicable).
 - 1.2.4 Equipment Tag Number.
 - 1.2.5 Document identification number, title, revision number, and date.
 - 1.2.6 Seller's description and quantities of items sent.
 - 1.2.7 Seller's "Master List" (see 1.5 below).
- 1.3 Drawings, technical documentation and instruction manuals shall be directed to:

<u>Mailing Address</u>	<u>Shipping Address</u>
FERMCO P.O. Box 398704 Cincinnati, Ohio 45239-8704 Att: CRU1 Document Control	FERMCO 7400 Willey Road Fernald, Ohio 45030 Att: CRU1 Document Control

- 1.4 The quantity of instruction manuals to be provided shall be as listed in FERMCO's specification and "Seller Drawing and Data Commitment Form" (Form E-212). The manuals shall be in durable covers with project identification on the front cover and spine.
- 1.5 FERMCO's requirements as shown on the "Seller Drawing and Data Commitment Form" shall be cross referenced by the Seller on a "Master List." This "Master List" shall identify all drawings and

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data that the Seller is providing and the FERMCO requirement that it satisfies. All drawings to be submitted shall be listed by drawing number, title, revision identification and date.

- 1.6 The Seller shall submit to FERMCO all drawings and data on or before the date specified and as mutually agreed upon on the "Seller Drawing and Data Commitment Form." If Seller is unable to meet the required submittal date, Seller must notify FERMCO at least 15 working days (3 weeks) in advance and commit to a new submittal date to the satisfaction of FERMCO.
- 1.7 Large drawings/data shall be rolled and sent in mailing tubes. Drawing size of 30" x 42" are preferred. The minimum acceptable drawing size is 24" x 36". A copy of the transmittal letter shall be included inside the tube.

Certified for Construction (CFC) and As-Built drawings shall be supplied as dry erasable Mylars (30" x 42") unless otherwise stated in the specification or approved by FERMCO. Drawing reproducibles shall not be folded. In addition, CFC and As-Built drawings shall be on floppy disc in Intergraph CAD format.

- 1.8 Documents submitted to FERMCO will be reviewed for completeness and compliance with requirements of Section 1.1 above. Drawings, data sheets, manuals and other documents supplied will be returned for corrections if information thereon is incomplete, incorrect or of unacceptable quality.

All documents submitted to FERMCO will be returned to the Seller marked as follows:

<u>Instruction</u>	<u>Definition</u>
A	Proceed
B	Proceed with fabrication. Change drawings/data as noted and resubmit.
C	Do not proceed. Change drawings/data as noted and resubmit.
IO	Information Only

For all documents that receive an "A" or "IO" authorization, a copy of the transmittal will be mailed or FAXed to show the authorization. Copies of the documents will not be attached. Seller shall then stamp the documents "Certified for Construction" and re-send them to FERMCO (see 1.7 above).

All documents returned with "B" or "C" instruction shall be

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resubmitted by the Seller with corrections as requested on the document. In the event of disagreement, the Seller shall contact FERMCO immediately to resolve differences. Acceptance of changes shall not relieve Seller of any contractual obligations to FERMCO. Once the documents are resubmitted by the Seller and approved by FERMCO, the Seller shall stamp the documents "Certified For Construction" and re-send them to FERMCO (see 1.7 above).

To accelerate flow of information, major comments on drawings and data submitted may be confirmed by telex in addition to returning marked-up copies to the Seller.

1.9 Unless otherwise specified in writing by FERMCO, all documents returned to Seller with comments must be resubmitted to FERMCO within ten (10) working days after receipt by Seller.

1.10 Seller as-built drawings shall be stamped "Final As-Built Drawing" and submitted to FERMCO (see 1.7 above).

2.0 DOCUMENT QUALITY REQUIREMENTS

All submittals of documentation shall meet the following quality requirements and be suitable for microfilm reproduction.

- 2.1 Legibility and contrast of the documents shall be such that every line, number, letter and character shall be clearly legible.
- 2.2 Reproductive quality shall be of such clarity that a third generation copy will meet the legibility requirements of Item 2.1.
- 2.3 Documentation shall be typed and arranged in a neat professional manner.
- 2.4 Documents, when applicable, shall contain a table of contents, list of figures, and tables of applicable, reference or complementary documents.

END OF SPECIFICATION

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DATE:

SPECIFICATION NO. _____ DATE: _____ REQ NO. _____ DATE: _____

EQUIPMENT TAG NUMBER(S) _____ SERVICE _____

SELLER _____ SELLER'S JOB NO. _____

INSTRUCTIONS:

1. All drawings/data submitted shall be marked with PURCHASE ORDER (PO) NUMBER or REQUISITION NUMBER (whichever is applicable) and EQUIPMENT TAG NUMBER(S).
2. Identical items may be represented on common drawing with all EQUIPMENT TAG NUMBERS clearly shown.
3. All drawings/data submitted shall be of good quality that will allow production of legible copies and microfilming.
4. FERMCO will specify in Column I the QUANTITY.
5. The SELLER enters in Column IV the PROMISED SUBMITTAL time (in weeks) After Receipt of Order (ARO). SELLER shall state if required items are being included with proposal submittal. FERMCO will assign priorities in Column III to drawings/data (HIGHEST PRIORITY = LOWEST number). SELLER shall return this form to FERMCO with its proposal. The SELLER'S signature is required.
6. The DUE DATE (Column V) will be entered by FERMCO at the time the PO is issued. The DUE DATE shall be based upon the promised submittal time furnished by the SELLER (Column IV). Upon receipt of the PO, the SELLER shall provide FERMCO the drawings and data as specified.

DRAWINGS/DATA REQUIRED BY FERMCO

I	II	III	IV	V
QTY	DESCRIPTION	PRIORITY	SELLER PROMISED SUBMITTAL (WEEKS)	DATE DUE TO FERMCO
2	Visual Examination Procedure	2		
2	Weld Procedure & Procedure Qualification	3		
2	Welder Performance Personnel Certification	3		
2	Integrated Manufacturing Inspection/Test Plan	2		
2	Inspection/Test Data	5		
2	Supplier Quality Assurance Release	5		
2	Detailed Inspection/Test Procedure	3		
2	Supplier Certification	4		
1	Schematics	1		
1	Block Diagram (Outline Arrangement Drawing)	1		
4	Piping Plan	2		
4	Piping Elevation	2		
4	Foundation Plan	2		

CERTIFIED BY: _____ COMPANY: _____ DATE: _____

SELLER DRAWING AND DATA COMMITMENT FORM

FERMCO

DATE: _____
 SPECIFICATION NO. _____ DATE: _____ REQ NO. _____ DATE: _____
 EQUIPMENT TAG NUMBER(S) _____ SERVICE _____
 SELLER _____ SELLER'S JOB NO. _____

DRAWINGS/DATA REQUIRED BY FERMCO

I	II	III	IV	V
QTY	DESCRIPTION	PRIORITY	SELLER PROMISED SUBMITTAL (WEEKS)	DATE DUE TO FERMCO
4	Elevation Drawing/Outline Drawing	2/1		
4	General Arrangement Drawing/Outline Drawing	2/1		
4	Structural Detail Drawing	2		
4	Assembly Drawing	2		
4	Interface Drawings	2		
4	Flow Diagrams (P&ID)	2		
4	Panel Cutout Drawings	2		
4	Weld Map	2		
2	CFC and As-Built Drawings (Mylar)	5		
1	Weight of Unit	1		
1	Descriptive Data	1		
4	Connection Drawing	2		
4	Characteristic Curves	4		
4	Performance Curves	4		
4	Test Result Curves	4		
4	Calibration Curves	4		
4	Operating Curves	4		
4	Failure Mode Analysis	2		
4	Special Tool List	4		
4	Spare Parts List - Priced	5		
8	Installation Manual	4		
8	Maintenance Manual	4		
8	Operating Manual	4		
4	Specifications (Conforming)	2		

CERTIFIED BY: _____ COMPANY: _____ DATE: _____

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APPENDIX 3
DATA SHEETS

Date: 03/01/96
Rev.: C RE: CT

WBS No.: 1.1.1.1.1.1.1
ERA/WPRAP/145/DRYER

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R	NO.	DATE	BY	CK	APP	DESCRIPTION	R	NO.	DATE	BY	CK	APP	DESCRIPTION
E							E						
V							V						
S							S						

DESIGN OPERATING CONDITIONS

Elevation ASL _____ Installation Indoors Outdoors Ambient Temp Min _____ °F Max _____ °F

Application _____

Gas Temp Design _____ °F Min _____ °F Max _____ °F Vol _____ cfm Static Pressure _____ in. WG(1)

Fan Inlet Density _____ lb/cu ft. Design Outlet Vel _____ fpm (± 10%) Allow Noise Level _____ db(2)

Service Continuous Intermittent Environment Rel Clean Dusty Corrosive Other _____

FAN PHYSICAL DATA

Rotation CW CCW Inlet Single Double Discharge Single Width Double Width

Arrangement _____

Drive Direct V-Belt (3)(4)(5) Other _____ Motor (6) Position _____

CONSTRUCTION AND ACCESSORIES

Fan Housing - Standard Other _____ Bearings(8) Pillow Block Roller Sleeve Ball

Connection - Inlet Flanged Slip-on Split Housings Solid Housings

Disch Flanged Slip-on Grease Lube Oil Lube Other _____

Drain Flanged Thd Pipe Cplg Discharge Damper - Opposed Blade Req Yes No

Access Door Bolted Plate Quick Release Parallel Blade Req Yes No

Wheel(7) Type Backward Incl Forward Curved Vaned Inlet Damper Required Yes No

Other _____ Drive Direct Rigid Coupling Direct Coupling

Const Standard Other _____ V-Belt Fixed Adjustable(4)

Spark Resistant Req'd Yes No Guard(5) Required Yes No

Type A B C Vibration - Isolators Required Yes No

Shaft Standard Other _____ Isolation Base Required Yes No

Seal Required Yes No Painting - Mfr Standard Yes No

Heat Slinger Required Yes No Other _____

Insulation Clips Required Yes No Motor and Drive Weather Cover Required Yes No

Screen Req'd - Inlet Yes No Outlet Yes No

(1) At Design Temperature and Elevation.

(2) Performance ratings shall be based on tests made in accordance with the latest AMCA codes.

(3) V-belt drive shall have a minimum of two belts and shall be rated 2.5 times rated motor horsepower.

(4) Adjustable V-belt drive shall be adjustable 10% above and 10% below design fan rpm.

(5) V-Belt Drive guard shall have a 3-inch diameter tachometer test hole at drive and driven shafts.

(6) Refer to Standard Motor Specifications for motor characteristics.

(7) Wheel and shaft shall be statically and dynamically balanced as a unit.

(8) Bearings shall be self-aligning. Grease fittings shall be of the extended hydraulic type.

*** TO BE COMPLETED BY VENDOR ***

Fan Mfr _____ Model _____ Size _____ Class _____

Fan rpm @ Design Conditions _____ Mfr Max _____ Sound (re: 10⁻² W) Pressure (db re: 0.0002 Microbar)

Brake hp @ Design Conditions _____ Min Temp _____ Band 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 _____ 8 _____

@10% Above Design rpm _____ Weights Fan Wheel _____ lb Shaft _____ lb

Motor hp _____ No. Drive Belts _____ hp/Belt _____ Fan Excluding Motor and Drive _____ lb

Design Outlet Velocity _____ fpm Tip Speed _____ fpm Fan Including Motor and Drive _____ lb

WR² _____ lb ft² Blade Frequency _____ Hz Housing Material _____ Thickness _____ in

Does the proposed equipment meet all requirements as specified on this Data Sheet? Yes No

If not, have all deviations been identified and alternates proposed? Yes No

Notes: _____

_____ Tag No. _____

DATA SHEET PARSONS	CENTRIFUGAL FAN	Sheet of	Job Number
		Document Number	Rev

~~DATA SHEET~~
INDIRECT ROTARY DRYER

SELLER to fill in information marked with a "*."

A. Dryer Section Duty Requirements

1. Feed Rate, maximum required (lbs/hr) 44,000
2. Product Moisture Content, design (%DB) 10
3. Water to be Evaporated, maximum required (lbs/hr) 8,400
4. Feed Composition See Appendix 5, Sections 5.1 and 5.2
5. Feed Screen Analysis See Appendix 5, Section 5.3
6. Feed General Nature (Yes/No)

a. Sticky	Yes <u>x</u>	No <u> </u>
b. Plastic	Yes <u>x</u>	No <u> </u>
c. Abrasive	Yes <u>x</u>	No <u> </u>
d. Corrosive	Yes <u>x</u>	No <u> </u>
7. Feed Temperature Ambient
8. Dried Product Temperature Average °F 200 - 270
9. Dryer Process Off-Gas

a. Flow (SCFM)	*	<u> </u>
b. Temperature (°F)	*	<u> </u>
c. Sweep/air (cocurrent)	Yes <u>x</u>	No <u> </u>
1) Inlet Flow SCFM	*	<u> </u>
Temp °F	*	<u> </u>
2) Outlet Flow SCFM	*	<u> </u>
Temp °F	*	<u> </u>
10. Thermal Conditions

a. Dryer		
1) Rated Thermal Transfer Capacity (Btu/Hr)	*	<u> </u>
2) Heat Transfer coefficient Btu/ft ² (heated shell)/hr/°F	*	<u> </u>
3) Water evaporation (max.) lbs/hr	*	<u> </u>
b. Furnace		
1) Furnace rated capacity (max)	*	<u> </u>
2) Heat load, btu/ft ³ (furnace)/hr		<u> </u>
c. System Overall Heat Efficiency %		<u> </u>

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WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/145/DRYER

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B. Design Data

1. Dryer

a. Shell

- 1) Length-Inside diameter (ft-in) * _____
- 2) Length-Heated section (ft-in) * _____
- 3) Number of support stations * _____
- 4) Length-Cantilevered section
 - (a) @ feed end (ft-in) * _____
 - (b) @ discharge end (ft-in) * _____
- 5) Length-Overall (ft-in) * _____

b. Shell wall thickness:

- | | <u>(ft-in)</u> | <u>Material of Construction</u> |
|----------------------------|----------------|---------------------------------|
| 1) Main Cylinder | * _____* | _____ |
| 2) Under riding ring | * _____* | _____ |
| 3) Height feed spirals | _____ | _____ |
| 4) Height flow disturbers | _____ | _____ |
| 5) Weight (lbs) | | |
| (a) Steel shell only | | * _____ |
| (b) Complete w/gear, rings | | * _____ |

c. Material of construction

- 1) Shell * _____

d. Drive assembly²

- 1) Gear ratio * _____
- 2) Mechanical efficiency (%) _____
- 3) Manufacturer _____
- 4) HP rating * _____
- 5) AGMA service factor * _____
- 6) Center distance (ft-in) * _____
- 7) Shell (installed) centerline tolerance (in.) _____

- | | <u>GIRTH GEAR</u> | <u>PINION GEAR</u> |
|---------------------------|-------------------|--------------------|
| 8) Lubrication: Type* | _____ | _____ |
| Reservoir capacity (gal.) | _____ | _____ |
| 9) Enclosure: Type* | _____ | Size (ft-in) _____ |
| Wall thk. (in.) | _____ | Material* _____ |
| 10) Seal: Type* | _____ | Material* _____ |

e. Gear reducer:

- 1) Overall reduction ratio * _____
- 2) Mechanical efficiency (%) _____
- 3) Manufacturer _____
- 4) HP rating * _____

² Attach description and component data sheet if any other type of drive assembly is proposed by the SELLER.

- b. Connections Outline Dimensions (ft-in)
 - 1) Feeder (rect. flange) _____
 - 2) Water lines _____
 - 3) Sight port _____
 - 4) Camera port _____
 - 5) Pressure tap _____
 - 6) Sweep air inlets _____

- 4. Dryer discharge head:
 - a. Connections Outline Dimension (ft-in)
 - 1) Connection to shell _____
 - 2) Process off-gas _____
 - 3) Product outlet _____
 - 4) Manway _____
 - 5) Camera port _____
 - 6) Sight port _____
 - 7) Thermocouples _____
 - 8) Grab Sampler _____

- 5. Dryer seal:
 - a. Manufacturer * _____
 - b. Type * _____
 - c. General Description * _____
 - d. Material:
 - 1) Seal * _____
 - 2) Body * _____
 - 3) Rub Ring* _____
 - 4) Springs* _____
 - e. No. of Springs _____ Load Per Spring. lbs _____
 - f. Start-up Torque Due To Seal Drag, lb-ft _____
 - g. Running Torque Due To Seal Drag, lb-ft _____
 - h. Seal Design Pressure Differential, in. WC* _____
 - i. Approx. Air inleakage per seal:
 - @ 0.5 in. WC pres. diff., scfm * _____
 - @ 2.0 in. WC pres. diff., scfm * _____
 - j. Operating Speed Range, rpm _____
 - k. Expected Working Life of Seal Material, mos. _____
 - l. Approx. Time req'd to Remove & Replace Seal, man hrs. _____
 - m. NOTES: _____

C. Furnace

1. Number of zones * _____
2. Number of burners/zone * _____
(see burner data sheet)
3. Shell material of construction* _____
4. Dimensions:
 - a. Inside diameter (hot face) * _____
 - b. Refractory inside diameter * _____
 - c. Shell thickness * _____
5. Design
 - a. Shell split vertically* Yes _____ No _____
 - b. Shell split horizontally* Yes _____ No _____
 - c. Shell section horizontal length (ft-in) _____
 - d. Number of sections * _____
 - e. Overall furnace inside length (ft-in) * _____
 - f. Overall furnace outside length (ft-in) * _____
 - g. Total height (ft-in) _____
 - h. Sections are flanged* Yes _____ No _____
 - i. Refractories:
 - 1) Refractory brick
Type * _____
Thick (in.) _____
 - 2) Ceramic fiber
Type * _____
Thick (in.) _____
 - 3) Insulation
(a) Fiberboard * _____
(b) Type * _____
(c) Thick (in.)* _____
 - j. Brick/ceramic fiber properties
 - 1) Chemical composition _____
 - 2) Bulk density _____
 - 3) Cold crushing strength _____
 - 4) Modulus of rupture _____
 - 5) Thermal expansion _____
 - 6) Porosity _____
 - 7) Thermal conductivity _____
 - 8) Thermal shock membranes _____
 - 9) Specific heat _____

DATA SHEET
BURNERS

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Item No. * _____

Quantity * _____

Manufacturer * _____

Manufacturer's Model No. * _____

Type Fuel (see Article 2.2,
Paragraph C, Subparagraph 1.r) _____
Natural Gas

Max. Rated Output, btu/hr * _____

Turndown Ratio * _____

Size: (Attach Catalog Cut)

Fuel Inlet, in. * _____

Comb. Air (primary) Inlet, in. _____

Pilot Air Inlet, in. _____

Pilot Gas Inlet, in. _____

Comb. Air (secondary) Inlet, in. _____

Fuel Nozzle Orifice, in. _____

Supply pressures: psi

Fuel maximum* _____ minimum* _____

Comb. Air (primary) maximum* _____ minimum* _____

Comb. Air (secondary) maximum _____ minimum _____

Atomizing Fluid maximum _____ minimum _____

Pilot Gas * _____

Fluid flow Rates: lbs/hr

Fuel maximum* _____ minimum* _____

Comb. Air (primary) maximum* _____ minimum* _____

Comb. Air (secondary) maximum* _____ minimum* _____

Pilot Gas * _____

Length of Flame, in. maximum* _____ minimum* _____

Scanner: No. per burner * _____

Type _____

Materials:

Body * _____

Nozzle * _____

Tiles * _____

APPENDIX 4

DRAWINGS AND SKETCHES

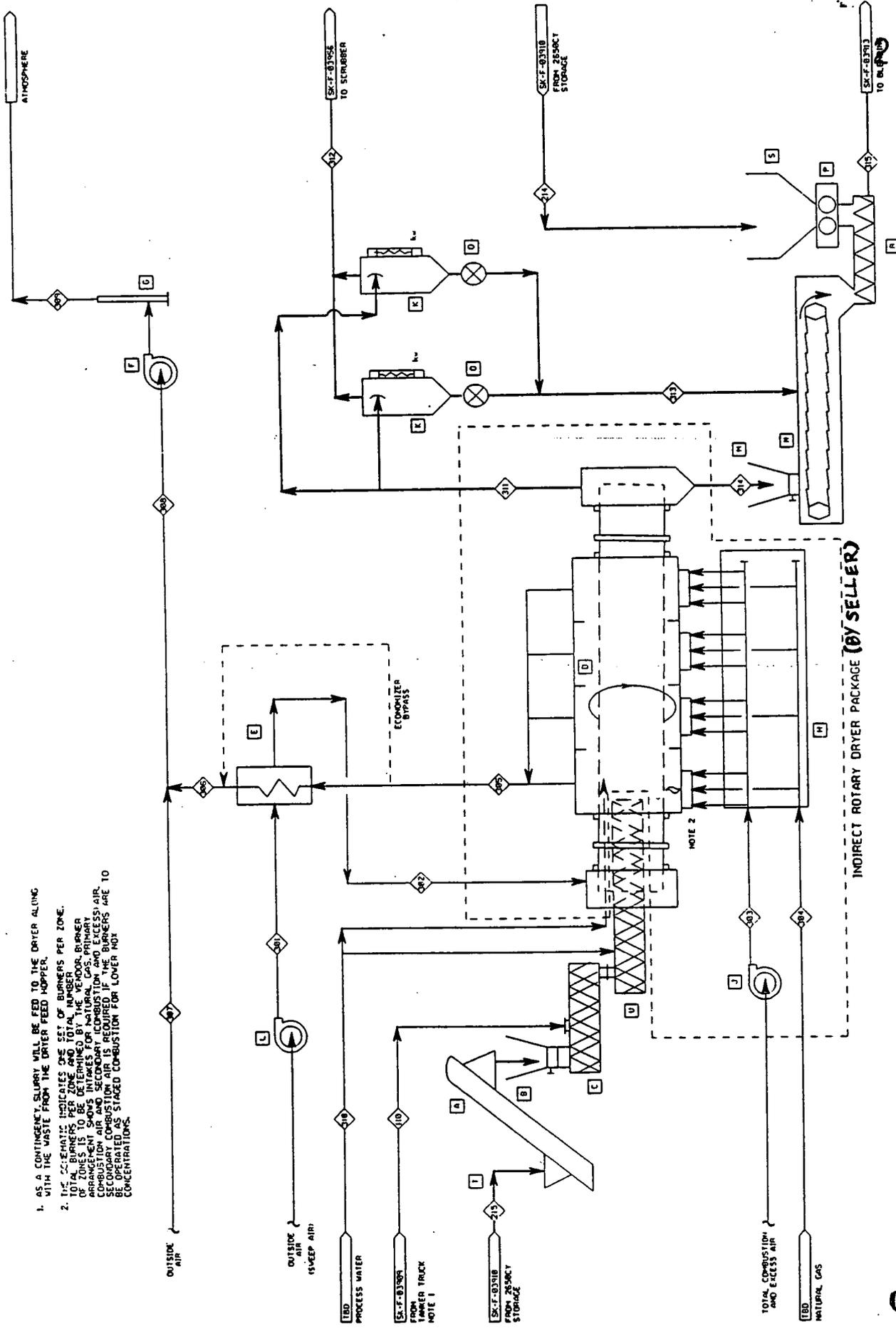
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ERA/WPRAP/145/DRYER

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1. AS A CONTINGENCY, SLURRY WILL BE FED TO THE DRYER ALONG WITH THE WASTE FROM THE DRYER FEED HOPPER.
2. THE SCHEMATIC INDICATES ONE SET OF BURNERS PER ZONE. TOTAL BURNERS PER ZONE AND TOTAL NUMBER OF ZONES IS TO BE DETERMINED BY THE FUEL BURNER ARRANGEMENT AND PRIMARY FUEL GAS. PRIMARY, SECONDARY AIR AND SECONDARY COMBUSTION AND EXCESS AIR. SECONDARY COMBUSTION AIR IS REQUIRED IF THE BURNERS ARE TO BE OPERATED AS STAGED COMBUSTION FOR LOWER NOX CONCENTRATIONS.

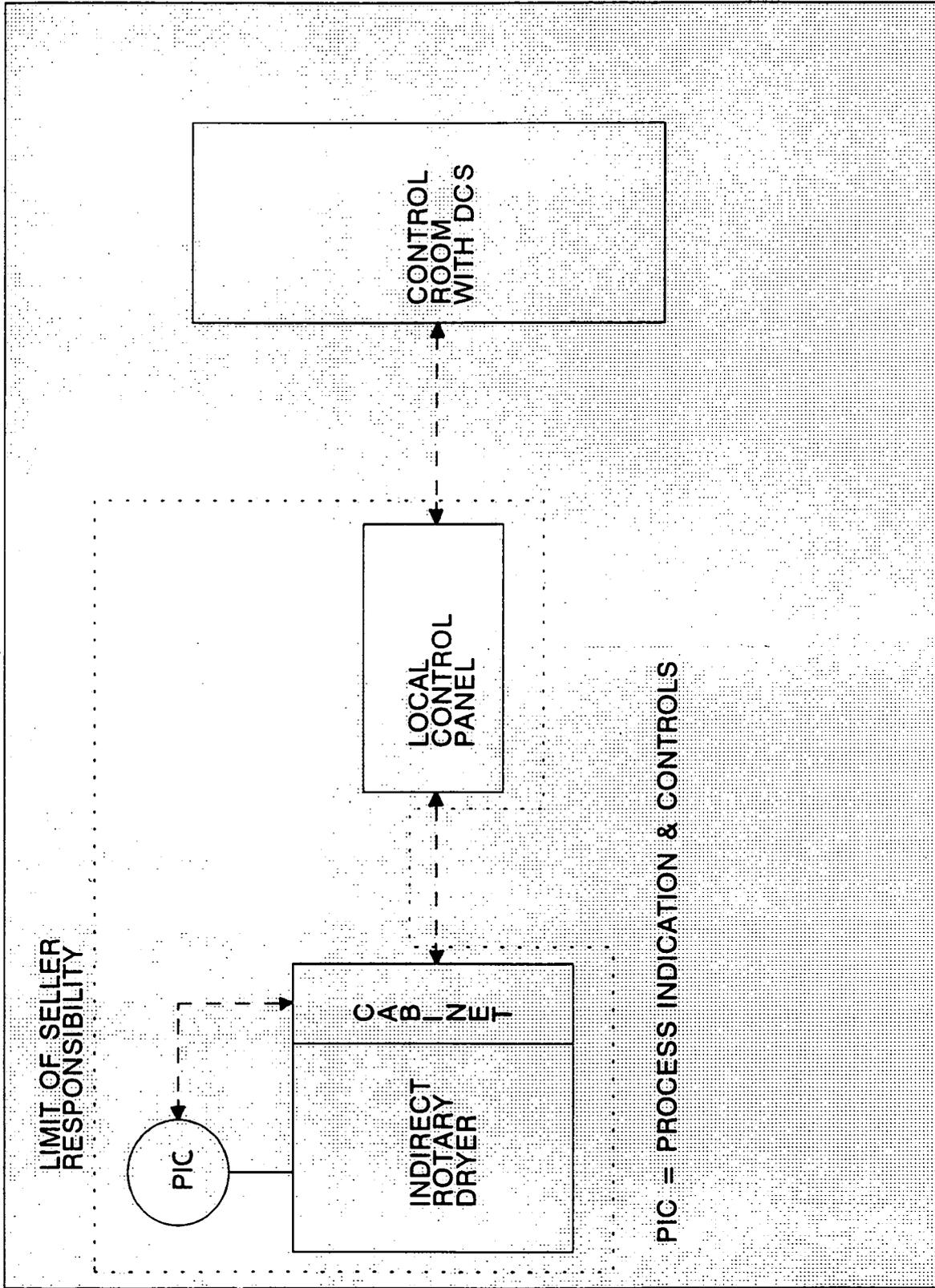


WBS No.: 1.1.1.1.1.3.3
 ERA/WPRAP/145/DRYERO

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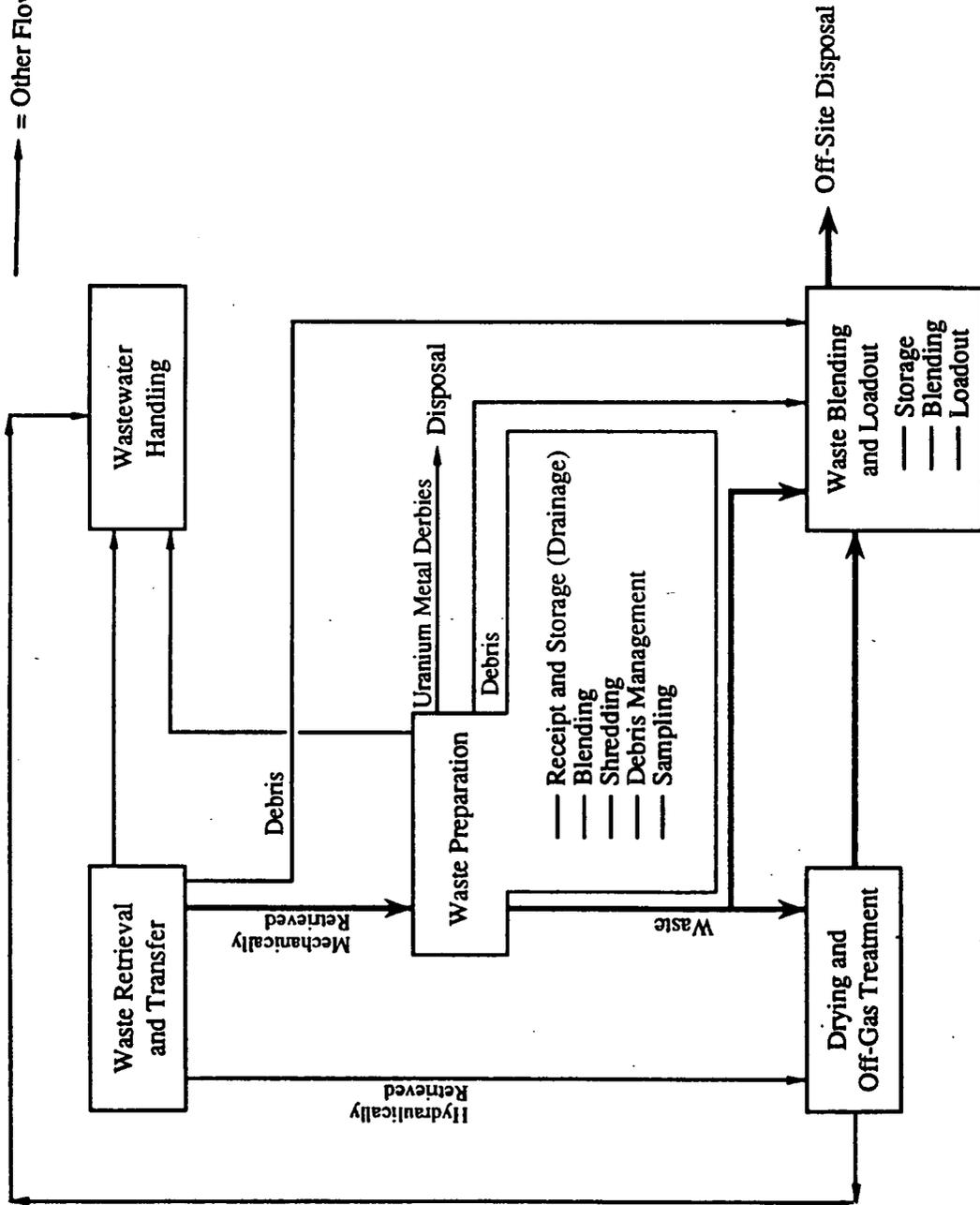
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→ = Main Flows

→ = Other Flows



Overall Process Block Flow Diagram

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ERA/WPRAP/145/DRYER

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Date: 03/01/96
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APPENDIX 5

SUPPORTING INFORMATION

Date: 03/01/96
Rev.: C RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/145/DRYER 000183

~~SECRET~~

5.1 Background

Bench- and pilot-scale drying tests were performed using surrogate materials. Refer to the *Report on Execution of Surrogate Waste Drying Tests*. Purchase requisitions for each surrogate chemical are attached to this appendix for ease in determining physical and chemical properties of the final surrogate formulation. The pilot-scale drying tests were performed in batch and continuous, indirect and direct rotary dryers. The following actual pit waste data are for information only, and can be used for selection of materials of construction and weight loading for the rotary dryer shell.

The feed to the dryer will consist of the contents from eight separate waste pits (Pits 1 through 6, the Burn Pit, and Clearwell). These pits contain secondary processing wastes resulting from a uranium processing facility. Consequently, the feed will cover a broad range of characteristics. The majority of feed material is composed of general sump sludge, neutralized raffinate, and magnesium fluoride.

The general sump sludge consists of 1) filtrates from various processing plants, 2) wastewater from the laboratory, and 3) general decontamination and cleanup water that was neutralized with lime. Raffinate from the solvent extraction operation was neutralized and sent to the pits. The magnesium fluoride in the pits was produced by the reduction of uranium tetrafluoride to uranium metal using magnesium metal. Some of the resulting magnesium fluoride slag was reprocessed to recover uranium. The insoluble materials left over after the acid digestion recovery process were filtered out, reslurried, mixed with lime, and pumped to the pits.

Other wastes known to have been deposited in the pits include:

- 1) Contaminated asbestos materials
- 2) Contaminated rags, paper, and polyethylene
- 3) Dust collector bags
- 4) Scrap salts
- 5) Uranium and thorium tetrafluoride
- 6) Contaminated soil, rocks, sand, brick, and ceramics
- 7) Dust collector residues
- 8) UO₃ and U₃O₈
- 9) Miscellaneous sludges

- 10) Uranium chips and turnings
- 11) Water softening and treatment sludges
- 12) Graphite crucibles and molds
- 13) Ash from burning or incineration (pallets, paper, graphite, oils)
- 14) Flyash from coal-fired boiler
- 15) Steel drums

(Note that all dryer feed will be processed to size reduce items so they do not exceed 4 inches in any dimension.)

Samples of the pit wastes have been characterized by several organizations. They classified the wastes based on the Unified Soil Classification System (USCS). Subsequent test work has focused on four major classifications: nonplastic (NP-Type 1), low-plasticity silt (ML-Type 2), high-plasticity silt (MH-Type 3), and low-plasticity clay (CL-Type 4).

5.2 Pit Waste Composition

The composition of the pit wastes was developed from several data sources. To be conservative, for data reported in more than one source, the highest data point was used. Some inorganic data reported cations only. The cations were assumed to combine with oxygen or other anions to form chemical components. The selection of chemical components was based on historical knowledge of the process and in-house experience. The results are shown in Table A. For all the pits, the total weight of each element/substance was preserved. With the chemical components determined, appropriate adjustments to the values of the cations were made to account for the added elements, and a total weight of all the components was determined. Finally, the weight of each component was divided by the total weight to normalize the data and provide a weight fraction value for each component. Note that the organic content is very small. Pit 2 has the highest organic content with less than 0.4 percent. Consequently, the organic content does not affect the drying characteristics of the pit wastes.

5.3 Size Distribution

The particle size distribution is reported in Figures 5-1 through 5-8. The data are presented as weight fractions in four size classifications: 1) gravel, 2) sand, 3) fines, and 4) clay-sized. The gravel fraction is material greater than 4 mesh, the sand fraction ranges from 200 mesh to 4 mesh, and the "fines" fraction is less than 200 mesh (note that this fraction includes the clay-sized material).

In general, the bulk of the feed is very fine (less than 200 mesh). Note that all feed must be less than 4 inches in any dimension so any debris from the pits will be size reduced prior to being fed to the dryer.

5.4 Moisture Content

The moisture contents of the actual pit wastes vary from 10 percent to over 600 percent (all moisture contents expressed on a dry basis = [lb water/lb dry solids] x 100 percent). However, the pit materials will be pre-processed by FERMC0 to provide feed to the dryer with a specified moisture content ranging from 17 to 150 percent.

5.5 Bulk Density

The solid specific gravities of the feed range from 2.50 to 3.25. Bulk (slurry) densities calculated at the maximum and minimum moisture contents of the pre-processed feed assuming an average solid specific gravity of 2.9, range from 84 to 140 lb/ft³, respectively.

5.6 Off-Gas Composition

The following off-gas concentrations were estimated from the preliminary design of the indirect rotary dryer as described in this specification. They assume a water vapor load of 80 mol%, with the balance being air and gases. The maximum concentrations shown reflect assumed decomposition products of actual pit waste components. The main constituent of concern is the 4,700 ppm of HF gas. With the introduction of ambient leak-in air, especially at the discharge end after all vapors have been collected, there is a potential for some condensation to occur. This shall be taken into

consideration for design of the dryer controls, operating philosophy, and the materials of construction.

Maximum Concentration Conditions

NO₂ - 15,450 ppm

CO₂ - 7,365 ppm

HF - 4,700 ppm

NH₃ - 2,850 ppm

Temperature (°F, max/design): 350/270

Volume (acfm, min-max): 1,400 - 5,850

Particle Size Distribution in Off-Gas:

Finest Distribution	
% finer	size (microns)
100	100
83	50
63	20
47	10
33	6
17	3
6	1

Coarsest Distribution	
% finer	size (microns)
100	100
83	70
67	40
50	25
33	12
25	9
17	5
8	2.5
2	1

TABLE A

**DERIVED FROM REMEDIAL INVESTIGATION REPORT FOR OU1,
FINAL
US DOE, AUGUST 1994**

Date: 03/01/96
Rev.: C RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/145/DRYER

~~000188~~

Table A - Pit Waste Composition

Component	Normalized Weight Fraction (of Total Organics)							Burn Pit	Clearwell
	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6			
Organics									
1,4-Dioxane	7.49E-02	0.00E+00							
2,4-Dichlorophenol	0.00E+00	0.00E+00	0.00E+00	1.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,4-Dinitrophenol	0.00E+00	0.00E+00	0.00E+00	5.55E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,6-Dinitrotoluene	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2-Butanone	4.56E-02	0.00E+00	8.67E-02	0.00E+00	0.00E+00	5.53E-02	0.00E+00	0.00E+00	0.00E+00
4,4-DDT	1.92E-02	6.69E-04	0.00E+00						
4-Chloro-3-Methylphenol	0.00E+00	0.00E+00	0.00E+00	1.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acenaphthene	0.00E+00	2.05E-02	0.00E+00						
Acenaphthylene	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acetone	0.00E+00	0.00E+00	2.89E-02	0.00E+00	2.82E-01	0.00E+00	0.00E+00	5.72E-02	0.00E+00
Anthracene	0.00E+00	5.73E-02	2.41E-02	1.67E-02	0.00E+00	0.00E+00	2.66E-02	4.00E-02	0.00E+00
AROCLOR 1221	7.20E-02	0.00E+00							
AROCLOR 1248	1.20E-01	0.00E+00	1.16E-01	3.79E-02	1.39E-01	0.00E+00	0.00E+00	9.44E-03	0.00E+00
AROCLOR 1254	1.56E-01	0.00E+00	8.19E-02	3.43E-02	2.78E-01	1.86E-02	6.60E-02	2.11E-02	0.00E+00
AROCLOR 1260	9.36E-02	0.00E+00							
Benzo(a)Anthracene	0.00E+00	6.21E-02	2.41E-02	2.37E-02	0.00E+00	0.00E+00	5.40E-02	4.00E-02	0.00E+00
Benzo(a)Pyrene	0.00E+00	5.73E-02	2.41E-02	2.42E-02	0.00E+00	0.00E+00	3.34E-02	4.00E-02	0.00E+00
Benzo(b)Fluoranthene	0.00E+00	6.21E-02	2.41E-02	2.93E-02	0.00E+00	0.00E+00	8.22E-02	4.00E-02	0.00E+00
Benzo(g,h,i)Perylene	0.00E+00	2.01E-02	2.41E-02	1.16E-02	0.00E+00	0.00E+00	2.48E-02	4.00E-02	0.00E+00
Benzo(k)Fluoranthene	0.00E+00	3.58E-02	0.00E+00	1.87E-02	0.00E+00	0.00E+00	4.28E-02	4.00E-02	0.00E+00
Benzoic Acid	5.28E-02	0.00E+00	1.18E-01	2.22E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bis(2-Ethylhexyl)Phthalate	2.16E-02	0.00E+00	2.65E-02	1.36E-02	1.03E-01	2.65E-02	8.31E-02	1.92E-02	0.00E+00
Chlorobenzene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.85E-05	0.00E+00	0.00E+00
Chloroform	7.80E-03	0.00E+00	0.00E+00	6.56E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chrysene	0.00E+00	4.78E-02	2.41E-02	2.27E-02	0.00E+00	0.00E+00	6.00E-02	4.00E-02	0.00E+00
Di-n-Butylphthalate	0.00E+00	0.00E+00	2.41E-02	1.16E-02	8.51E-02	0.00E+00	0.00E+00	4.86E-02	0.00E+00
Dibenzofuran	0.00E+00	1.72E-02	0.00E+00						
Diethylphthalate	0.00E+00	0.00E+00	1.04E-01	1.16E-02	0.00E+00	0.00E+00	4.28E-02	4.00E-02	0.00E+00
Fluoranthene	0.00E+00	2.34E-01	2.41E-02	9.08E-02	0.00E+00	0.00E+00	1.37E-01	8.87E-02	0.00E+00
Fluorene	0.00E+00	2.96E-02	0.00E+00	1.72E-02	0.00E+00	0.00E+00	1.46E-02	4.00E-02	0.00E+00
Indeno(1,2,3-cd)Pyrene	0.00E+00	2.20E-02	2.41E-02	1.16E-02	0.00E+00	0.00E+00	1.88E-02	4.00E-02	0.00E+00
Isophorone	0.00E+00	0.00E+00	2.27E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene Chloride	0.00E+00	0.00E+00	1.01E-02	1.11E-02	2.82E-02	2.85E-02	0.00E+00	2.86E-02	0.00E+00
N-Nitroso-di-n-Propylamine	0.00E+00	0.00E+00	2.27E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Naphthalene	0.00E+00	1.10E-02	0.00E+00	1.36E-02	0.00E+00	0.00E+00	4.28E-02	0.00E+00	0.00E+00
Pentachlorophenol	0.00E+00	6.69E-03	6.99E-02	0.00E+00	0.00E+00	0.00E+00	2.23E-02	0.00E+00	0.00E+00
Phenanthrene	2.88E-02	1.77E-01	2.41E-02	8.07E-02	0.00E+00	0.00E+00	1.29E-01	6.01E-02	0.00E+00
Pyrene	0.00E+00	1.19E-01	2.41E-02	4.54E-02	0.00E+00	0.00E+00	1.20E-01	4.00E-02	0.00E+00
Tetrachloroethene	7.80E-03	2.15E-05	0.00E+00	2.67E-03	0.00E+00	8.44E-01	0.00E+00	0.00E+00	0.00E+00
Tributyl Phosphate	3.00E-01	1.86E-02	0.00E+00	3.63E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Vinyl Chloride	0.00E+00	9.08E-04	0.00E+00	8.07E-05	0.00E+00	0.00E+00	1.29E-04	0.00E+00	0.00E+00
Phenol	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methyl Butyrate	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E-04	0.00E+00	0.00E+00	0.00E+00
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.71E-02	0.00E+00	0.00E+00	0.00E+00
Toluene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AROCLOR 1242	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.44E-03	0.00E+00
2,4,5-Trichlorophenol	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E-01	0.00E+00

Date: 03/01/96
Rev.: C RE: CT

Appendix 5
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WIS No.: 1.1.1.1.1.3.1
ERA/WPRAP/145/DRYER

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Table A - Pit Waste Composition (Continued)

Component	Normalized Weight Fraction (of Total Inorganics)							
	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6	Burn Pit	Clearwell
Inorganics								
NH4HCO3	0.00E+00	0.00E+00	0.00E+00	2.35E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NH4NO3	2.42E-04	1.99E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Al2O3	4.09E-02	7.68E-02	1.18E-01	4.35E-02	3.88E-02	4.17E-02	4.52E-02	7.76E-02
SbO2	1.65E-04	2.71E-04	1.51E-04	3.32E-04	1.08E-04	0.00E+00	3.09E-04	6.97E-05
As2O3	2.12E-05	9.83E-04	4.80E-02	1.85E-05	4.92E-03	4.68E-05	1.04E-04	4.10E-05
BaCl2	4.09E-04	2.93E-03	1.22E-03	3.82E-04	4.27E-02	3.85E-04	1.29E-03	1.04E-02
BaO2	0.00E+00	0.00E+00	0.00E+00	1.74E-02	0.00E+00	0.00E+00	1.61E-02	0.00E+00
BaSO4	4.00E-04	2.87E-03	2.28E-02	0.00E+00	4.18E-02	3.77E-04	8.39E-04	1.01E-02
BeO	3.73E-05	1.31E-04	6.52E-05	3.03E-04	6.66E-05	7.38E-05	8.93E-05	4.36E-05
CdO	5.67E-06	6.44E-06	1.08E-05	8.56E-05	6.47E-06	7.60E-06	8.04E-05	3.55E-06
CdSO4	2.76E-05	3.14E-05	5.26E-05	0.00E+00	3.15E-05	3.70E-05	0.00E+00	1.73E-05
CaCl2	0.00E+00	0.00E+00	3.01E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca(OH)2	3.32E-01	3.09E-02	3.06E-01	2.44E-01	4.32E-01	1.63E-01	4.31E-01	4.96E-01
Ca3(PO4)2	0.00E+00	1.77E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CaF2	4.12E-02	0.00E+00	0.00E+00	0.00E+00	5.35E-02	2.02E-02	0.00E+00	6.16E-02
Ca(NO3)2	4.33E-02	3.75E-03	3.81E-02	0.00E+00	3.50E-02	1.32E-02	0.00E+00	4.03E-02
CrO2	6.01E-04	8.02E-04	3.70E-04	5.22E-03	4.80E-04	2.26E-04	2.96E-04	2.12E-04
CoO	6.38E-05	3.29E-03	6.30E-05	5.01E-04	7.45E-05	1.54E-04	2.84E-04	5.04E-05
CuO	2.18E-04	2.97E-03	2.87E-03	1.31E-03	3.03E-02	1.29E-03	6.56E-04	2.42E-03
NaN	1.48E-06	9.62E-06	3.13E-06	2.60E-06	0.00E+00	0.00E+00	7.95E-07	2.99E-05
Fe2O3	6.04E-02	1.97E-01	4.06E-02	9.89E-02	3.41E-02	1.83E-02	1.79E-01	5.20E-02
FeS2	0.00E+00	0.00E+00	1.58E-05	1.17E-04	0.00E+00	0.00E+00	2.23E-04	0.00E+00
Fe2(SO4)3	0.00E+00	0.00E+00	4.31E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PbO	1.04E-04	1.44E-03	8.82E-04	1.47E-04	3.39E-04	3.01E-04	6.04E-04	1.54E-04
MgF2	2.86E-01	0.00E+00	3.75E-03	6.34E-03	1.74E-01	3.09E-01	4.73E-05	1.59E-01
Mg(OH)2	5.02E-02	2.81E-01	1.03E-01	1.71E-01	3.05E-02	5.43E-02	2.77E-01	2.79E-02
Mg(NO3)2	3.41E-02	1.56E-02	3.26E-02	0.00E+00	2.60E-02	4.62E-02	0.00E+00	2.37E-02
MnO	5.15E-03	6.47E-03	2.55E-02	1.56E-02	8.15E-03	2.11E-04	2.50E-03	3.70E-03
MoO2	4.68E-05	5.04E-04	3.70E-04	2.74E-04	0.00E+00	0.00E+00	6.65E-05	0.00E+00
HgO	3.47E-07	4.94E-06	5.38E-06	1.44E-06	2.59E-06	0.00E+00	2.60E-06	8.20E-06
NiO	8.86E-05	3.89E-03	6.26E-04	6.10E-04	4.18E-04	3.02E-04	5.26E-04	1.47E-04
P2O5	1.65E-05	1.75E-01	1.29E-01	7.20E-04	0.00E+00	0.00E+00	3.60E-03	0.00E+00
KOH	2.37E-03	1.64E-02	2.84E-03	7.81E-03	1.71E-03	3.67E-03	2.51E-03	5.43E-03
KCl	1.04E-03	7.21E-03	1.25E-03	0.00E+00	7.53E-04	1.62E-03	0.00E+00	2.39E-03
KF	4.08E-04	0.00E+00	0.00E+00	0.00E+00	2.95E-04	6.33E-04	0.00E+00	9.36E-04
K2CO3	4.86E-04	6.72E-03	1.17E-03	6.41E-03	3.51E-04	7.53E-04	2.06E-03	1.11E-03
SeO2	9.35E-07	3.24E-04	1.24E-04	0.00E+00	3.37E-05	0.00E+00	5.65E-06	8.97E-06
Ag2O	2.18E-04	8.03E-05	4.39E-05	1.75E-03	1.35E-05	7.92E-04	1.09E-03	7.23E-06
Na2B4O7	7.97E-03	1.88E-03	1.04E-03	9.78E-03	0.00E+00	0.00E+00	4.36E-04	0.00E+00
NaNO3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NaOH	2.82E-03	1.56E-02	1.32E-02	3.62E-03	1.83E-02	3.84E-03	3.37E-03	8.30E-03
Na3PO4	0.00E+00	1.88E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na3UO4	3.20E-05	3.71E-03	1.50E-04	8.62E-04	7.15E-04	1.50E-04	8.02E-04	3.25E-04
NaCl	1.04E-03	7.00E-03	4.86E-03	0.00E+00	6.71E-03	1.41E-03	0.00E+00	3.05E-03
Ti2O	1.38E-06	8.78E-06	2.44E-05	0.00E+00	1.52E-05	0.00E+00	2.09E-06	3.76E-06
SiO2	1.65E-02	9.96E-03	1.05E-02	1.88E-02	0.00E+00	0.00E+00	5.81E-03	0.00E+00
SnO2	0.00E+00	0.00E+00	2.37E-04	3.63E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VO2	2.48E-04	1.70E-03	3.50E-03	1.95E-03	1.17E-02	7.59E-04	9.48E-04	7.30E-03
ZnO	7.75E-05	7.13E-03	3.96E-04	5.37E-04	3.52E-04	2.96E-04	1.26E-03	4.17E-04
U3O8	2.07E-02	5.24E-02	2.87E-03	1.58E-01	1.74E-03	1.01E-01	6.43E-03	1.29E-03
UF4	2.24E-02	0.00E+00	0.00E+00	1.77E-02	1.89E-03	1.13E-01	2.88E-04	1.40E-03
UO3	2.04E-02	5.34E-02	2.93E-03	1.45E-01	1.72E-03	1.03E-01	6.29E-03	1.28E-03
ThO2	2.72E-03	6.05E-03	0.00E+00	1.86E-02	3.79E-04	2.89E-05	8.51E-03	3.47E-04
Th(SO4)2	4.36E-03	2.26E-04	6.43E-03	0.00E+00	6.09E-04	4.65E-05	0.00E+00	5.58E-04

Table A -- Pit Waste Composition (Continued)

Component	Normalized Weight Fraction (of Total Inorganics)							
	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6	Burn Pit	Clearwell
Radionuclides								
Cs-137	1.36E-14	7.32E-14	4.07E-14	0.00E+00	1.17E-12	1.67E-12	0.00E+00	8.97E-12
Np-237	0.00E+00	0.00E+00	0.00E+00	1.22E-09	3.59E-08	2.38E-08	1.71E-09	5.38E-09
Pu-238	0.00E+00	1.03E-14	5.71E-15	6.29E-14	3.42E-13	3.81E-13	5.87E-14	0.00E+00
Pu-239	0.00E+00	1.70E-11	9.46E-12	1.39E-11	2.79E-10	1.13E-09	1.29E-11	0.00E+00
Pu-240	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ra-226	1.08E-10	1.69E-09	9.41E-10	1.09E-10	0.00E+00	0.00E+00	7.96E-11	0.00E+00
Ra-228	1.62E-13	2.83E-12	1.57E-12	1.12E-12	0.00E+00	0.00E+00	7.68E-14	0.00E+00
Ru-106	0.00E+00	5.86E-15	3.26E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-90	6.04E-14	5.14E-14	2.86E-14	2.26E-12	3.03E-13	1.74E-13	7.36E-15	3.29E-13
Tc-99	1.39E-09	9.43E-08	5.24E-08	4.20E-08	3.45E-07	6.63E-08	1.12E-08	4.16E-08
Th-228	1.03E-12	1.50E-12	8.31E-13	6.48E-12	7.15E-14	6.83E-15	2.21E-12	1.18E-13
Th-230	2.84E-07	1.57E-06	8.72E-07	1.89E-07	5.48E-07	9.95E-09	4.42E-07	4.69E-07
U-234	2.03E-07	5.14E-06	2.86E-06	1.41E-06	2.67E-07	3.99E-06	5.51E-07	1.04E-07
U-235/6	4.28E-06	2.38E-04	1.32E-04	3.10E-05	1.62E-06	1.26E-04	3.16E-12	1.30E-06
% Inorganics								
(including radionuclides)	99.9879	99.6330	99.9959	99.9574	99.9970	99.9840	99.9765	99.9940
% Organics	0.0089	0.3670	0.0041	0.0426	0.0030	0.0160	0.0235	0.0060
% Gaseous Components	0.0032							

Date: 03/01/96
 Rev.: C RE: CT

Appendix 5
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WBS No.: 1.1.1.1.1.3.1
 ERA/WPRAP/145/DRYER

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FIGURES 5-1 THROUGH 5-8

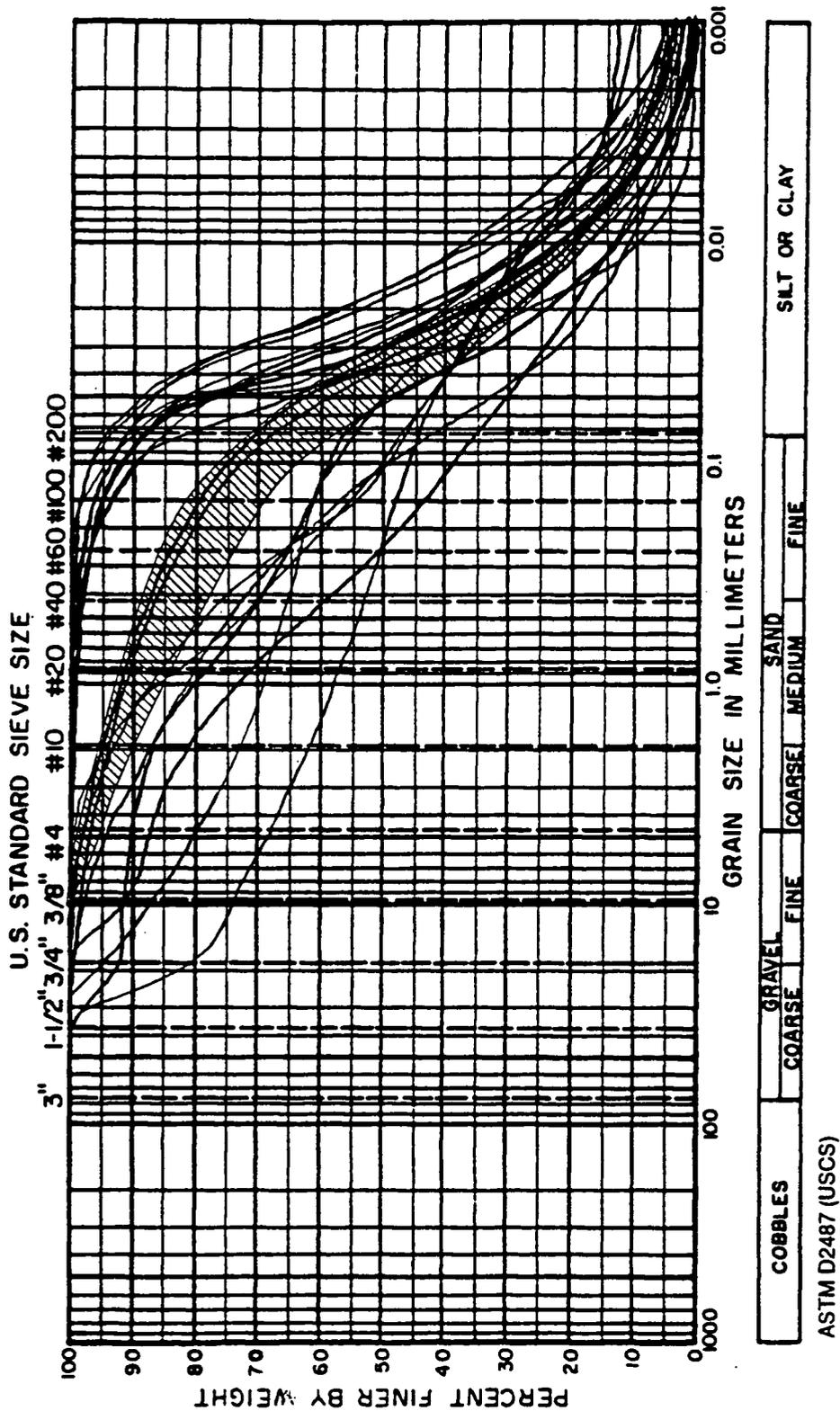
FROM

***TECHNICAL SUMMARY OF DEEP TEST DATA
OU1, PO-145, FEBRUARY 1996, REVISION B, DRAFT FINAL***

Date: 03/01/96
Rev.: C RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/145/DRYER

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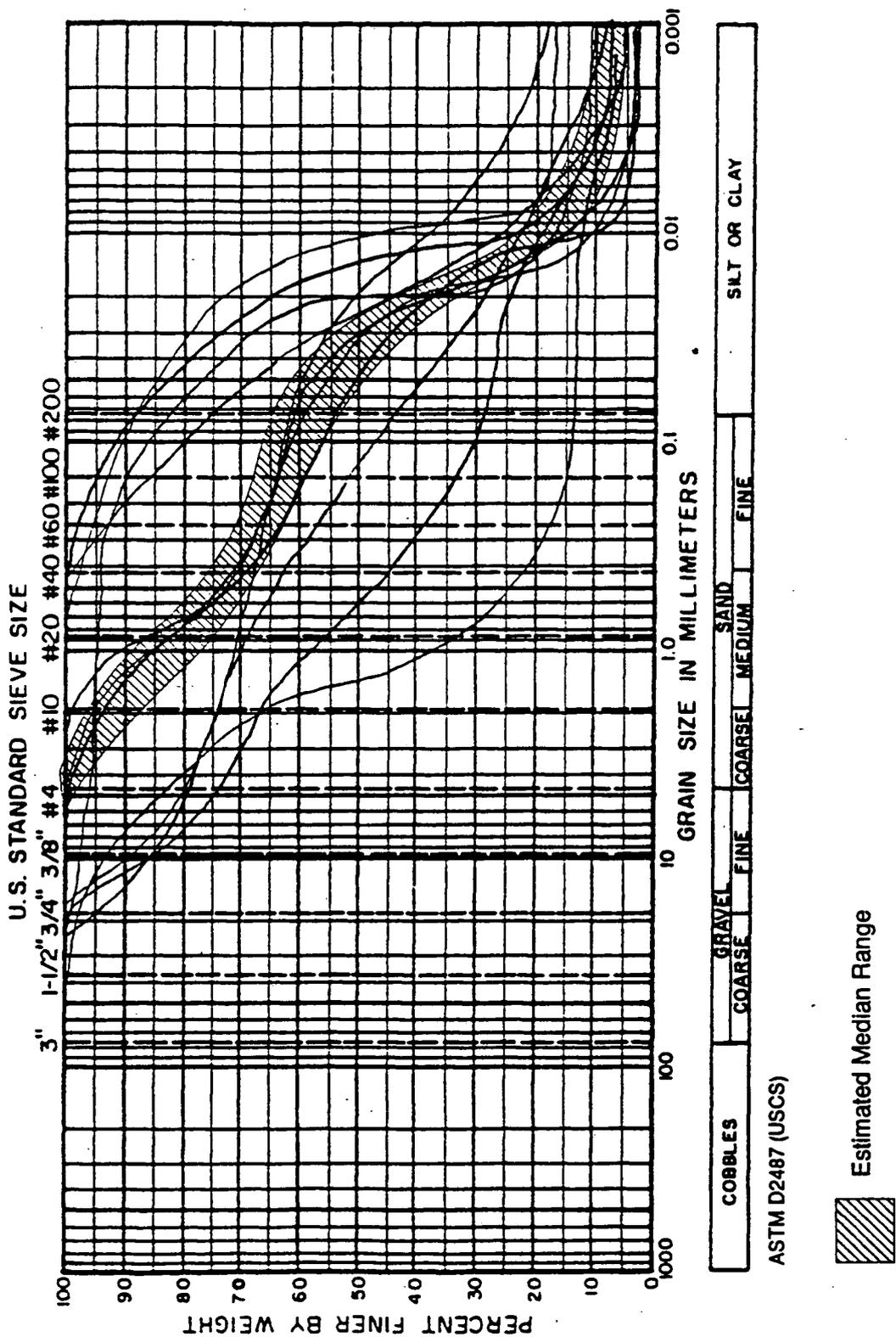
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Figure 5-1 - Grain Size Distribution for OU1 Waste Pit 1 Materials
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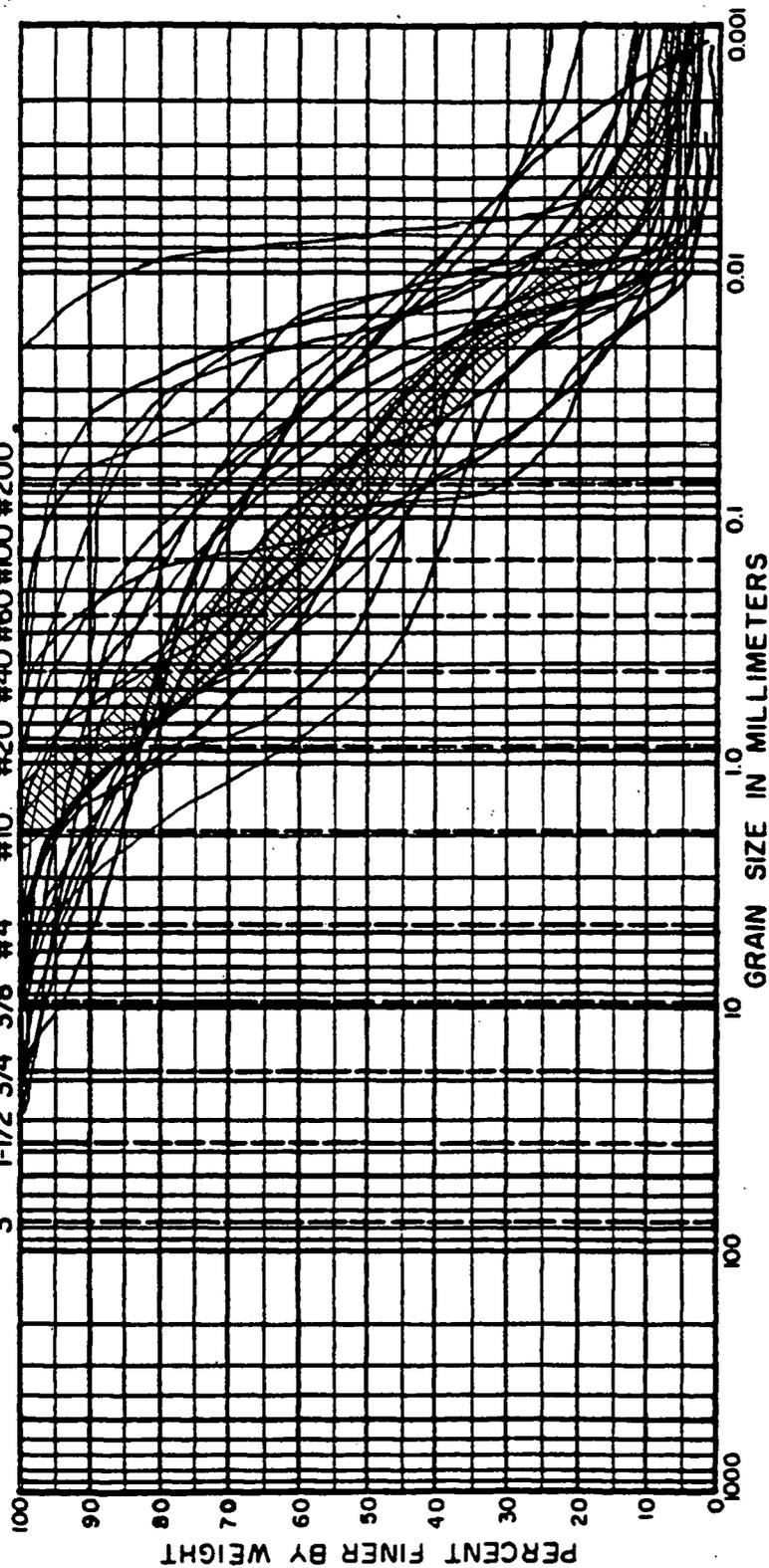
Figure 5-2 - Grain Size Distribution for OU1 Waste Pit 2 Materials
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U.S. STANDARD SIEVE SIZE

3" 1-1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



COBBLES	GRAVEL	SAND			SILT OR CLAY	
	COARSE	FINE	COARSE	MEDIUM	FINE	

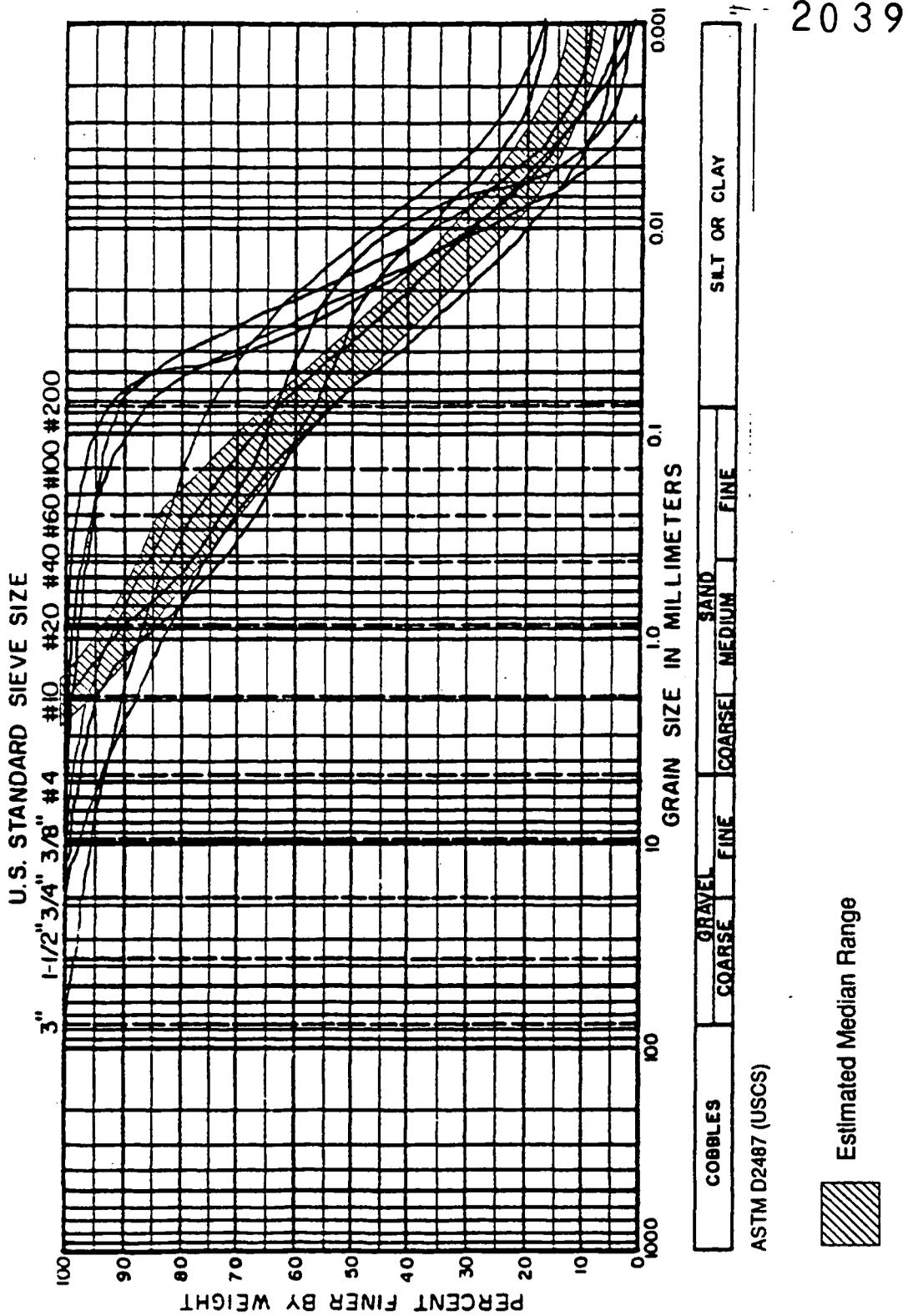
ASTM D2487 (USCS)

 Estimated Median Range

Figure 5-3 - Grain Size Distribution for OU1 Waste Pit 3 Materials
Appendix 5

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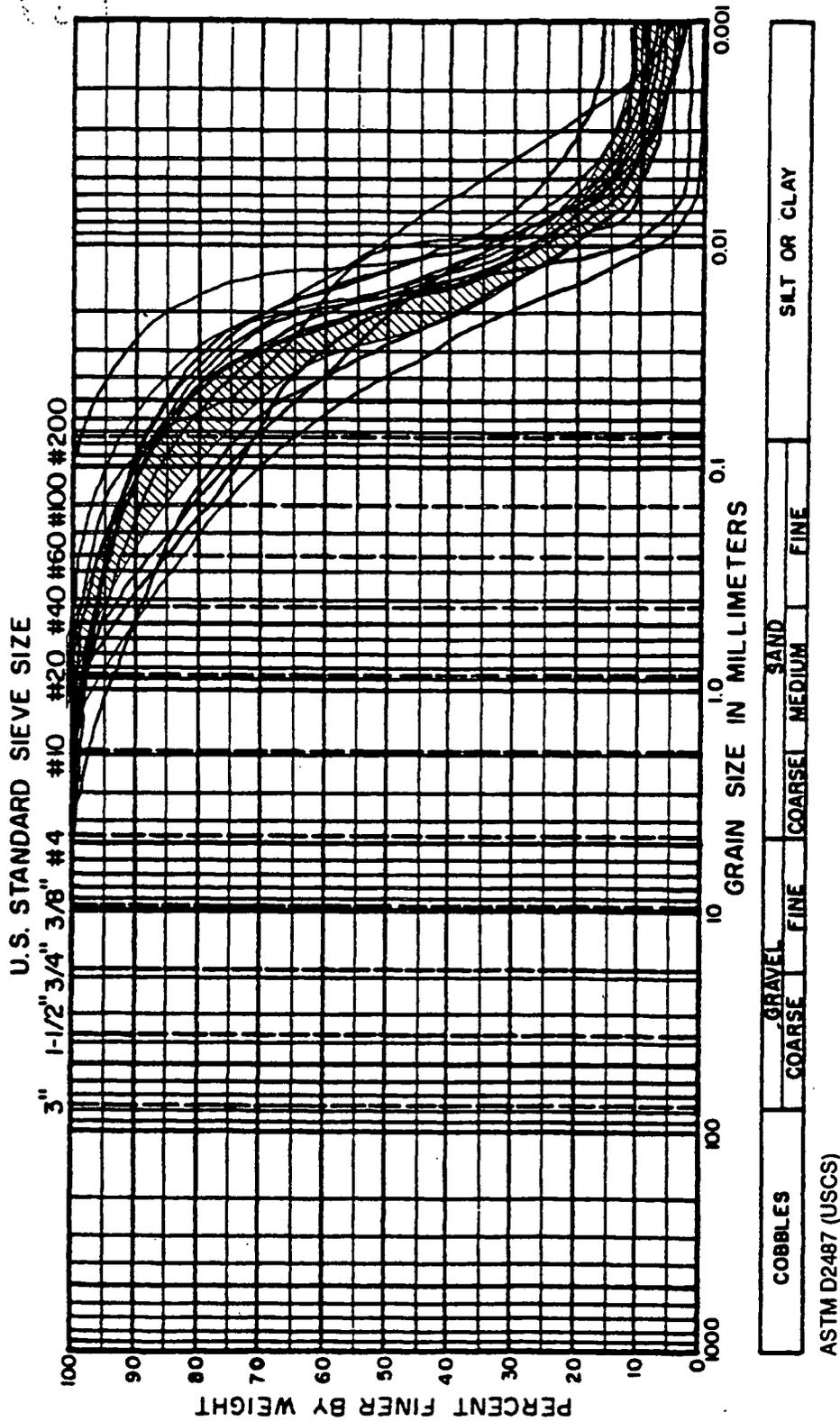
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Figure 5-4 - Grain Size Distribution for OUI Waste Pit 4 Materials
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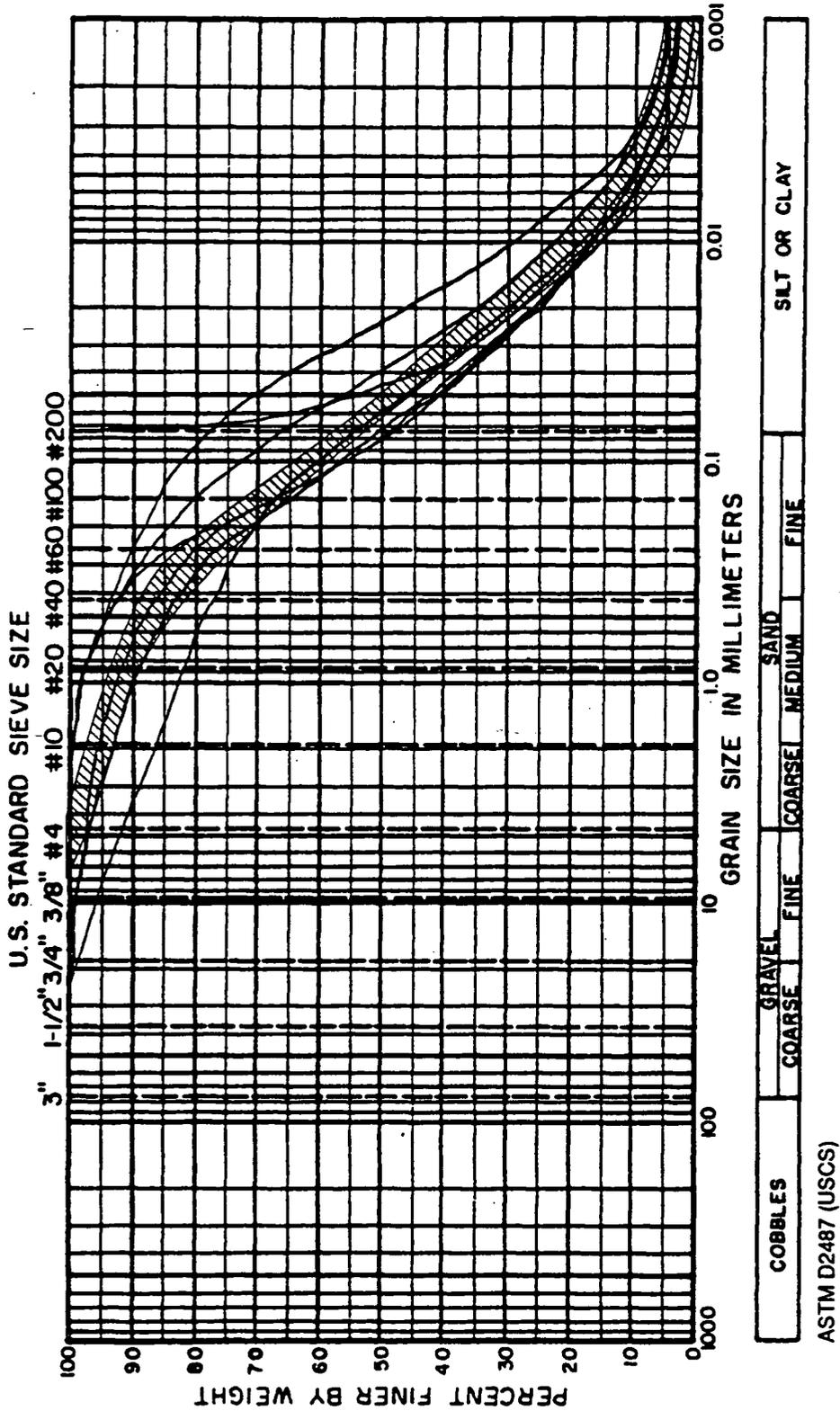
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Figure 5-5 - Grain Size Distribution for OU1 Waste Pit 5 Materials
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Figure 5-6 - Grain Size Distribution for OU1 Waste Pit 6 Materials
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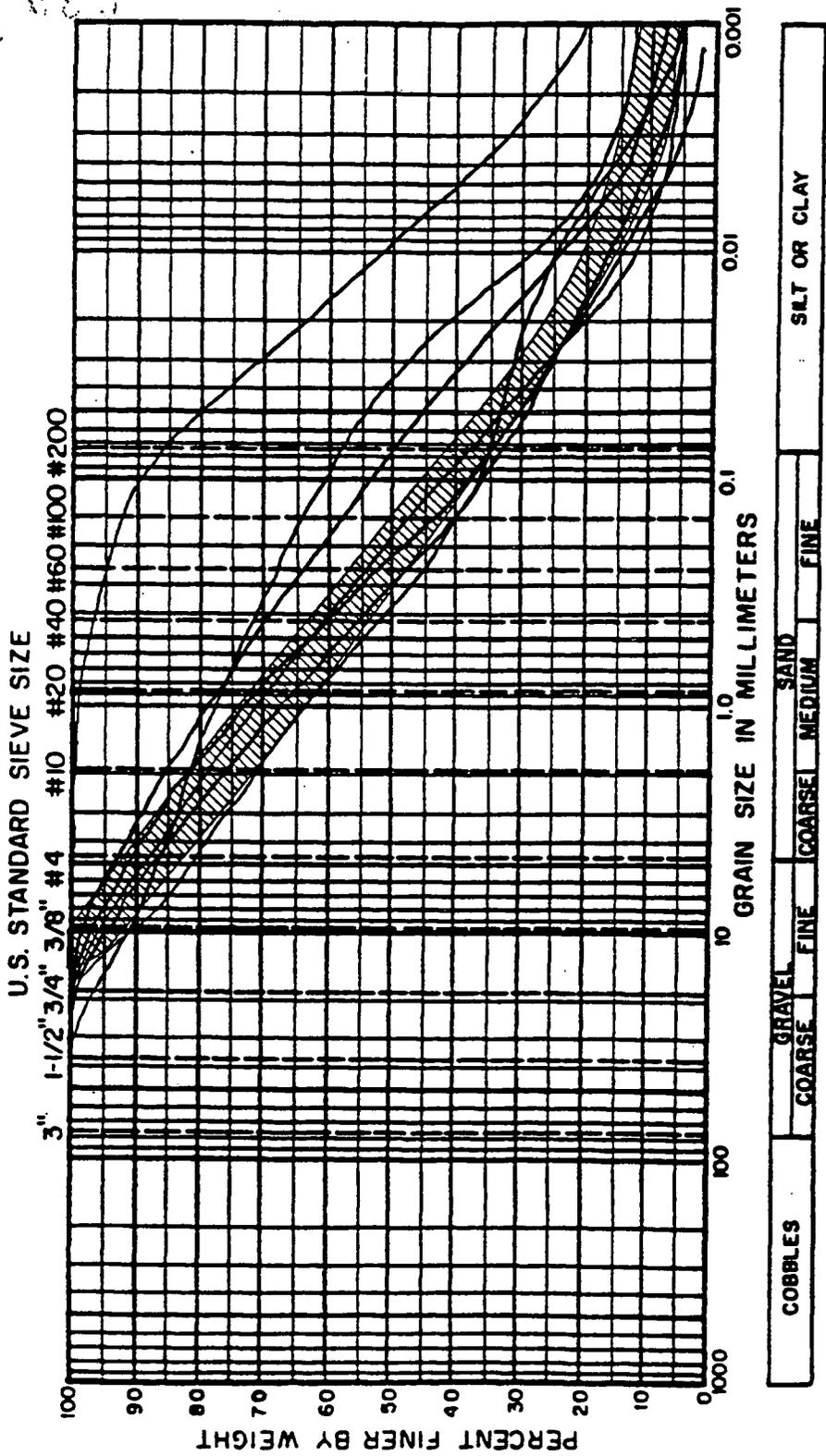
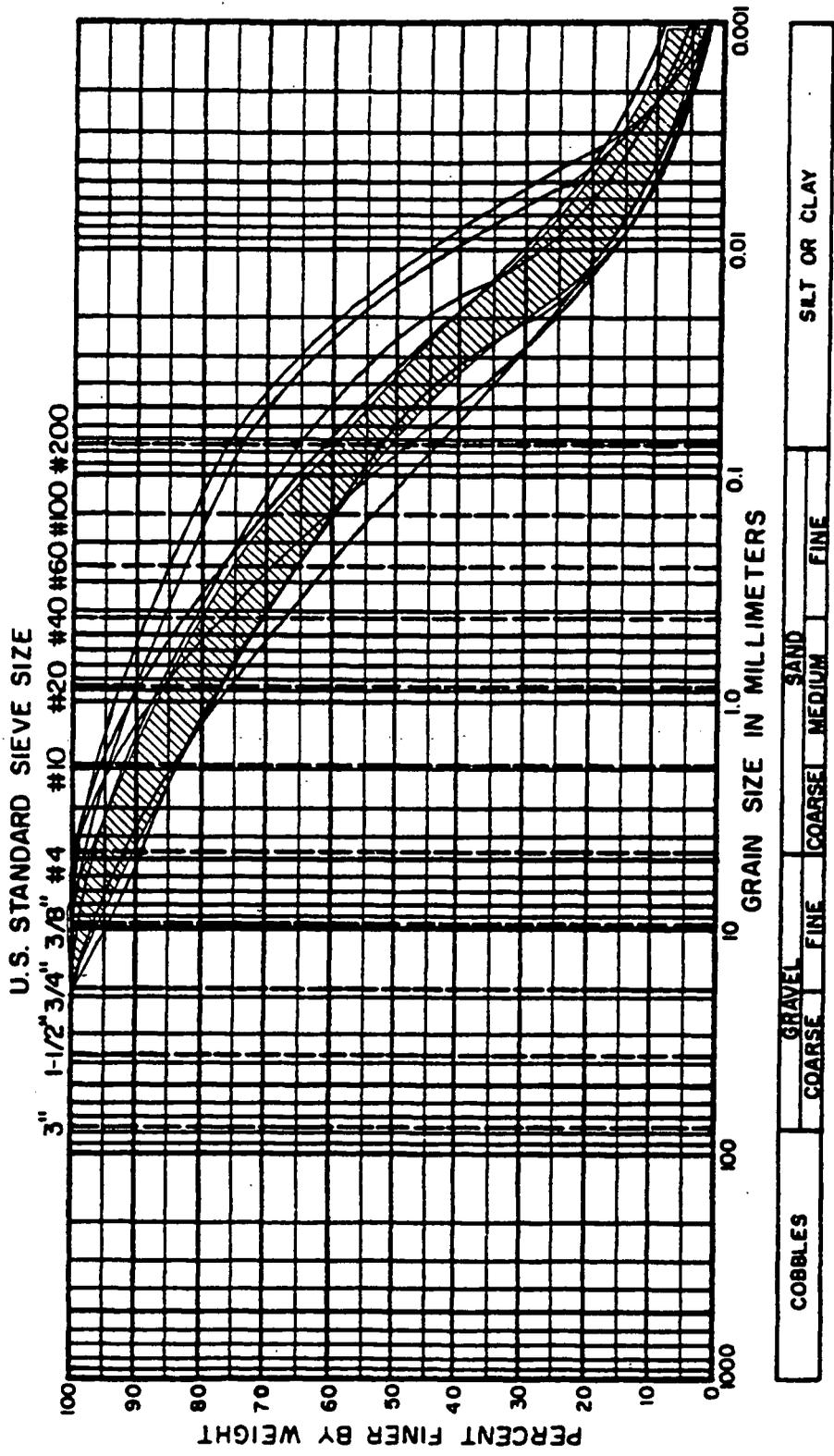


Figure 5-7 - Grain Size Distribution for OU1 Burn Pit Materials
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Figure 5-8 - Grain Size Distribution for OU1 Clearwell Materials
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PARSONS
ERA PROJECT

PURCHASE REQUISITION

PART I - APPROVAL OF THE REQUIREMENT

1. AC 5/12/94
Originator Date

2. AC 5/12/94
Expenditure Approval Date

3. _____
Operations Manager Date

4. _____
Deputy Project Director Date

5. _____
Reviewed by Project Administration Date

ESTIMATE
Charles B. Chynesta Co., Inc.
30 Vesey St.
New York, NY 10007
917/945-3115

212/227-2151
PHONE

Peter Schnur
CONTACT

PART II - QUOTES ADDED BY PURCHASING

VENDOR		VENDOR		VENDOR	
UNIT COST	EXTENDED COST	UNIT COST	EXTENDED COST	UNIT COST	EXTENDED COST
15.00	1500				
<i>BROKE PALLET CHARGE</i>					
5111	50000				
Total		Total		Total	
	400.00				

Special Instructions:
The Originator is the individual with a requirement who prepares the Requisition. Suggested sources and estimated cost are optional, but the information will assist Purchasing. The requirement for Department Manager approval is established by Department Managers. Transmit the Requisition to the Finance Department. The Finance Manager, or his designee, approves the Requisition. If the estimated cost is over \$1,000, the Requisition is approved by the Deputy Project Director or designee, after Finance approval, and prior to Procurement.

**PARSONS
ERA PROJECT**

PURCHASE REQUISITION

PART I - APPROVAL OF THE REQUIREMENT

1. *Asst. Dir. AEG*
Date: 5/12/94
2. Department Approval
Date: 5/12/94
3. Finance Accounting Code
4. Operation Manager
Date:
5. Deputy Project Director
Date:

ESTIMATE
GLOBAL DRILLING SUPPLIES, INC.
SUGGESTED PRICE
12101 CENTRON PLACE
ADDRESS
CINCINNATI, OH 45246
PHONE 671-8700
FAX 671-8705
BRIAN WALKER
CONTACT

PART II - QUOTES ADDED BY PURCHASING

VENDOR		VENDOR		VENDOR	
UNIT COST	EXTENDED COST	UNIT COST	EXTENDED COST	UNIT COST	EXTENDED COST
54H	80.00				
Total		Total		Total	
					2039

Instructions:
The Originator is the individual with a requirement who prepares the Requisition. Suggested sources and estimated cost are optional, but the information will assist Purchasing. The requirement for Department Manager approval is established by Department Managers. Transmit the Requisition to the Finance Department. Accounting enters the accounting code. The Finance Manager, or his designee, approves the Requisition. If the estimated cost is over \$1,000, the Requisition is approved by the Deputy Project Director or designee, after Finance approval, and prior to Procurement. Procurement date stamps requisition. Quotes are appended after requisition approval.

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PARSONS
ERA PROJECT

PURCHASE REQUISITION

PART I - APPROVAL OF THE REQUIREMENT

1. *[Signature]*
Date: 5/12/94

2. Department Approval
Date: 5/12/94

3. Finance Accounting Code

4. Operation Manager

5. Deputy Project Director

Received by Project Administration

PART II - QUOTES ADDED BY PURCHASING

VENDOR		VENDOR		VENDOR	
UNIT COST	EXTENDED COST	UNIT COST	EXTENDED COST	UNIT COST	EXTENDED COST
5411	265.00				
Total		Total		Total	

ITEM	DESCRIPTION	QTY	UNIT	UNIT COST	EXTENDED COST
1	MGO: ELASTOMAG 170 MGD. FINE (99% < 325 MESH) PACKAGED IN 50 LB. BAGS OR EQUIVALENT	5 1/2	BAGS	49.25	3,546.00
				Total	3,546.00

Special Instructions:

DATE REQUIRED: _____
 USE: CRU - 1, PO - 19, TASK 231
 OTHER: DRYING TESTS

Instructions:
 The Originator is the individual with a requirement who prepares the Requisition. Suggested sources and estimated cost are optional, but the information will assist Purchasing.
 The requirement for Department Manager approval is established by Department Managers.
 Transmit the Requisition to the Finance Department.
 Accounting enters the accounting code.
 The Finance Manager, or his designee, approves the Requisition.
 If the estimated cost is over \$1,000, the Requisition is approved by the Deputy Project Director or designee, after Finance approval, and prior to Procurement.
 Procurement date stamps requisition. Quotes are appended after requisition approval.

FILE: P:\DATA\ER\MSTR

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SECTION 15060
PIPE, FITTINGS, VALVES, AND ACCESSORIES

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aboveground piping, fittings, valves, and accessories.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 01012 - Schedule of Drawings.
- D. Section 15020 - Packaged Equipment.
- E. Section 15090 - Piping Supports and Anchors.
- F. Section 15250 - Insulation.

1.3 REFERENCES, CODES, AND STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME A13.1-81 Scheme for the Identification of Piping Systems (R1985).
 - 2. ASME B16.5-88 Pipe Flanges and Flanged Fittings.
 - 3. ASME B16.21-92 Nonmetallic Flat Gaskets for Pipe Flanges.
 - 3. ASME B31.3-93 Chemical Plant and Petroleum Refinery Piping.
 - 4. ASME Boiler and Pressure Vessel Code (BPVC), Section IX-95 (as specified herein).

~~B~~ American Society for Nondestructive Testing (ASNT):

1. ASNT-SNT-TC-1A-92 Personnel Qualifications and Certification Recommended Practice, December 1992 Edition.

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

1. ASTM-A53-95 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
2. ASTM-A105/
A105M-Rev. B-95 Standard Specification for Carbon Steel Forgings for Piping Applications.
3. ASTM A182/
A182M-95 Standard Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
4. ASTM A193/
A193M-95 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.
5. ASTM-A194/
A194M-95 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
6. ASTM-A216/
A216M-93 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
7. ASTM-A234/
A234M-Rev. A-95 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
8. ASTM A276-95 Standard Specification for Stainless Steel Bars and Shapes.
9. ASTM-A307-94 Standard Specification for Carbon Steel Bolts and Studs.
10. ASTM A312/ Standard Specification for

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	312M-Rev. B-94	Seamless and Welded Austenitic Stainless Steel Pipes.	1
11.	ASTM A351/ 351M-Rev. A-94	Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts.	2 3 4 5 6
12.	ASTM A403/ A403M-95	Standard Specification for Wrought Austenitic Stainless Steel Pipe Fittings.	7 8 9
13.	ASTM A515/ A515M-92	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.	10 11 12 13
14.	ASTM B61-93	Standard Specification for Steam or Valve Bronze Castings.	14 15 16
15.	ASTM-B62-93	Standard Specification for Composition Bronze or Ounce Metal Castings.	17 18 19 20
D.	Expansion Joint Manufacturer's Association (EJMA):		21
	1.	EJMA-1976 EJMA Standards.	22 23
1.4	SYSTEM DESCRIPTION		24
A.	Design Requirements		25 26
	1.	Double-Walled Piping: When the process requires secondary containment (as shown on the Piping and Instrumentation Drawings [P&IDs] and on the piping drawings) and piping is routed outside a process containment area, the piping installation shall be a double-walled piping system and shall be electric heat traced and insulated.	27 28 29 30 31 32 33 34
1.5	SUBMITTALS		35
A.	Piping drawings.		36 37
B.	P&IDs (for "packaged systems" only).		38 39
C.	Product Data.		40 41 42

- D. Shop drawings, including spool piece drawings and construction isometric drawings. 1
 - E. Certificates of Conformance: Manufacturer shall certify and provide data which indicates that all supplied products meet or exceed specification requirements. 3
 - F. Test Procedures: Submit written procedures for all required testing. Test procedures shall include criteria for acceptable performance. 4
 - G. Detailed description of packaging materials and procedures including cleaning and closure of all openings. 5
 - H. Procedure for repair or replacement of piping failing pressure tests. 6
 - I. Flushing procedure. 7
 - J. Welder qualification, inspector qualifications, procedure qualification records, and welding procedure specification in accordance with the ASME BPVC, Section IX. 8
 - K. Pressure test reports. 9
 - L. Test reports for expansion joint pressure tests. 10
- 1.6 **QUALITY ASSURANCE PROGRAM** 11
- A. Except where more stringent requirements are specified or indicated, the work specified herein shall conform to ASME B31.3. 12
 - B. Welding Procedures and Qualifications 13
 - 1. Welding procedures, welder qualifications, fabrication, assembly, and erection shall be in accordance with ASME B31.3, Chapter V and ASME BPVC, Section IX. 14
 - 2. Welder and inspector qualifications shall be made available to, and approved by, FERMC0. 15

- 3. Welding inspections shall be in accordance with ASME B31.3, Chapter VI. 1
- 4. Nondestructive testing personnel qualifications shall be in accordance with ASNT SNT-TC-1A. 2
- 5. All welding for expansion joints shall be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. 3

C. Testing 4

- 1. Shop testing shall be in accordance with ASME B31.3. 5

D. Inspection 6

- 1. Inspection shall be conducted in accordance with ASME B31.3. 7

1.7 DELIVERY, STORAGE, AND HANDLING 8

A. Packaging 9

- 1. Manufacturer's standard packaging shall be used. Materials shall be thoroughly cleaned to remove chips, slag, weld spatter, oil, grease, debris, and other foreign material prior to packaging for shipment. All openings shall be covered, capped, or plugged to prevent damage and the ingress of foreign materials during shipment and storage. Tape alone shall not be used for sealing openings. 10
- 2. Closures used for covering, capping, or plugging openings shall not be made of polyvinyl chloride (PVC) or other plastics that contain chloride. 11

B. Storage and Handling 12

- 1. Spool openings shall remain sealed. 13
- 2. Piping materials and prefabricated assemblies shall be stored off the ground and handled with care so that physical damage to the piping materials does not occur. End seals of pipe, flange covers, valve covers, and similar protection shall not be removed until necessary for cleaning, fabrication, inspection, and erection. 14
- 3. Piping materials shall be identified, inspected, controlled, and protected in a manner that will 15

assure conformance with the applicable codes and specifications.

4. Care shall be taken in the storage and handling of all piping materials and prefabricated assemblies so that contamination by grease, moisture, or other foreign matter does not occur.
5. Welding rods and electrodes shall be stored, handled, and identified at all times to ensure the use of the proper welding rod. Electrode ovens for the storage of low-hydrogen welding rods must be used at all times.
6. Austenitic stainless steel materials shall be stored separately from carbon steel materials.

PART 2 PRODUCTS

2.1 PRODUCTS/EQUIPMENT

A. Piping and Valve Specification

1. All piping and valve materials shall meet the requirements indicated on the attached piping material data sheets.

B. Double-Walled Piping

1. Double-walled piping shall be supplied in prefabricated assemblies that shall include anchors, guides, spacers, drip legs, and end closures. Internal anchors, guides, and spacers shall be in accordance with Section 15090.

C. Expansion Joints

1. Expansion joints shall be designed and manufactured in accordance with EJMA.
2. Bellows: Metallic bellows shall be formed from seamless tubing or tubing having longitudinal seam welds only. Longitudinal welds shall be planished and the finished weld shall be within plus 2 percent of the tube thickness. Maximum thinning in the bellows shall not exceed 15 percent. Bellows shall not be exposed to any stress relief or to any post-forming procedures. Where weld ends are specified, they shall be beveled for welding in accordance with ASME B31.3, Chapter V.

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- 3. Flow Liners: Flow liners shall be long enough to extend past the bellows section through the full range of movement. Flow liners shall not restrict the bellows from any designed movements (i.e., lateral, axial, or rotation).
- 4. External Covers: External covers shall be removable and shall be capable of protecting the corrugations from accidental damage during shipment, installation, and operation. The covers shall not restrict the designed movements of the assembly.
- 5. Limit Rods: Limit rods shall be designed to limit overcompression and/or overextension and to absorb the full pressure thrust of the system in the event of anchor failure.
- 6. Control Rods: Control rods shall be used in universal type joints to prevent excessive displacement of one bellows relative to another. Control rods shall be designed to absorb the full pressure thrust of the system.
- 7. Flow Tags: A flow arrow indicating the direction of flow shall be permanently attached to the assembly and shall be clearly visible on the outside.
- 8. Temporary Tie Bars: Tie bars shall be provided to control the required installation dimensions and to prevent damage to the bellows. Tie bars shall be clearly marked as temporary and shall be designed for easy removal.
- 9. Testing: Expansion joint assemblies shall be pressure tested at the place of manufacture.

2.2 MATERIALS

A. Procurement

- 1. All piping materials shall be procured in accordance with the piping material data sheets.
- 2. Quarter turn valves shall be used to the maximum extent practical in the liquid and air piping services.
- 3. For slurry applications (including drains), quarter turn, full port valves shall be used, if practicable.

4. Expansion joint materials shall comply with Appendix A of ASME B31.3.

2.3 FABRICATION

A. Welding

1. All welding shall be in accordance with the applicable codes.
2. All socket welds shall be made by a shielded metal arc or gas tungsten arc welding process.
3. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1/16 inch and no more than 1/8 inch.

B. Shop Assembly

1. Any parts made in a fabrication shop shall be completely shop assembled prior to shipment to the site.

C. Shop/Factory Finish

1. All carbon steel parts shall be prime coated after fabrication.

2.4 LABELING

A. Valve Identification

1. Each valve shall be identified with the unique valve number, as shown on the P&IDs, embossed on a stainless steel identification tag permanently attached to the valve by a stainless steel wire. Lettering shall be a minimum of 3/8 inch high. The tag shall not be attached to any part of the valve which may interfere with valve operation.
2. Valve identification tags on insulated valves shall be located outside the insulation jacketing and be easily accessible for inspection.

B. Pipe Identification

1. Identify the flow medium and the flow direction for all piping systems including insulated pipe by labeling adjacent to each valve, adjacent to where the pipe passes through a wall or floor, adjacent

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to abrupt pipe directional change, and at intervals of 50 feet along exposed pipe. Pipes shall be labeled as indicated on the P&IDs and in accordance with ASME A13.1.

- 2. Content, size, material type, line number, and insulation requirements for each pipeline shall be identified on drawings as follows:

Example SL - 2" - A - 7000 - ET

<u>Medium Code</u>	<u>Size</u>	<u>Material Code</u>	<u>Line Number</u>	<u>Insulation</u>
SL*	2"	A	7000***	ET**

- * See attached piping material data sheet service index for medium codes.
- ** ET indicates that the pipeline is electric heat traced.
- *** A different number series is used for each service.

C. Product Marking

- 1. All piping materials, welding rods, and electrodes shall be marked and identified in accordance with the applicable codes.

D. Expansion Joints

- 1. Each expansion joint shall have manufacturer's standard nameplate permanently attached at a location which is easily readable. The nameplate shall contain the following information:
 - a. Item description.
 - b. Item number.
 - c. Manufacturer's name.
 - d. Purchase order number.
 - e. Date of manufacture.
 - f. Spring rates.
 - g. Rates movements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examination shall be in accordance with ASME B31.3.

B. FERMCO will perform all field examination.

3.2 PREPARATION

A. Protection

1. All welding/fabricating activities shall be protected from inclement weather at all times.

B. Primer Application

1. All non-insulated carbon steel piping shall be prime coated after fabrication.

3.3 ERECTION/INSTALLATION/APPLICATION

A. Layout, Cutting, and Fitting Up

1. All piping, tubing, fittings, components, welding, bonding, fabrication, erection, and assembly shall be in accordance with ASME B31.3.

B. Flanged Joints

1. All flanged joints shall be assembled in accordance with ASME B31.3.
2. Where a raised-face flange mates with a flat-face flange, it shall be substituted with a flat-face flange of the material type specified on the attached Piping Material Data Sheet.
3. Flat ring-type gaskets shall be used between steel flanges equipped with raised serrated faces.
4. Where metallic flanges are bolted to non-metallic flanges, both shall be flat-faced flanges. Full-face gaskets shall be used.
5. When valves, fittings, or equipment having cast iron flanges are used, mating flanges shall be flat faced with full-faced gaskets.
6. Flange isolation kits shall be used between all dissimilar metal flanges.

3.4 QUALITY CONTROL

A. Inspections and Tests

1. Piping shall be hydrostatically or pneumatically pressure tested in accordance with ASME B31.3.

- 2. All pressure vessels, equipment, in-line instruments, gauge glasses, flow meters, and all other pressure parts of instruments shall not be included in these tests if they will be damaged by the test pressure.
- 3. Equipment which is not to be subjected to the pressure test shall be disconnected from the piping and a pipe spool inserted in its place, or the equipment may be isolated by way of a single-line blind.

B. Hydrostatic Testing

- 1. Potable water or other approved fluids shall be used for hydrostatic pressure testing of piping systems in accordance with ASME B31.3.
- 2. The containment pipe (outer pipe) in double-walled piping systems shall be hydrostatically pressure tested at the same pressure as the carrier pipe (inner pipe).
- 3. All test pressures shall be maintained a minimum of 10 minutes before visual examination of joints begins. Hydrostatic test pressures shall be as shown in the following table:

SERVICE	MEDIUM CODE	DESIGN PRESSURE (psig)	TEST PRESSURE (psig)
Chilled Water	CHS, CHR	100	150
Condensate	LC	100	150
Drain	DR	100	150
Flush Water	FW	100	150
Process Water	TW	100	150
Recycle Water	RC	100	150
Scrubber Recycle	RSL	100	150
Slurry	SL	100	150
Sodium Hydroxide	NA	100	150
Sump Discharge	SU	100	150
Wastewater	WW	100	150

C. Pneumatic Testing

1. Pneumatic test pressures shall be as shown in the following table:

SERVICE	MEDIUM CODE	DESIGN PRESSURE	TEST PRESSURE
Plant Air	PA	100 psig	110 psig
Instrument Air	IA	100 psig	110 psig
Fuel Gas	FG	100 psig	110 psig
Off-Gas	OG	-80 in w.g./+10 in w.g.	15 psig
Blower Air	BA	20 in w.g.	15 psig

D. Hydrostatic/Pneumatic Test Reports

1. The Subcontractor shall provide a report for each piping system tested containing the following information:
 - a. Date of test.
 - b. Line designation number.
 - c. Test fluid.
 - d. Type of test.
 - e. Pressure applied.
 - f. Start time.
 - g. Completion time
 - h. Total time at test pressure.
 - i. Certification by examiner of acceptability.
 - j. Calibration test gauge number and calibration date.
 - k. Comments, if any.

3.5 CLEANING

A. System Cleaning and Flushing

1. The interior and exterior of all pipe shall be kept clean at all times.

- 2. After erection and welding of piping, all lines 1
- except air and gas shall be flushed with potable 2
- water prior to leak testing or hydrostatic 3
- testing. Upon completion of flushing, lines shall 4
- be drained at all low points. 5

END OF SECTION

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ATTACHMENT A OF SECTION 15060

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SERVICE: PIPING MATERIAL DATA SHEET
(SEE SERVICE INDEX)

MAT'L CODE A
(SPEC)
PAGE 1 OF 4

RATING: CLASS 150
FACING: RF
MATERIAL: CARBON STEEL

CORROSION ALLOWANCE: 0.125"
PRESSURE LIMIT: PER ASME/ANSI B16.6
TEMPERATURE LIMIT: -20°F TO 750°F

CODE NUMBER	ENCODER	SIZE FROM TO	DESCRIPTION	NOTES	REV
			PIPE		
		1/2" - 2"	SEAMLESS CARBON STEEL, ASTM A53 GRADE B, EXTRA STRONG, PLAIN ENDS		
		2-1/2" - LARGER	SEAMLESS CARBON STEEL, ASTM A53 GRADE B, STANDARD WEIGHT, BEVELED ENDS		
			FLANGES		
		1/2" - 2"	CLASS 150, CARBON STEEL, RF, ASTM A105, SOCKETWELD (XS BORE)		
		2-1/2" - LARGER	CLASS 150, CARBON STEEL, RFSF, ASTM A105, WELD NECK (STANDARD WEIGHT BORE)		
			ORIFICE FLANGES		
		2-1/2" - LARGER	CLASS 300, CARBON STEEL, ASTM A105, RF WITH 1/2" SCREWED TAPS AND JACK SCREWS, WELD NECK (STANDARD WEIGHT BORE)		
			FITTINGS		
		1/2" - 2"	CLASS 3000, CARBON STEEL, ASTM A105, SOCKETWELD		
		1/2" - 2"	CLASS 3000, SCREWED CARBON STEEL, ASTM A105; THREDOLET	1	
			PLUG, ROUNDHEAD	1	
			CAP	1	
			PLUG, HEX HEAD	4	
		2-1/2" - LARGER	SEAMLESS CARBON STEEL, BUTT WELD ENDS, ASTM A234 GRADE WPB		
			SWAGES		
		1/2" - 8"	SCHEDULE 80 CARBON STEEL, ASTM A234, GRADE WPB, PREPARE ENDS AS REQUIRED (BEVELED, PLAIN OR THREADED)	2	
			GASKETS		
		1/2" - LARGER	TEFLON, 1/16 INCH THICK		

**PARSONS
ERA PROJECT**

JOB NUMBER
7663-0145

DOCUMENT NO.
15060

REV
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SERVICE: PIPING MATERIAL DATA SHEET (SEE SERVICE INDEX)			MAT'L CODE A (SPEC) OF 4 PAGE 2		
CODE NUMBER	ENCODER	SIZE FROM TO	DESCRIPTION	NOTES	REV
			<p style="text-align: center;">BOLTING</p> <hr/> <p>STUD BOLTS WITH TWO HEAVY HEX NUTS, ASTM A193 GR B7/ASTM A194 GR 2H</p> <hr/> <p style="text-align: center;">PIPING INSTRUMENT CONNECTIONS</p> <hr/> <p>PRIMARY INSTRUMENT CONNECTIONS TO PIPING:</p> <p>TEMPERATURE CONN. 1-1/2" FLANGED VALVE@ PRESS CONN. 3/4" SW/SCRD VALVE@ ORIFICE FLG. 1/2" SW/SCRD</p> <hr/> <p style="text-align: center;">BALL VALVES</p> <hr/> <p>1/2" - 2" CLASS 600, CARBON STEEL, ASTM A105, THREE PIECE, SOCKETWELD, CHROME PLATED BALL, TFE SEATS, WRENCH OPERATOR 6</p> <p>2-1/2" - 4" CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF FLANGE, CHROME PLATED BALL, TFE SEATS, WRENCH OPERATOR 6</p> <p>6" - LARGER CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF FLANGE, CHROME PLATED BALL, TFE SEATS, GEAR OPERATOR 6</p> <hr/> <p style="text-align: center;">BUTTERFLY VALVES</p> <hr/> <p>2" - LARGER CLASS 150, CARBON STEEL, ASTM A515, WAFER STYLE, 316 SS STEM AND DISC, 316SS SEAT, INTEGRAL FLANGE SEALS, LEVER HANDLE OPERATOR FOR 1-4", GEAR OPERATOR FOR 6" AND LARGER 6</p> <hr/> <p style="text-align: center;">PLUG VALVES</p> <hr/> <p>1/2" - 2" CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, THREADED ENDS, REINFORCED PTFE SEATS 5,6</p> <p>2-1/2" - LARGER CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RF FLANGED ENDS, REINFORCED PTFE SEATS 5,6</p> <hr/> <p style="text-align: center;">CHECK VALVES</p> <hr/> <p>1/2" - 2" CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF FLANGE, SWING TYPE 3</p> <p>2-1/2" - LARGER CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF, FLANGE, CHROME TRIM, BOLTED COVER, INTEGRAL SEAT, SWING TYPE 3</p>		2039
PARSONS ERA PROJECT		JOB NUMBER	DOCUMENT NO.	REV	
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SERVICE: PIPING MATERIAL DATA SHEET (SEE SERVICE INDEX)		MAT'L CODE (SPEC)	
		PAGE 3	A OF 4
		GATE VALVES	
	1/2" - 2"	CLASS 150, CARBON STEEL, ASTM A105, CHROME TRIM, O S AND Y, SOCKETWELD ENDS	3,6
	2-1/2" - LARGER	CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF FLANGE, CHROME TRIM, O S AND Y, SOLID WEDGE DISC, INTEGRAL SEAT	3,6
		GLOBE VALVES	
	1/2" - 2"	CLASS 800, CARBON STEEL, ASTM A105, SOCKETWELD, BOLTED BONNET, 12% CHROME TRIM, HANDWHEEL OPERATOR	6
	2-1/2" - LARGER	CLASS 150, CARBON STEEL, ASTM A216 GRADE WCB.RF FLANGE, 12% CHROME TRIM, HANDWHEEL OPERATOR	6
		PIPE NIPPLES	
		CARBON STEEL, ASTM A53, GRADE B	
	1/2" - 2"	SCH 160, TBE, SMLS 3" LONG	
	1/2" - 2"	SCH 160, TBE, SMLS 6" LONG	
	1/2" - 2"	SCH 160, POE-TOE, SMLS 3" LONG	
	1/2" - 2"	SCH 160, POE-TOE, SMLS 6" LONG	
		STEAM TRAPS	
	1/2" - 2"	CLASS 600, SCREWED, DISC TYPE, INTEGRAL STRAINER, LOW CARBON CHROME-MOLY BODY, ASTM A182, GRADE F-11	
		DOUBLE WALLED CONTAINMENT PIPE	
	3" - 12"	CONTAINMENT (OUTER PIPE), SEAMLESS, CARBON STEEL, ASTM A53, GRADE B, STANDARD WEIGHT, BEVELED ENDS	
		DOUBLE WALLED (CONTAINMENT) FITTINGS	
	3" - 12"	CONTAINMENT (OUTER FITTING), SEAMLESS, CARBON STEEL, BUTT WELD ENDS, ASTM A234, GRADE WPB	
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SERVICE: PIPING MATERIAL DATA SHEET
(SEE SERVICE INDEX)

MAT'L CODE A
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NOTES

2039

1. USE FOR UNVALVED VENTS AND DRAINS.
2. USE SWAGES WHERE SMALL END IS 2" AND SMALLER. USE WELD REDUCER WHERE SMALL END IS 2-1/2" AND LARGER.
3. INSTALL IN HORIZONTAL POSITION OR WITH FLOW UP.
4. USE FOR PROCESS DRAINS.
5. USE FOR FUEL GAS ONLY, DEAD-TIGHT SHUTOFF IS REQUIRED.
6. EQUIP VALVE WITH LOCKING DEVICE WITH NOT LESS THAN 3/8" DIAMETER HOLE FOR LOCK.

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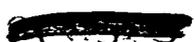
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PIPING MATERIAL DATA SHEET
SERVICE: (SEE SERVICE INDEX)

MAT'L CODE W
(SPEC)
PAGE 2 OF 3

RATING: CLASS 150
FACING: RF
MATERIAL: GALVANIZED (2" AND SMALLER)
CARBON STEEL

CORROSION ALLOWANCE: 0.0625"
PRESSURE LIMIT: 150 psig
TEMPERATURE LIMIT: -20°F TO 250°F

2039

			SWAGES		
		1/2" - 8"	SCHEDULE 80, CARBON STEEL, ASTM A234, GRADE WPB, PREPARE ENDS AS REQUIRED (BEVELED OR THREADED)	2	
			GASKETS		
		1/2" - LARGER	CLASS 150, RED RUBBER, 1/8" THICK		
			BOLTING		
		1/2" - LARGER	MACHINE BOLT WITH 1 HEAVY HEX NUTS, ASTM A307, GRADE B (CADMIUM PLATED)		
			PIPING INSTRUMENT CONNECTIONS		
			<u>PRIMARY INSTRUMENT CONNECTIONS TO PIPING:</u> TEMPERATURE CONN 1-1/2" FLG'D VALVE AT PRESS CONN'S 3/4" SCR'D VALVE AT ORIFICE FLGE 1/2" SCR'D		
			BALL VALVES		
		1/2" - 2"	200 WOG, BRONZE, THREADED ENDS, REINFORCED TFE SEATS, CHROME-PLATED BALL, WRENCH OPERATOR		
		2 1/2" - 4"	CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, TFE SEATS, CHROME-PLATED BALL, WRENCH OPERATOR		
		6" - LARGER	CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF, CHROME PLATED BALL, TFE SEATS, GEAR OPERATOR		
			CHECK VALVES		
		1/2" - 2"	CLASS 150, BRONZE, THREADED ENDS, ASTM B61, SWING TYPE, BRONZE TRIM		
		2 1/2" - LARGER	CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, CHROME TRIM, BOLTED COVER, INTEGRAL SEAT, SWING TYPE.		

**PARSONS
ERA PROJECT**

JOB NUMBER
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PIPING MATERIAL DATA SHEET
 SERVICE: (SEE SERVICE INDEX)

MAT'L CODE W
 (SPEC)
 PAGE 3 OF 3

RATING: CLASS 150
 FACING: RF
 MATERIAL: GALVANIZED (2" AND SMALLER)
 CARBON STEEL

CORROSION ALLOWANCE: 0.0625"
 PRESSURE LIMIT: 150 psig
 TEMPERATURE LIMIT: -20°F TO 250°F

GATE VALVES

1/2" - 2"

CLASS 150, BRONZE, THREADED ENDS, ASTM B62,
 BRONZE BONNET, HANDWHEEL OPERATOR

2 1/2" - LARGER

CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216,
 GRADE WCB, O.S.& Y, CHROME TRIM, HANDWHEEL
 OPERATOR

GLOBE VALVES

1/2" - 2"

CLASS 150, BRONZE, THREADED ENDS, ASTM B62,
 BRONZE TRIM, HANDWHEEL OPERATOR

2 1/2" - LARGER

CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216,
 GRADE WCB, O.S.&Y CHROME TRIM, HANDWHEEL
 OPERATOR

PIPE NIPPLES

1/2" - 2"

SCH 160, TBE, SMLS, 3" LONG

1/2" - 2"

SCH 160, TBE, SMLS, 6" LONG

1/2" - 2"

SCH 160, POE-TOE, SMLS, 3" LONG

1/2" - 2"

SCH 160, POE-TOE, SMLS, 6" LONG

NOTES

1. USE FOR UNVALVED VENTS AND DRAINS.
2. USE SWAGES WHERE SMALL END IS 2" AND SMALLER. USE WELD REDUCER WHERE SMALL END IS 2-1/2" AND LARGER.
3. USE FOR PROCESS DRAINS.

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PIPING MATERIAL DATA SHEET
 SERVICE: (SEE SERVICE INDEX)

MAT'L CODE T3
 (SPEC)
 PAGE 1 OF 1

RATING: CLASS 150
 FACING: RF
 MATERIAL: 304L SS

CORROSION ALLOWANCE: 0.030"
 PRESSURE LIMIT: PER ASME/ANSI B16.5
 TEMPERATURE LIMIT: -20°F TO 750°F

2039

CODE NUMBER	ENCODER	SIZE FROM TO	DESCRIPTION	NOTES	REV
			PIPE		
		1/2" - larger	ELECTRIC RESISTANCE WELD (ERW), 304L STAINLESS STEEL, SCHEDULE 10S, ASTM A312, GRADE TP304L, BEVELED ENDS		
			FLANGES		
		1/2" - larger	CLASS 150, STAINLESS STEEL 304L, ASTM A182, GRADE F304L, RF WELD NECK, SCHEDULE 10S BORE		
			FITTINGS		
		1/2" - larger	304L STAINLESS STEEL, BUTT WELD, ASTM A403, GRADE WP304L, SCHEDULE 10S		
			GASKETS		
		1/2" - larger	FLAT RING PER ASME B16.21, REINFORCED FLEXIBLE GRAPHITE, 1/16" THICK		
			BOLTING		
		1/2" - larger	STUD BOLT, 304 STAINLESS STEEL, ASTM A193, GRADE B8, WITH 2 HEAVY HEX NUTS, ASTM A194, GRADE 8MN		
			BUTTERFLY VALVES		
		2" - larger	CLASS 150, STAINLESS STEEL 316, ASTM A351, GRADE CF8M, 316 SS DISC AND STEM, ASTM A276, TYPE 316, 316SS SEAT, LEVER HANDLE OPERATOR FOR 2-4", GEAR OPERATOR FOR 6" AND LARGER	1	
			NOTES		
			1. EQUIP VALVE WITH LOCKING DEVICE.		

PARSONS
ERA PROJECT

JOB NUMBER	DOCUMENT NO.	REV
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SECTION 15090
PIPING SUPPORTS AND ANCHORS

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Design and location of piping supports and anchors for piping 2 inches in diameter and smaller.
- B. Design and location of piping supports and anchors for piping of all sizes when piping is supplied in combination with other equipment (i.e., "packaged systems").
- C. Furnishing and installing all piping system hangers, supports, clamps, rods, turnbuckles, bracing, rolls, plates, brackets, saddles, restraints, anchors, and other support elements as required.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 01012 - Schedule of Drawings.
- D. Section 15020 - Packaged Equipment.
- E. Section 15060 - Pipe, Fittings, Valves, and Accessories.

1.3 REFERENCES, CODES, AND STANDARDS

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A36/A36M-94 Standard Specification for Carbon Structural Steel.
 - 2. ASTM A576 Rev. B-90 Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.

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B. American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME):

- 1. ANSI/ASME B31.3-93 Chemical Plant and
1993 and 1994 Addenda Petroleum Refinery
Piping.

C. Manufacturers Standardization Society (MSS):

- 1. MSS-SP-58-93 Pipe Hangers and Supports
- Materials, Design, and
Manufacture.
- 2. MSS-SP-69-91 Pipe Hangers and Supports
- Selection and
Application.
- 3. MSS-SP-89-91 Pipe Hangers and Supports
- Fabrication and
Installation Practices.

D. American Welding Society (AWS):

- 1. AWS A5.1-91 Carbon Steel Electrodes
for Shielded Metal Arc
Welding.
- 2. AWS D1.1-94 Structural Welding Code -
Steel.

1.4 SYSTEM DESCRIPTION

A. Design Requirements

- 1. All pipe anchors, guides, and auxiliary steel shall be of bolted or welded construction incorporating a design safety factor of five.
- 2. Anchors and guides shall be used to prevent excessive forces or moments on pipe or equipment caused by hydraulic surges.
- 3. Hangers and support types for all process lines shall be selected to withstand all static and dynamic load conditions and shall take into consideration limitations imposed by the surrounding structures, equipment, adjacent piping, ductwork, and electrical trays.

Consideration shall be given to the following 2039 loads:

- a. Weight of the pipe, valves, fittings, insulation materials, hanger components, and normal fluid contents.
 - b. Weight of the hydrostatic test fluid or cleaning fluid, if normal operating fluid density is less than test or cleaning fluid.
 - c. Loads imposed during erection.
4. Support Spacing:
- a. Hangers and supports shall be spaced in accordance with ASME B31.3, Table I for Schedule 10 steel pipe, and Attachment A for Schedule 40 and Schedule 80 steel pipe. The pipe span chart is applicable to both single- and double-walled piping systems. Due consideration shall be given to ensure that the sag of the pipe between supports is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads.

Table I - Maximum Support Spacing (feet) for Schedule 10 Steel Pipe

Nominal Pipe Size (inches)	1/2	3/4	1	1-1/2	2	2-1/2	3	4	5	6	8	10
Maximum Clear Span (feet)	5	6	7	9	10	11	12	14	16	17	19	21

5. Restrictions:
- a. Pipe support assemblies shall be used only for supporting pipelines. Electrical trays, instrument trays, cable, or tubing shall be supported from separate assemblies unless written approval has been received from FERMCO. Pipe hanger rods or supports shall not pass through heat or ventilating ducts nor through electrical or instrument trays.

6. Pipe shoes:
a. Pipe shoes shall be 12 inches long, attached to the longitudinal run of pipe, and centered on the structural member.
7. Heat-Traced Pipe:
a. Electric-traced pipe lines shall rest on support steel, adjustable roller hangers, or an adjustable pipe roll and base attached to a horizontal steel member. Insulation shall be cut away at support to facilitate installation.
8. Combination Supports:
a. Where the piping design incorporates multiple horizontal pipelines with the bottom of all the pipelines at the same elevation, rack type supports shall be used. Where multiple pipelines are supported on a single support member, consideration shall be given to the difference in expansion of the pipelines and possible resultant misalignment of the support during normal operation.
9. Unit Support:
a. Where single horizontal pipelines are to be supported, the selection of the pipe attachment shall be based on the application, considering workability, function, strength, and economics. This attachment may be a pipe clamp, clevis, U-bolt, double-rod roll, or other pipe attachment best suited for the condition. The movement of the pipe due to hydraulic surges and other sources shall be considered. The attachments between the pipe and the supporting structure (usually hanger rod) shall be able to swivel at the ends to accommodate a 4-degree movement of the pipe.
10. Structural Integrity:
a. The supports shall be designed and installed so that they cannot become disengaged by movements of the supported pipe. A lock nut shall be used to prevent turning and disengagement.

1.5 SUBMITTALS

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- A. Certificate of Conformance: Manufacturer shall certify and provide data which indicate that all products supplied meet or exceed specification requirements.
 - B. Product data.
 - C. Shop drawings which indicate support type and location, arrangement, dimensions, materials, weld details, and anchor details.
 - D. Manufacturer's installation instructions and catalog data.
 - E. Welder and inspector qualifications, procedure qualification records, and welding procedure specifications in accordance with AWS D1.1.

1.6 QUALITY ASSURANCE PROGRAM

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- A. All pipe anchors, guides, and auxiliary steel shall be of bolted or welded construction. Welded construction shall comply with AWS D1.1.

1.7 DELIVERY, STORAGE, AND HANDLING

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- A. Packaging
 - 1. Materials shall be cleaned to remove chips, slag, weld spatter, oil and grease, debris, and other foreign matter prior to packing for shipment.
 - B. Storage and Handling
 - 1. Piping support materials and piping hanger systems shall be stored off the ground and handled with care so that physical damage or contamination of the materials does not occur.
 - 2. Welding rods and electrodes shall be stored, handled, and identified at all times to ensure the use of proper welding rod. Electrode ovens for the storage of low-hydrogen welding rods must be used at all times.

PART 2 PRODUCTS

2.1 PRODUCTS/EQUIPMENT

- A. Product Shipping Requirements
 - 1. All job-related materials and/or equipment shall be delivered to the job site.

2.2 MATERIALS

- A. Hangers and component parts shall be constructed of galvanized carbon steel and comply with MSS-SP-58 and MSS-SP-69.
- B. Pipe clamps shall comply with ASTM A576 and be constructed of galvanized carbon steel.
- C. ASTM A36 steel shall be used for all plate and structural shape support components.

2.3 FABRICATION

- A. Welding
 - 1. All welding shall be in accordance with the applicable codes as specified and referenced in Article 1.3.
- B. Shop Assembly
 - 1. Any parts made in the fabricator's shop shall be completely shop assembled, as far as practical, prior to shipment to the site.
- C. Shop/Factory Finish
 - 1. All carbon steel parts shall be shop prime coated after fabrication.

2.4 LABELING

- A. Product Marking
 - 1. All welding rods and electrodes shall be identified with at least one imprint per rod showing an AWS classification number in accordance with AWS A5.1.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Installation

- 1. Hanger and support components shall be installed in accordance with MSS-SP-89.

B. Structural Connections for Pipeline Supports

- 1. Locations: Pipeline supports and/or hangers shall be attached to structural members. The supports shall be located at the following places and at intermediate points so that the maximum support spacing described in Article 1.4 is not exceeded:
 - a. For changes in direction on horizontal or sloped lines, refer to the attached allowable pipe spans chart.
 - b. Both sides of flanged flow meter joints on horizontal or sloped lines.
 - c. Within 2 feet on one side of valves on horizontal or sloped lines.
 - d. The underside of floor or platform steel on vertical lines that pass through the floor or platform.
- 2. Cold Lines: Hanger rods supporting cold pipelines, or lines whose point of support does not move, may be bolted directly to angle, beam, or supporting members.
- 3. Prohibited Attachments: Pipelines shall not be attached to the following:
 - a. Floor opening pipe sleeves.
 - b. Grating or floor plate.
 - c. ASME coded vessels.
 - d. Other pipe hangers or other pipes.
- 4. Supports shall be provided to avoid the need for temporary supports in the following cases:
 - a. Where regular maintenance necessitates the removal of equipment.
 - b. Where flanged connections must be broken to remove or insert spectacle blinds.
- 5. Anchors and guides shall be designed and installed at the locations shown.

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ADJUSTING

- A. At Pumps: Where required, the suction piping and discharge piping adjacent to pumps shall be supported with an adjustable support.
- B. Riser Guides: All risers that may sway or vibrate from pump pulsations or mechanical equipment operation shall be guided. The guides/braces shall prevent movement resulting from equipment operation/vibration, but shall not limit or restrain movement of pipe due to thermal expansion. On overflow lines, a brace or restraint shall be installed near the discharge.
- C. Vertical Adjustment
 - 1. All rod-type hangers shall be provided with a means of vertical adjustment after erection. If a turnbuckle is used, the right hand thread shall be at the top, so that turning to the right will raise the pipe.
- D. Riser Piping
 - 1. Where practical, riser piping shall be supported independently of the connected horizontal piping. Pipe support attachments to riser piping shall be by riser clamps and/or lugs welded to the pipe.

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END OF SECTION

ATTACHMENT A
ALLOWABLE PIPE SPANS

Date: 03/01/96
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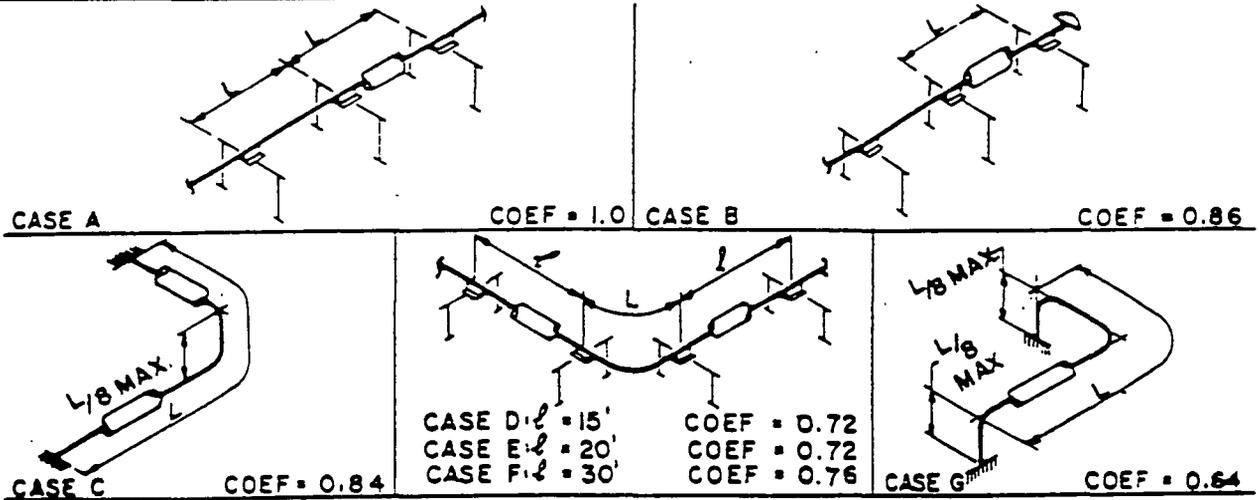
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Subject

ALLOWABLE PIPE SPANS

2039



Notes:

1. The limiting factors are deflection and weight stress. Pipe span not entered if weight stress of 6,000 pounds per square inch (psi) is exceeded.
2. The pipe spans are based on carbon steel pipe with modulus of elasticity of 30×10^6 psi. This chart can be applicable to alloy pipe.
3. Deflection is based on a compromise between a beam with fixed-ends and for a free-ended beam, $d = 17.1 (w^{1/4}/EI)$.
4. This chart is adequate for standard-wall and extra-strong walled pipe.
5. Boxed figures represent Parsons standard. Job instructions may allow deviation.
6. When using Cases B, C, D, E, F, and G, multiply pipe span by their coefficient.
7. These spans are the maximum to be used under American National Standards Institute B31.3, Piping. Design conditions and other codes should be investigated before using these spans.

PIPE SIZE	1	1½	2	3	4	6	8	10	12	14	16	18	20	24	DEF'L
BARE PIPE	-	-	-	-	-	-	-	36	38	42	45	47	50	54	1/4
	14	17	19	24	27	33	38	43	46	49	52	55	58	64	1/2
	15	18	21	25	29	35	40	46	49	52	55	58	62	68	5/8
	16	19	22	26	30	37	42	48	52	55	58	62	65	71	3/4
	17	21	23	28	32	40	45	-	-	-	-	-	-	-	1
BARE PIPE + WATER	-	-	-	-	-	-	-	31	33	35	36	37	39	42	1/4
	14	17	19	22	25	29	33	36	39	40	42	44	46	48	1/2
	14	18	20	23	26	31	35	39	41	43	45	47	49	51	5/8
	15	19	21	24	27	33	37	41	43	45	47	49	51	-	3/4
	16	20	22	26	29	35	40	-	-	-	-	-	-	-	1
PIPE + 2" INSUL.	-	-	-	-	-	-	-	34	36	39	42	44	47	52	1/4
	12	15	17	22	25	31	36	41	42	46	50	52	56	61	1/2
	13	16	18	23	26	33	38	43	45	49	53	56	59	65	5/8
	13	17	19	24	27	35	40	45	47	52	55	58	62	68	3/4
	14	18	20	26	28	37	42	-	-	-	-	-	-	-	1
PIPE + 2" INSUL. + 0.8 WATER	-	-	-	-	-	-	-	31	33	35	36	37	39	42	1/4
	12	15	16	20	23	29	33	36	39	40	42	44	46	48	1/2
	12	16	17	22	25	31	35	39	41	43	45	47	48	52	5/8
	13	17	18	23	26	32	36	41	43	45	47	49	51	-	3/4
	14	18	20	25	28	34	39	-	-	-	-	-	-	-	1

SECTION 15171
MOTORS FOR INDIRECT DRYER

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Low voltage, three phase induction motors.
- B. Low voltage, single phase induction motors.

1.2 RELATED SECTIONS

- A. Section 11182 - Indirect Dryer Performance Specification.
- B. Section 16051 - Basic Electrical Materials and Methods for Indirect Dryer.

1.3 REFERENCES

- A. American Bearing Manufacturers Association (ABMA):
 - 1. ABMA 9-90 Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11-90 Load Ratings and Fatigue Life for Roller Bearings.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE 112-91 Standard Test Procedure for Polyphase Induction Motors and Generators.
- C. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA MG 1-93 Motors and Generators.
 - 2. NEMA MG 13-84 Frame Assignments for Alternating Current Integral-Horsepower Induction Motors.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code, 1996 Edition.

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1.4 SYSTEM DESCRIPTION

- A. Provide electric motors as required for the indirect dryer. Each motor shall be selected especially for its respective driven equipment. Each motor shall be adequate for the full range of the driven equipment's performance.

1.5 SUBMITTALS

- A. Product Data: Provide data for motors, including full load amps, NEMA frame size, and additional standard nameplate data. Provide efficiency and power factor for each of 1/2, 3/4, and full load. Include catalog sheets and drawings showing voltage, ratings, impedances, normal and short circuit current ratings, dimensions, and enclosure details.
- B. Operation and maintenance data. Include assembly drawings and bearing data, including replacement sizes and lubrication instructions.
- C. Certificate of Conformance: Provide statement certifying that the materials supplied meet or exceed contract requirements.
- D. Testing Procedures: Submit written procedures for all required testing. Test procedures shall include criteria for acceptable performance.
- E. Manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and commissioning of products.
- F. Recommended Spare Parts Lists: Provide, where applicable.
- G. Submit Material Safety Data Sheets for all cutting oils, caulks, sealants, and all similar components.

H. Test Reports: Indicate satisfactory completion of required tests and inspections. Submit results verifying performance in accordance with IEEE 112. 2039

I. Motor Data Sheets: Provide completed motor data sheet (Attachment 1) for each motor provided.

1.6 QUALITY ASSURANCE

A. Conform to NFPA 70 and NEMA MG 1.

PART 2 PRODUCTS

The listing of equipment suppliers below in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal. It is the offerer's responsibility to propose equipment that is best suited for this project in combined terms of quality and price.

2.1 MANUFACTURERS

A. Reliance Electric.

B. U. S. Motors.

C. General Electric.

2.2 EQUIPMENT

A. General Construction and Requirements

1. Electrical Service: Refer to related sections of the specifications and the drawings for required characteristics.

2. Motors: Design for continuous operation at a temperature of 40 degrees C ambient, and for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type. Motors to be controlled by

variable frequency drives shall be of a design suitable for this type of operation.

3. Visible Nameplate: Indicating motor horsepower, voltage, phase, frequency, rpm, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, serial number, and bearing numbers. Nameplate shall be stainless steel, permanently attached to the motor frame.
4. Electrical Connection: Conduit connection boxes, threaded for conduit and designed to allow for 90 degree step rotation of the conduit entrance. Oversize conduit boxes shall be provided.
5. Motor Service Factor: Furnish motors with service factors required by table in Article 2.2, Paragraph D. Motor size in hp shall be selected to serve the driven equipment over its full performance range as though the service factor is 1.0.
6. Motor voltage shall be 115 V, single-phase for motors 1 hp or less. Other motors shall be 460 V, three-phase.
7. Motors drawing less than 250 W that are intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.

B. Three Phase - Squirrel Cage Induction Motors

1. Motors shall be 460 V, three phase, 60 Hz.
2. The motor connection diagram shall be stainless steel, permanently stamped and attached to the motor either inside the conduit box or on the same side as the conduit box.
3. Starting Torque: To be matched to the driven equipment.
4. Starting Current: Not to exceed six times full-load current.
5. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics or as required by the driven equipment.
6. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

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- 7. Insulation System: Non-hygroscopic NEMA Class F or better. 1
- 8. Testing Procedure: In accordance with IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and for compliance with performance data. 3
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- 9. Motor Frames: NEMA MG 13 standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts. 7
8
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- 10. Bearings: Grease lubricated, anti-friction ball bearings with housings equipped with plugged provision for prelubrication, rated for minimum ABMA 9 and 11, L-10 life of 20,000 hours. 10
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- 11. Sound Power Levels: To NEMA MG 1. 14
- 12. Motors shall be high efficiency type. 15
- 13. Motors shall be totally enclosed fan cooled (TEFC). 16
17
- 14. Nominal Efficiency: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112. 18
19
20
- 15. Nominal Power Factor: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112. 21
22
23

C. Performance Schedule: Three Phase - Energy efficient, TEFC. 24
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HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor	
1	1200	145T	81	72	28
1-1/2	1200	182T	83	65	29
2	1200	184T	85	68	30 31
3	1200	213T	85	63	32
5	1200	215T	86	66	33
7-1/2	1200	254T	89	68	34 35
10	1200	256T	89	75	36
15	1200	284T	90	72	37
20	1200	286T	90	76	38 39
25	1200	324T	90	71	40 41 42 43 44

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HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor	
30	1200	326T	91	79	1
40	1200	364T	92	78	2
50	1200	365T	92	81	3
60	1200	404T	92	83	4
75	1200	405T	92	80	5
100	1200	444T	93	83	6
125	1200	445T	93	85	7
					8
1	1800	143T	82	84	9
1-1/2	1800	145T	84	85	10
2	1800	145T	84	85	11
					12
3	1800	182T	87	83	13
5	1800	184T	88	83	14
7-1/2	1800	213T	89	85	15
					16
10	1800	215T	90	84	17
15	1800	254T	91	86	18
20	1800	256T	91	85	19
					20
25	1800	284T	92	84	21
30	1800	286T	93	86	22
40	1800	324T	93	83	23
					24
50	1800	326T	93	85	25
60	1800	364T	93	87	26
75	1800	365T	93	87	27
					28
100	1800	405T	94	86	29
125	1800	444T	94	87	30
150	1800	445T	94	88	31
200	1800	447T	95	87	32
					33
1-1/2	3600	143T	82	85	34
2	3600	145T	82	87	35
3	3600	182T	82	87	36
					37
5	3600	184T	85	88	38
7-1/2	3600	213T	86	86	39
10	3600	215T	86	86	40
					41
15	3600	254T	88	91	42
20	3600	256T	89	89	43

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HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor	
25	3600	284T	90	92	1
					2
30	3600	286T	91	92	3
40	3600	324T	91	91	4
50	3600	326T	90	92	5
					6
60	3600	364T	91	93	7
75	3600	365T	91	91	8
100	3600	405T	92	92	9
					10

For motors not in schedule, provide manufacturer's standard high-efficiency motor.

D. Service Factor Schedule

HP	3600 rpm	1800 rpm	1200 rpm	900 rpm	
1/6 - 1/3	1.35	1.35	1.35	1.35	16
1/2	1.25	1.25	1.25	1.15	17
3/4	1.25	1.25	1.15	1.15	18
1	1.25	1.15	1.15	1.15	19
>1 - 150	1.15	1.15	1.15	1.15	20
					21
					22

E. Single phase motors shall conform to the following respective requirements. The driven equipment supplier shall furnish motor starter, motor type, and motor enclosure type suitable for the application.

1. Single Phase Power - Split Phase Motors
 - a. Starting Torque: Less than 150 percent of full load torque.
 - b. Starting Current: Up to seven times full load current.
 - c. Breakdown Torque: Approximately 200 percent of full load torque.
 - d. Drip-Proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
 - e. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, .0 Service Factor, prelubricated ball bearings.

- 2. Single Phase Power - Permanent-Split Capacitor Motors
 - a. Starting Torque: Exceeding 1/4 of full load torque.
 - b. Starting Current: Up to six times full load current.
 - c. Multiple Speed: Through tapped windings.
 - d. Open Drip-Proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.
- 3. Single Phase Power - Capacitor Start Motors
 - a. Starting Torque: Three times full load torque.
 - b. Starting Current: Less than five times full load current.
 - c. Pull-Up Torque: Up to 350 percent of full load torque.
 - d. Breakdown Torque: Approximately 250 percent of full load torque.
 - e. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
 - f. Drip-Proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated bearings.
 - g. Enclosed Motors: Class A (50 degrees C temperature rise).

PART 3 EXECUTION

Not used.

END OF SECTION

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ATTACHMENT 1

MOTOR DATA SHEET

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MOTOR DATA SHEET

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Submit for each motor. Mark N/A if not applicable.

- 1. Driven Equipment Number _____
- 2. Driven Equipment Name _____
- 3. Motor Manufacturer _____
- 4. Quantity _____
- 5. Horsepower (hp) _____
- 6. RPM _____
- 7. Voltage _____
- 8. Enclosure Type _____
- 9. Frame _____
- 10. Phase/Frequency _____
- 11. Insulation Class _____
- 12. Service Factor _____
- 13. NEMA Design _____
- 14. Space Heaters _____
- 15. Full Load Amperes (FLA) _____
- 16. Locked Rotor Amperes (LRA) _____
- 17. Efficiency:
 - 1/2 Load _____
 - 3/4 Load _____
 - Full Load _____
- 18. Power Factor:
 - 1/2 Load _____
 - 3/4 Load _____
 - Full Load _____

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SECTION 15250
INSULATION

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PART I GENERAL

1.1 SECTION INCLUDES

- A. Labor, materials, and equipment required for installing pipe and equipment insulation as specified herein.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 01012 - Schedule of Drawings.
- D. Section 15060 - Pipe, Fittings, Valves, and Accessories.
- E. Section 15090 - Piping Supports and Anchors.
- F. Section 16856 - Heating Cables and Panel for Off-Gas Treatment Systems.

1.3 REFERENCES, CODES, AND STANDARDS

- A. American Society for Testing and Materials (ASTM):
1. ASTM B209-95 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 2. ASTM C533-85 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 3. ASTM C552-91 Standard Specification for Cellular Glass Thermal Insulation.
 4. ASTM C795-92 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

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1.4 SUBMITTALS

- A. Certificate of Conformance: Manufacturer shall certify and provide data which indicate that all products supplied meet or exceed specification requirements.
- B. Product data.
- C. Installation instructions.
- D. Material safety data sheets.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Insulation Materials
 - 1. Insulation materials shall be identified, inspected, controlled, and protected in a manner that will ensure conformance with the referenced codes and standards.
 - 2. Care shall be taken in the storage and handling of all insulation material so that contamination by grease, moisture, or other foreign matter does not occur. Insulation materials shall be stored off the ground, protected from the weather, and handled so that physical damage to the insulation material does not occur.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cellular glass: Board and molded (rigid), inorganic, maximum 'k' value of 0.345 Btu-inch/hour per square foot per degree F at 75 degrees F, conforming to ASTM C552 (Type II) and to ASTM C795 when installed on stainless steel pipe. To be used for temperatures below 400 degrees F.
- B. Calcium Silicate: Preformed pipe covering, flat block or curved block, in accordance with ASTM C533 (Type I). To be used for temperatures above 400 degrees F.

- C. Jacketing Aboveground: Aluminum, Alloy 3003, H14 temper, 0.020 inches thick, embossed, conforming to ASTM B209. 2
- D. Jacketing - Underground Heat Trace Applications: Wrapping consisting of polymer modified bituminous compound with a 4-mil, high-density, cross laminate, polyethylene top film and release paper backing, total thickness of 40 mils. 3
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- E. Elbow insulation covers: Aluminum, Alloy 1100, H14 temper, embossed. 10
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- F. Bedding Compound: Non-volatile, 0.008 perm inch; service temperature range of -60 degrees F to 180 degrees F; application temperature 40 degrees F to 100 degrees F, sealant. 13
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- G. Reinforcing Cloth: White open-weave, asbestos free, glass cloth, 10 by 10 weave-set mesh with nonasphaltic binder. 19
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- H. Mastic Vapor Barrier: Non-toxic fire resistant vapor-retarder type for outdoor service. 23
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25

2.2 ACCESSORIES 26

- A. Insulation Bands: 27
28
 - 1. Piping: 1/2-inch wide (minimum) by 0.015-inch thick (minimum), 304 stainless steel bands. 29
30
 - 2. Equipment: 3/4-inch wide (minimum) by 0.015-inch thick (minimum), 304 stainless steel bands. 31
32
33
- B. Screws: Number 8, by 1/2-inch, sheet metal type 302 or 304 stainless steel. 34
35
36
- C. Adhesives: Fire-resistant adhesive shall be compatible with insulation. 37
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PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

- A. Piping, valves, fittings, and flanges, shall be insulated and jacketed when the suffixes "I," "ET," or "P" appear in the pipe line number as indicated on the drawings. Equipment shall be insulated when required on the drawings.
- B. - Install materials in accordance with the manufacturer's instructions. Maintain temperatures and conditions required by the manufacturer for installation.
- C. Manholes and flanges shall have removable insulation and aluminum jacketing to permit servicing of take-down joints. Removable covers may be fabricated from segments of block insulation or from preformed sectional pipe covering and premolded components. A removable cover shall be of the same material as the adjoining pipe insulation.
- D. Fill joints and seams with bedding compound to form a smooth surface.
- E. All insulation, except for insulation on chilled water piping, shall be stopped at a sufficient distance from flanges to permit ease of bolt removal. Insulation shall be beveled at a 45-degree angle at this point.
- F. Install jacketing with screws on 3-inch centers on all fittings and valves where banding is not possible.
- G. Where aluminum insulation covers are not available, coat exterior surfaces of equipment and piping component insulation with caulking mastic to protect insulation from mechanical damage. Do not depend on caulking mastic to seal open cracks and improperly made joints.

H. Mastic Coating Application

1. Apply mastic coating by palming, troweling, or spraying. Install glass fiber cloth embedded in mastic to conceal dry weave of cloth.
2. Lap cloth joints a minimum of 2 inches and apply with a smooth unbroken surface with a minimum finished dried thickness of 1/16 inch.
3. When applying mastic coatings by spraying, protect adjacent surfaces that are not to be coated.
4. Before applying mastic coating, apply a heavy fillet of caulking mastic to inside corners of insulation and junctions of insulation and metal.
5. Apply double layer of reinforcing cloth in mastic to outside corners of insulation. Round outside corners of insulation.

I. Labels indicating "asbestos-free" shall be attached to the outside of all insulation jacketing, adjacent to all piping and equipment identification labels.

J. Pipe Insulation

1. All piping and heat tracing shall be tested in accordance with Sections 15060 and 16856 before installing insulation.
2. Piping shall be insulated and jacketed as follows:

Piping	Insulation Material	Minimum Thickness**	Jacketing
Aboveground Piping <400°F			
Up to 1-1/2"	Cellular Glass	1"*	Aluminum
2" through 4"	Cellular Glass	1-1/2"	Aluminum
6" through 8"	Cellular Glass	2"	Aluminum
10" and over	Cellular Glass	2-1/2"	Aluminum
Aboveground Piping > 400°F	Calcium Silicate	4"	Aluminum
Below Grade Piping	Cellular Glass	1-1/2"	Polymer Modified Bituminous Compound

* All electric heat traced piping shall be provided with 1-1/2 inches minimum insulation thickness.

** Insulated skin temperature shall not exceed 140 degrees F. Contractor shall determine actual insulation thickness required, but thicknesses shall not be less than those listed above.

3. Insulation shall be applied in a single layer with joints tightly butted, and shall be secured in place with bands on 12-inch centers.
4. Aluminum jacketing shall be applied directly over insulation (except below grade applications). Minimum lap for longitudinal joints shall be 1 inch, and minimum lap for circumferential joints shall be 2 inches. The jacketing shall be secured in place with bands on 9-inch centers.
5. Premolded elbow insulation and aluminum elbow covers shall be installed at all elbows. Aluminum jacketing shall be used for all other fittings, valves, flanges, etc.
6. Lap all seams against weather.
7. Finish insulation at supports, protrusions, and interruptions. At pipe supports, remove only enough insulation to provide a snug fit.
8. Inserts shall be of the same thickness, material, and contour as adjoining piping insulation. For intersection at tees or other equipment, use block or curved segments. Miter cut to fit neatly on the surface, with joints tightly butted.
9. Seal jacketing below ground per manufacturer's recommendation.
10. All insulated valves and piping systems shall be labeled in accordance with Section 15060.

K. Equipment Insulation

1. Apply insulation board directly to equipment surfaces with all joints staggered and tightly butted. Secure insulation in place with stainless steel bands on 18-inch centers.
2. Board insulation shall be cemented to irregular surfaces and all voids shall be filled with bedding compound.
3. Apply aluminum jacketing over insulation with 3-inch minimum lap on longitudinal and circumferential joints.

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4. Equipment shall be insulated as follows:

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Equipment Design Temperature	Insulation Material	Minimum Thickness*
<400°F	Cellular Glass	2-1/2"
>400°F	Calcium Silicate	4"

* Insulation skin temperature shall not exceed 140 degrees F. Contractor shall determine actual insulation thickness required, but thicknesses shall not be less than those listed above.

5. Insulation shall be cut away from all equipment identification nameplates and beveled at a 45-degree angle.
6. All equipment and heat tracing shall be tested before installing insulation.
7. All insulation shall be stopped at a sufficient distance from flanged nozzles to permit ease of the bolt removal and to allow installation of flange covers. Insulation shall be beveled back at a 45 degree angle at this point.

END OF SECTION

SECTION 16051

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BASIC ELECTRICAL MATERIALS AND METHODS FOR INDIRECT DRYER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical equipment, material, and services required for indirect dryer.
 - 1. Disconnect switches.
 - 2. Motor starters.
 - 3. Selector switches.
 - 4. Enclosures for electrical equipment.
 - 5. Molded case circuit breakers.
 - 6. Variable frequency drives.
 - 7. Conduit.
 - 8. Wire and cable.
 - 9. Instrument cable.
 - 10. Nameplates.
 - 11. Wire markers and cable tags.
 - 12. Splicing and termination components.

1.2 RELATED SECTIONS

- A. Section 11182 - Indirect Dryer Performance.
- B. Section 15171 - Motors for Indirect Dryer.
- C. Section 16856 - Heating Cables and Panel for Indirect Dryer.

1.3 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code, 1996 Edition.
- B. American National Standards Institute (ANSI):
 - 1. ANSI C80.1-90 Rigid Steel Conduit-Zinc Coated.

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- C. Underwriters Laboratories, Inc. (UL):
1. UL 360-86 UL Standard for Liquid-Tight Flexible Steel Conduit.
 2. UL 486A-91 Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 3. UL 510-94 Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
- D. National Electrical Manufacturers Association (NEMA):
1. NEMA AB 1-93 Molded Case Circuit Breakers and Molded Case Switches.
 2. NEMA ICS 1-93 Industrial Controls and Systems General Requirements.
 3. NEMA ICS 2-93 Industrial Controls and Systems, Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
 4. NEMA ICS 3.1-90 Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.
 5. NEMA ICS 6-93 Industrial Controls and Systems Enclosures.
 6. NEMA KS 1-90 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 7. NEMA 250-91 Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. Code of Federal Regulations (CFR):
1. 29 CFR 1910-92 Occupational Safety and Health Standards.

1.4 SYSTEM DESCRIPTION

- A Design Conditions: As noted in Section 11182. Ambient shall be 40 degrees C.

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- B. Design Criteria: As noted in Section 11182. 2
- C. Electrical starters, controls, wiring, and conduit 3
 required to operate the indirect dryer specified and as 4
 indicated on drawings. Where these electrical items are 5
 mounted on the same shipping section, they shall be 6
 electrically connected using wire or cable and conduit as 7
 specified herein. For items not mounted on the same 8
 shipping section, electrical interconnection diagrams 9
 shall be furnished, conveying clearly how these items are 10
 to be wired. Disregard requirements herein for material 11
 or equipment not required for the indirect dryer. 12

1.5 SUBMITTALS 13

- A. Product Data: Provide data for all equipment and 14
 materials specified. Include catalog sheets and drawings 15
 showing voltage, ratings, impedances, normal and short 16
 circuit current ratings, dimensions, and enclosure 17
 details. 18
 19
 20
 21
- B. Manufacturer's Installation Instructions: Indicate 22
 application conditions and limitations of use stipulated 23
 by product testing agency. Include instructions for 24
 storage, handling, protection, examination, preparation, 25
 installation, and commissioning of products. Provide 26
 interconnection wiring diagrams indicating actual point- 27
 to-point termination of wiring between electrical 28
 switches, controls, starters, and other equipment. Wire 29
 terminations and individual wires must be labeled with 30
 numbers. 31
 32
- C. Testing Procedures: Submit written procedures for all 33
 required testing. Testing procedures shall include 34
 criteria for acceptable performance. 35
 36
- D. Certificate of Conformance: Provide statement certifying 37
 that the equipment and materials supplied meet or exceed 38
 contract requirements. 39
 40
- E. Material Safety Data Sheet (MSDS): Submit MSDSs for 41
 cutting oils, caulks, sealants, and all other similar 42
 components. 43

F. Test Reports: Indicate satisfactory completion of required tests and inspections.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: All products and services performed shall conform to the requirements of NFPA 70.
- B. Certifications: All items shall be tested and listed for the purpose intended by Underwriters Laboratories or Factory Mutual, Inc., with label attached.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Disconnect Switches

- 1. Nonfusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- 2. Fusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: FS W-F-870. Designed to accommodate Class R fuses.

B. Motor Starters

- 1. Magnetic Motor Controller: NEMA ICS 1 and ICS 2, AC general purpose, circuit breaker, combination, Class A magnetic controller for induction motor. Each controller shall have a control power transformer with two primary fuses, one secondary fuse with other secondary lead grounded.
- 2. Coil Operating Voltage: 120 volts, 60 hertz.
- 3. Overload Relay: NEMA ICS 2 bimetal, ambient compensated.

- 4. Enclosure: NEMA ICS 6, type 4. 1
- 5. Selector Switch: Cover mounted, rotary type, on-off. 2
- 6. Minimum Size Contactor: Size 1. 3
- 7. Circuit Breaker: Instantaneous trip only, minimum 22 kA symmetrical interruption. 4
- 8. Pilot Lights: Two push-to-test, industrial type with nameplates. 5
- 9
- C. Selector Switches 10
 - 1. Stainless steel enclosure, NEMA ICS 6, type 4. 11
 - 2. Two-position, maintained contact (start/stop). 12
 - 3. Three-position, maintained contact (hand/off/auto). 13
 - 14
 - 15
- D. Enclosures for Electrical Equipment 16
 - 1. All enclosures for electrical equipment shall be type 4, conforming to NEMA ICS 6 or NEMA 250, as appropriate. 17
 - 18
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 - 20
- E. Molded Case Circuit Breakers 21
 - 1. NEMA AB 1 with integral thermal and instantaneous magnetic trip in each pole. Provide common trip handle for all poles with capability of physical lockout. Terminals, minimum 75 degrees C rated. 22
 - 23
 - 24
 - 25
 - 2. Breaker enclosures shall be type 3R, conforming to NEMA 250. 26
 - 27
 - 28
- F. Variable Speed Drives 29
 - 1. Manufacturers: 30
 - a. Cutler Hammer. 31
 - b. Allen Bradley. 32
 - c. Westinghouse. 33
 - d. Substitutions: Submit to the FERMC0 Construction Manager for engineering approval. The listing of equipment suppliers in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal. 34
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It is the offerer's responsibility to propose equipment that is best suited for this project in combined terms of quality and price.

2. Provide enclosed variable frequency drive suitable for load intended, conforming to the requirements of NEMA ICS 3.1.
3. Ratings
 - a. Rated Input Voltage: 480 volts, three phase, 60 Hertz.
 - b. Motor Nameplate Voltage: 460 volts, three phase, 60 Hertz.
 - c. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
 - d. Operating Ambient: -10 degrees C to 40 degrees C.
 - e. Humidity: 20-90 percent noncondensing.
4. Design
 - a. Employ microprocessor-based inverter logic isolated from power circuits.
 - b. Employ pulse width modulated inverter system.
 - c. Employ switching power supply operating off DC link.
 - d. Design for ability to operate drive with motor disconnected from output.
 - e. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.
5. Product Options and Features
 - a. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.
 - b. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
 - c. Volts per Hertz Adjustment: Manufacturer's standard.
 - d. Current Limit: 150 percent of rated for 1 minute.
 - e. Acceleration Rate Adjustment: 0.5-30 seconds.
 - f. Deceleration Rate Adjustment: 1-30 seconds.

- g. Provide hand-off-automatic selector switch and manual speed control. 1
- h. Input Signal: 4-20 mA DC, 250 ohms loop impedance (maximum). 2
- i. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic mode. 3
- j. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode. 4
- k. Manual Bypass: Provide contactor, motor running overload protection, and short circuit protection for full voltage, nonreversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation. 5
- l. Disconnecting Means: Include integral circuit breaker on the line side of each drive. 6

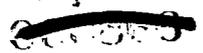
2.2 MATERIALS

A. Conduit

- 1. Rigid steel, heavy wall, galvanized conduit conforming to ANSI C80.1. Conduit shall be 3/4 inch minimum in diameter. Attachment straps, hangers, and struts shall be galvanized. 21
- 2. Liquid-tight flexible metal conduit conforming to UL 360. Conduit shall be 3/4 inch minimum in diameter. 22

B. Wire and Cable

- 1. Single conductor, 600-volt insulated copper conductor. Conductors for power and lighting branch circuits shall not be smaller than No. 12 AWG. Conductors No. 12 AWG and larger shall be stranded. Conductors for control shall not be smaller than No. 14 AWG stranded. Conductors for Class 1 remote-control and signal circuits shall be enclosed in cable and shall comply with NFPA 70. Conductors for solenoid valves and/or limit switches shall be multiconductor No. 16 AWG, as required. Power and lighting conductor insulation 23



shall be Type THW, XHHW, or THWN. Conductors required to be rated 90 degrees C in accordance with NFPA 70 shall be type XHHW-2 or THW-2.

2. Any special conductors shall be as required and UL listed for the purpose intended.

C. Instrument Cable

1. Instrumentation cable shall be No. 16 AWG stranded tinned copper conductors. Conductors shall be polyethylene insulated and rated 600 volts, 60 degrees C. Conductors shall be twisted with aluminum-polymer shield; No. 18 AWG stranded, tinned copper drain wire. Cable shall have overall-chrome gray FR-PVC jacket.

D. Nameplates

1. Nameplates shall be engraved, three-layer laminated plastic, 5/16-inch bold style, black letters on white background.

E. Wire Markers and Cable Tags

1. Wire markers shall be single-conductor, slip-on, heat-shrinkable sleeve with typed or printed black letters on a white background. Wire markers shall be similar to W. H. Brady Co. computer-printable "Bradysleeve" or approved equal.
2. Cable tags shall be rectangular, flat, non-heat-shrinkable tags with 1/8-inch-high letters. Cable markers shall be similar to Raychem-type TMS or approved equal.

F. Splicing and Termination Components

1. Wire connectors, UL 486A, as applicable.
2. Insulation tape, UL 510.
3. Provide solderless terminal lugs on stranded conductors.
4. Twist-on splicing connectors (wire nuts) are not acceptable for 480-volt splices.

2.3 FABRICATION

A. Conduit

- 1. Route conduit parallel or at right angles to equipment lines. Provide conduit supports at approximately 8-foot intervals.
- 2. Cut conduit square using saw or pipecutter. All cut ends of conduit shall be reamed.
- 3. Install no more than the equivalent of three 90-degree bends between boxes. Use hydraulic one-shot conduit bender or factory elbows for conduit diameter larger than 1-1/2 inch.
- 4. Use form 8 conduit bodies to make sharp changes in direction. Avoid moisture traps; provide junction box with weep hole.
- 5. Provide cast metal boxes such as FS or FD.
- 6. Provide 1/8-inch nylon pull cord in empty conduits.
- 7. Final conduit connections to motors or other vibrating equipment shall be made with approximately 3-foot liquid-tight flexible metal conduit.

B. Wire and Cable

- 1. All wire and cable shall be completely enclosed in conduit or in junction boxes, metal raceway, or panels.
- 2. Swab conduit before installing cable. Remove burrs, dirt, or other debris.
- 3. When pulling cable into conduit, use wire pulling compound.
- 4. Splices shall be made only in outlet or junction boxes.
- 5. Provide equipment grounding conductor along with phase conductors in all conduits.
- 6. Multiconductor cables shall contain an integral ground conductor.
- 7. Grounding conductors shall be connected to equipment with compression lugs. Grounding connections shall be made to clean, dry surfaces. Scale, rust, grease, and dirt shall be removed from surfaces to which grounding connections are to be made.

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8. Conductors shall be color coded. Conductors No. 6 AWG and larger shall be identified using colored tape at terminals and splice points. Conductors No. 8 AWG and smaller shall be identified using colored insulation or jacket. Color coding shall be as follows:

480Y/277V Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral (grounded)	Gray
Ground	Green or bare

208Y/120V Phase A	Black
Phase B	Red
Phase C	Blue
Neutral (grounded)	White
Ground	Green or bare

240/120V Phase	Black
Phase	Red
Neutral (grounded)	White
Ground	Green

C. Nameplates

1. Degrease and clean surfaces to receive nameplates.
2. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using self-tapping screws.

D. Wire and Cable Markers

1. Provide wire markers on each conductor in pull boxes and junction boxes, and at each load connection. Provide cable tags in pull boxes for multiconductor cables.
2. Wire and cable tags shall identify panel and circuit number or control wire number, as required.

E. Motor Starters

1. Install motor controllers with selector switches approximately 54 inches above finished floor.

- 2. Install overload heater elements in motor controllers to match motor characteristics. 1
- 3. Provide engraved nameplate identifying motor served. 2
- 3. Provide engraved nameplate identifying motor served. 3
- 4 4
- 5 5
- F. Selector Switches 6
- 1. Mount selector switches at a mounting height of 54 inches above the floor, adjacent to the equipment controlled. Provide unistrut mounting supports. 7
- 8 8
- 9 9
- 10 10
- G. Variable Speed Drives 11
- 1. Fabrication 12
- a. Wiring Terminations: Match conductor materials and sizes indicated. 13
- b. Enclosure: NEMA 250, Type 4. 14
- c. Finish: Manufacturer's standard enamel. 15
- 16 16
- 2. Do not install drive until building environment can be maintained within the service conditions required by the manufacturer. 17
- 18 18
- 19 19
- 3. Select and install overload heater elements in motor drives to match installed motor characteristics. 20
- 21 21
- 22 22
- 4. Provide engraved plastic nameplates as specified herein. 23
- 24 24
- 5. Provide neatly typed label inside each motor drive door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. 25
- 26 26
- 27 27
- 28 28
- 29 29
- H. Grounding 30
- 1. Provide ground conductor termination lugs (minimum two) adequate for 4/0 wire on each shipping section. 31
- 32 32
- 33 33
- 2. Bond all electrical enclosures to any conducting structures on which they are mounted and to ground termination lugs in accordance with NFPA 70. 34
- 35 35
- 36 36
- 37 37

2.4 SOURCE QUALITY CONTROL 38

- A. Testing 40
- 1. Power and Control Wire: All wires shall be tested for continuity. Wire insulation shall be megger tested between each conductor and ground. A 1000- 41
- 42 42
- 43 43

volt megger shall be used for insulation rated 600 volts. Minimum resistance shall be 50 megohms.

2. Utilization Equipment:

- a. Make electrical connections to utilization equipment in accordance with manufacturer's instructions.
- b. Installation shall conform to the requirements of NFPA 70.
- c. Motor windings shall be checked for continuity.
- d. Motor windings rated 460 volts nominal shall be megger tested with a 1000-volt megger prior to connection of power leads. Minimum acceptable resistance shall be 50 megohms.
- e. Motor and phase rotation shall be checked with a phase rotation tester similar to G. Biddle Company (Catalog No. 56060) or equal on equipment which could be damaged by reverse rotation.
 - 1) Motor and phase rotation shall be verified before energizing motors.
 - 2) All motors shall be "bumped" to check for proper direction of rotation prior to performing operational tests on the equipment.

B. Verification of Performance: Record results for testing Article 2.4, Paragraph A above, for submittal.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 16857

HEATING CABLES AND PANEL FOR INDIRECT DRYER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Heat trace power distribution panel.
- B. Heating cable.

1.2 RELATED SECTIONS

- A. Section 11182 - Indirect Dryer Performance Specification.
- B. Section 15250 - Insulation.
- C. Section 16051 - Basic Electrical Materials and Methods for Indirect Dryer.

1.3 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code, 1996 Edition.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA AB 1-93 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA PB 1-90 Panelboards.
 - 3. NEMA ICS 2-93 Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 6-93 Industrial Control and Systems Enclosures.
 - 5. NEMA 250-91 Enclosures for Electrical Equipment (1000 Volts Maximum).

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1.4

SYSTEM DESCRIPTION

- A. Heat tracing for tanks, pumps, pipe, and any other outdoor equipment requiring freeze protection with outside temperature at -10 degrees F.
- B. Power distribution panel with heat trace freeze protection control package.

1.5 SUBMITTALS

- A. Product Data: Provide data for heating cable and control components. Provide manufacturer's catalog "cut sheets" for each type or piece of equipment supplied.
- B. Manufacturer's Installation Instructions: Provide installation instructions.
- C. Certificates of Conformance: Manufacturer shall certify and provide data which indicate that all supplied products meet or exceed specification requirements.
- D. Operation Data: Submit description of operating controls.
- E. Maintenance Data: Submit repair methods and parts list of components.
- F. Test Procedures: Submit written procedures for all required testing. Test procedures shall include criteria for acceptable performance.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum 3 years experience.

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1.7 SEQUENCING AND SCHEDULING

- A. Coordinate installation of heating cable with installation of piping and piping insulation.

PART 2 PRODUCTS

The listing of equipment suppliers below in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal. It is the offerer's responsibility to propose equipment that is best suited for this project in combined terms of quality and price.

2.1 MANUFACTURERS

- A. Raychem.
- B. Chromalox.
- C. Thermon.

2.2 EQUIPMENT

- A. Heat Trace Power Distribution Panel: As required for equipment requiring freeze protection, and consisting of the following:
 1. Distribution panelboard with 30 mA GFCI circuit breakers. Panel shall conform to NEMA PB 1 with circuit breakers conforming to NEMA AB 1. Panel shall be rated 100 amp minimum, 120/240 V, single phase (or as required by heating cables) with breakers sized for heating cables served and panel amperes adequate for heating cable load served.
 2. Selector Switch: Hand-Off-Auto.
 3. Contactor: NEMA ICS 2.
 4. Contactor coil status light.
 5. Enclosure: Type 4X according to NEMA 250.

2.3

MATERIALS

- A. Heating Cable
 - 1. Self-limiting, parallel resistance electric tracing cable. Maximum output temperature 150 degrees F.
 - 2. Rating: 120 V or as required.

2.4

ACCESSORIES

- A. Thermostat: Type 4X according to NEMA ICS 6, adjustable setpoint, suitable for -30 degrees F to 140 degrees F.
- B. Pilot light.
- C. Power termination kits, splice kits, tee kits, and end seals shall be utilized.
- D. Provide stainless steel identification tags for all devices. Include assembly and circuit numbers.

2.5

FABRICATION

- A. Provide heat trace power distribution panel separately. Install heating equipment on tanks, filters, pumps, and piping systems as required. Install to allow for heat trace cable to be moved aside for maintenance of piping system.
- B. Install in accordance with manufacturer's instructions and NFPA 70.
- C. Avoid pinching and making sharp bends in cable.
- D. Prevent damage by sharp objects during installation.
- E. Do not install electric tracing cables across expansion joints.
- F. All electric heat trace cables shall be installed in the 7 and 8 o'clock positions or in the 4 and 5 o'clock positions on horizontal runs of pipes.

000271

G. Accurately record actual locations of heating cable, thermostats, and branch circuit connections. 2039

2.6 SOURCE QUALITY ASSURANCE

- A. Test continuity of heating cable.
- B. Measure insulation resistance to manufacturer's recommended values. Use test instruments in accordance with manufacturer's instructions.
- C. Perform continuity and insulation resistance test on completed cable installation prior to installation of thermal insulation.
- D. Measure voltage and current at each unit.

PART 3 EXECUTION

Not used.

END OF SECTION

2039

Off-Gas
Treatment System

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2039

**Basis of
Off-Gas Treatment System**

**Operable Unit 1
Project Order 145**

**March 1996
Revision B**

**Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487**



**25 Merchant Street
Cincinnati, Ohio 45246**

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BASIS OF OFF-GAS TREATMENT SYSTEM

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The off-gas treatment system consists of all components in contact with the off-gas from the rotary dryer outlet through the stack. The off-gas treatment system removes steam, particulates, organic contaminants and acid gases from the off-gas before release to the atmosphere. The system is illustrated on the Process Flow Diagram - Drying and Off-Gas Treatment, and begins on Process Flow Diagram (PFD) SK-F-03911 with the exit of off-gas from the dryer. The first step in the off-gas treatment system is the removal of large entrained solids in the electrically heated cyclone (shown on PFD SK-F-03911). The off-gas then passes through a venturi scrubber, for further removal of solids to protect the downstream equipment from solids buildup. From the venturi scrubber, the off-gas passes through a packed tower scrubber equipped with a mist eliminator where the majority of the acid gases are removed. The scrubber uses a caustic solution to scrub acid gases. The caustic solution is maintained at the desired strength in the combined sump for the two scrubbers. In addition, the water add/bleed rate from this sump is controlled to maintain the solids level below 5 wt% solids.

The off-gas from the packed tower is then cooled and condensed (water and organics) in a shell-and-tube type heat exchanger using chilled water as the cooling medium. An electrically powered heat exchanger is then used to reheat the off-gas and thus reduce its relative humidity to prevent condensation in the downstream MEPA and HEPA filters. Finally, the off-gas passes through the induced draft fan and stack before release to the atmosphere.

At this point, space is being reserved for potential future carbon beds in the event that radon emissions control is required. Ancillary equipment, which is located in the same area as the off-gas treatment equipment, will be procured together with the off-gas treatment equipment. Detailed integrated design for all of this equipment, including mounting skids, will be prepared as part of the Detailed Off-Gas and Ancillary Equipment Specification.

The components of the off-gas treatment system and ancillary equipment are described in individual specification sections, which are included in draft form in this package. The specifications are as follows:

- 1) Section 01010 - General Requirements
- 2) Section 11501 - Scrubber System - Packaged venturi and packed-tower type scrubber system
- 3) Section 13205 - Tanks and Immersion Heaters - Condensate transfer tank, wastewater transfer tank, and caustic day tank with immersion heater
- 4) Section 14570 - Rotary Airlock Feeders
- 5) Section 15060 - Pipe, Fittings, Valves, and Accessories

- | | | |
|-----|---|----|
| 6) | Section 15090 - Piping Supports and Anchors | 1 |
| 7) | Section 15160 - Pumps | 3 |
| 8) | Section 15173 - Motors for Off-Gas Treatment System | 4 |
| 9) | Section 15250 - Insulation | 5 |
| 10) | Section 15755 - Heat Exchangers - Includes off-gas condensers, off-gas reheater, and heat economizer | 6 |
| 11) | Section 15860 - Fans - Includes process and combustion off-gas exhaust fans and air supply fan | 7 |
| 12) | Section 15883 - Cyclone | 8 |
| 13) | Section 15885 - Air Cleaning Devices - Includes Medium-Efficiency Particulate Air (MEPA) filters, High-Efficiency Particulate Air (HEPA) filters, filter housing, and differential pressure gauges. | 9 |
| 14) | Section 15890 - Ductwork - Systems, Stack, and Supports. | 10 |
| 15) | Section 16053 - Basic Electrical Materials and Methods for Off-Gas Treatment System | 11 |
| 16) | Section 16170 - Grounding and Bonding for Off-Gas Treatment System | 12 |
| 17) | Section 16856 - Heating Cables and Panel for Off-Gas Treatment System | 13 |

In addition to the above, the following deliverables will become part of the Detailed Off-Gas and Ancillary Equipment Specification. These items are not included in the Prefinal Design package.

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| 1) | P&IDs | 14 |
| 2) | General arrangement drawings | 15 |
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| 4) | Instrumentation specification sections | 17 |
| 5) | Material and equipment list | 18 |
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| 7) | Instrument details | 20 |
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| 9) | Mechanical utilities drawings | 22 |
| 10) | Electrical drawings | 23 |

**Off-Gas Treatment and
Ancillary Equipment Specifications
Pre-Final Design**

**Operable Unit 1
Project Order 145
WBS No. 1.1.1.1.1.3.1
March 1996
Revision B**

**Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487**



**25 Merchant Street
Cincinnati, Ohio 45246**

U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERMCO SUBCONTRACT NO. 2-21487

PROJECT ORDER 145
WBS NO. 1.1.1.1.1.3.1
OFF-GAS TREATMENT AND
ANCILLARY EQUIPMENT SPECIFICATIONS

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SECTION 01010
GENERAL REQUIREMENTS

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PART 1 GENERAL

1.1 SCOPE

- A. These general requirements form a part of the technical divisions of these specifications.
- B. In all cases where the words "A/E Subcontractor" appear in these specifications, it shall be understood to refer to PARSONS or to such other individuals or organizations acting within the scope of the specific duties entrusted to them.
- C. In all cases where the terms "Vendor" or "Seller" or "Manufacturer" or similar terms appear in these specifications or in the appendices to these specifications, they shall be understood to refer to an individual or firm(s) providing materials, equipment, or services, as noted, under a subcontract to Fernald Environmental Restoration Management Corporation (FERMCO).
- D. The Vendor shall provide written procedures for FERMCO's review and approval of all tests to be performed as identified in the drawings and specifications. These procedures shall provide detailed step-by-step operations with sign-off columns and shall be submitted and approved prior to testing.
- E. All work shall be accomplished in accordance with the following code requirements:
 - 1. Ohio Basic Building Code (OBBC) 1995.
 - 2. Uniform Building Code (UBC) 1994.
 - 3. Code for Safety to Life from Fire in Buildings and Structures (NFPA 101, Life Safety Code) - 1994.
 - 4. All other National Fire Protection Association (NFPA) Codes - All inclusive, including 1996 revisions.

5. Occupational Safety and Health Administration
(OSHA) - 29 CFR 1910 and 29 CFR 1926.

1.2 SITE AND SCOPE

- A. The intent of these specifications is to provide all technical information required and necessary to provide the work as required by the Contract.
- B. Environmental Requirements
 - 1. Environment: Outdoor, low-level radioactive, contaminated area.
 - 2. Plant Condition:
 - a. Location: Fernald, Ohio.
 - b. Elevation: 578 feet above sea level.
 - c. Ambient Temperature: -10 to 110 degrees F.
 - d. Barometric Pressure: 29.31 inches Hg. absolute (mean at 70 degrees F).
 - e. Relative humidity: 20 to 90 percent.

1.3 LISTS OF MATERIALS, MANUFACTURERS, OR EQUIPMENT SUPPLIERS

- A. The listing of materials, equipment, manufacturers' names, or equipment suppliers in these specifications in no way precludes the offerer from proposing alternate materials, equipment, manufacturers' names, or equipment suppliers of any of the items to be furnished within the scope of these specifications, except where specifically precluded by these specifications. These lists are intended to identify the types and general quality of those items that will be included in the offerer's proposal. It is the offerer's responsibility to propose the materials, manufacturers' names, or equipment that is best suited for this project in combined terms of quality and price.

1.4 SUBMITTALS - SHOP DRAWINGS, SAMPLES, AND OTHER DATA

- A. Section 01011 has the submittal listing. Refer to Part 6 and 7, Statement of Work, in the Invitation for Bid for other submittal requirements. Any submittals not

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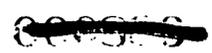
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in conformance with these requirements will be returned
without review for correction and resubmittal:

1. Assemble and submit, if required, in logically arranged folders, the following:
 - a. All instruction bulletins, diagrams, lubrication schedules, operating instructions, parts lists, and pamphlets for equipment and apparatus furnished, including vendor's or manufacturer's recommended procedure for lifting, handling, and installing equipment.
2. Submittals for equipment shall include manufacturer's catalog "cut sheets" or similar information bulletins indicating the model number or catalog number, ratings, size, weight, and performance curves and data. Indicate operating point on curves and tabular data for each piece of equipment that curves or data represent.
3. Submit wiring diagrams or connection diagrams for equipment items, accompanied by adequately defined symbols list. Schematic and wiring diagrams must be prepared in accordance with ANSI/IEEE Publication Y32E, "Electrical and Electronics Graphics Symbols and Reference Designations." Individual 8-1/2 by 11-inch elementary and wiring drawings are not acceptable.
4. Indicate all performance data, construction material finishes, and modifications to manufacturer's standard design specified.
5. Locate termination points for all required external wiring.
6. Indicate roughing-in, foundation, and support point dimensions.
7. Submit written test procedures for all required testing. Include criteria for acceptable performance. Submit test reports after completion of tests.
8. Submit Material Safety Data Sheets (MSDSs), if required, for all cutting oils, caulks, sealants, lubricants, paints, etc., and all other similar compounds.
9. The A/E Subcontractor's review of such submittals shall not relieve the Vendor from any



responsibility for deviations from contract drawings or specifications, unless the Vendor has in writing called the A/E Subcontractor's attention to such deviations at the time of submission, nor shall it relieve the Vendor from responsibility for errors of any sort in the submittals nor from responsibility for the proper fitting and construction of the work.

10. Submittals will be reviewed with respect to such factors as quality of draftsmanship, legibility, and evidence that the Vendor is aware of the necessity and importance of adequately detailing and illustrating special features and conditions relating to the work. Dimensions, sizes, construction details, and directive notes shown will be reviewed for accuracy, compliance with the specifications, adequacy, interferences, etc., on a spot check or incomplete basis to establish that the Vendor has given such factors careful attention.
11. Any changes marked on submittals during review will be for the purpose of indicating the requirements of the contract documents, and no change in the contract amount is authorized by such markings.
12. When submittals are found to be satisfactory with respect to the above factors and within the scope of the review outlined above, they will be returned by FERMCO to the Vendor bearing certificate attachment permitting the Vendor to employ them in the furtherance of the Vendor's work under the contract, but only with the express understanding that such permission shall not relieve the Vendor of the responsibilities for the full performance of the work required under the contract in conformance with the contract documents governing such performance, nor for any other deficiencies in the submittals such as inaccuracies, discrepancies, omissions, interferences in the work itself, or with the work of other contractors, whether or not such deficiencies were observed or noted in the course of the review of the shop drawings.

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1.5 REFERENCES

A. The publications listed in the technical specifications form part of this specification. Each publication shall be the latest revision and addendum in effect at the time of issue of contract and of issue of the specification unless notified otherwise. Except as modified herein or in the details of the drawings, work included in this specification shall conform to the applicable provisions of these publications.

1.6 OPERATING MANUALS AND SPARE PARTS LISTS

A. Copies of manufacturers recommended spare parts list shall be submitted prior to the shipment of any item of equipment.

B. An Installation, Operation, and Maintenance (IOM) Manual shall be prepared so as to provide optimum operation and maintenance of the equipment and systems being furnished.

C. The cover of the IOM Manual shall include the following information:

- 1. Project Title -
- 2. WBS No. -
- 3. A/E Subcontractor - PARSONS.
- 4. Construction Manager - FERMO.
- 5. Subcontractor (Name of Subcontractor, if any).

D. The IOM Manuals shall be bound into one or more volumes for ease of handling and shall have an index. The manual shall include descriptive literature, drawings, performance curves and rating data, test reports, and spare parts lists. The maintenance section shall divide maintenance procedures into two categories, "Preventive Maintenance" and "Corrective Maintenance," and a subsection for "Safety Precautions." Preventive maintenance shall include cleaning and adjustment instructions. Corrective Maintenance shall include instructions and data arranged in the normal sequence of corrective maintenance (i.e., troubleshooting) (logical effect to cause), then repair and replacement

of parts, then the parts list. Safety Precautions shall comprise a list of safety precautions and instructions to be followed before, during, and after making repairs, adjustments, or routine maintenance.

- E. Submit complete sets of final, approved manuals prior to the shipment of the equipment or system.

1.7 SPECIFICATION EXPLANATION

- A. General: The technical specifications are of the abbreviated, simplified, or streamlined type and include incomplete sentences. Omissions of words or phrases such as "the contractor shall," "in conformity therewith," "shall be," "as noted on the drawings," "according to the plans," "a," "the," and "all" are intentional. Omitted words or phrases shall be supplied by inference in the same manner as they are when a "note" occurs on the drawings.

For convenience of reference and to facilitate the letting of contracts, the specifications may be separated into titled divisions. Such separations, however, shall not operate to make the A/E Subcontractor an arbitrator to establish the limits of subcontracts in any manner. The following defines the separations referred to in the specifications.

- 1. Division: Separate numbered division of specifications (e.g., Div. 16)
- 2. Section: Separate numbered section of a division (e.g., Sec. 16020)
- 3. Article: Separate numbered article of a subsection (e.g., Article 2.1)

- B. Definitions: Certain terms and words as used throughout the specifications shall be defined as follows, unless otherwise particularly specified:

- 1. "Provide": Furnish and install, complete, in place.
- 2. "Indicated": As shown on the drawings and/or specified.
- 3. "Directed,"
"Authorized,"

- "Permitted": Shall be as directed, authorized, or permitted by FERMCO. 1
- 4. "Selected": Shall be as selected by the Subcontractor/A-E or FERMCO. 2
- 5. "Satisfactory," "Acceptable": Satisfactory or acceptable to FERMCO. 3
- 6. "Necessary," "Required," "Suitable": As necessary, required, or suitable for the intended purpose as determined by FERMCO. 4
- 7. "Submit": Submit to FERMCO unless otherwise specified 5

1.8 ABBREVIATIONS FOR REFERENCED STANDARDS AND SPECIFICATIONS

A. The following list denotes abbreviations used in the technical portions of these specifications:

<u>Abbreviation</u>	<u>Authority</u>	
AASHTO	American Association of State Highway and Transportation Officials.	21
ACI	American Concrete Institute	22
ADC	Air Diffusion Council	23
AGC	Associated General Contractors of America	24
AISC	American Institute of Steel Construction	25
AISI	American Iron and Steel Institute	26
AMCA	Air Movement and Control Association	27
ANSI	American National Standards Institute	28
APA	American Plywood Association	29
API	American Petroleum Institute	30
ARI	Air Conditioning and Refrigeration Institute	31
ASCE	American Society of Civil Engineers	32

<u>Abbreviation</u>	<u>Authority</u>	
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers	1 2 3
ASME	American Society of Mechanical Engineers	4 5
ASTM	American Society for Testing and Materials	6 7
AWS	American Welding Society	8
AWWA	American Water Works Association	9
CFR	Code of Federal Regulations	10
DHI	Door and Hardware Institute	11
FGMA	Flat Glass Marketing Association	12
FM	Factory Mutual System	13
GA	Gypsum Association	14
ICBO	International Conference of Building Officials	15 16
IEEE	Institute of Electrical and Electronics Engineers	17 18
IMIAC	International Masonry Industry All- Weather Council	19
MBMA	Metal Building Manufacturers Association	21 22
NAAMM	National Association of Architectural Metal Manufacturers	23 24
NCMA	National Concrete Masonry Association	25 26
NEC	National Electrical Code	27
NEMA	National Electrical Manufacturers Association	28 29
NFPA	National Fire Protection Association	30 31
NIST	National Institute of Science and Technology	32 33
NPCA	National Paint and Coatings Association	34 35
ODOT	Ohio Department of Transportation	36
PCA	Portland Cement Association	37
PCI	Prestressed Concrete Institute	38
PDCA	Painting and Decorating Contractors of America	39

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Abbreviation

Authority

PS	United States Department of Commerce, Voluntary Products Standards	1 2 3
SDI	Steel Deck Institute	4
SDI	Steel Door Institute	5
SIGMA	Sealed Insulating Glass Manufacturers Association	6 7
SJI	Steel Joist Institute	8
SMACNA	Sheet Metal and Air Conditioning Contractors National Association	9 10
SSPC	Steel Structures Painting Council	11
UL	Underwriters Laboratories, Inc.	12

END OF SECTION

SECTION 11501
SCRUBBER SYSTEM

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Packed-tower type scrubber system.
- B. Venturi scrubber system.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 13405 - Instruments and Equipment for Scrubber System.
- D. Section 15020 - Packaged Equipment.
- E. Section 15060 - Pipe, Fittings, Valves, and Accessories.
- F. Section 15173 - Motors for Off-Gas Treatment System.
- G. Section 15860 - Fans.
- H. Section 16053 - Basic Electrical Materials and Methods for Off-Gas Treatment System.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES, CODES, AND STANDARDS

- A. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7-93 Minimum Design Loads for Buildings and Other Structures.

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B. American Society of Mechanical Engineers (ASME);

1. ASME Boiler and Pressure Vessel Code, Section VIII, Division 1-95.

C. International Conference of Building Officials (ICBO):

1. Uniform Building Code - 1994.

1.5 SYSTEM DESCRIPTION

A. Design Requirements

1. The scrubber system shall use a venturi scrubber to remove the majority of the particulates from the off-gas, and a countercurrent caustic solution in a packed-bed column scrubber to remove NO₂, HF, CO₂, NH₃, and dust particulates (see Attachment A). The system shall include the associated recirculation pumps, tank, controls, instrumentation, and interconnecting piping.

1.6 SUBMITTALS

A. Submittals shall be in accordance with Section 01011.

B. Product Data: Certified performance data. Provide catalog sheets indicating rated capacity, size, model number, and materials of construction.

C. Spare parts recommendations.

D. Current user's list for similar scrubber system.

E. Shop drawings: Indicate general assembly and wiring diagrams, dimensions, and weights; include anchor settings, sizes, locations, and nozzle ratings, including sizes and locations.

F. Shipping Plan: The plan shall define routing, precautions, shipping weights of major components, loading and handling requirements, carrier, shipping documents, and any other data to ensure safe and timely delivery of the requisitioned items. The plan shall include a description of all items disassembled to ship the scrubber system.

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- integrated unit mounted on a skid. See Attachment
- B - Scrubber System Data Sheet.
 - a. Venturi scrubber.
 - b. Packed-bed type scrubber.
 - c. Column internals (packing, liquid distributors, mist eliminator, packing supports).
 - d. Recirculation tank with flanged connections.
 - e. Recirculation pump(s).
 - f. Instrumentation.
 - g. Recirculation piping, vents, drains, and valves including required supports.
 - h. All system controls and motor starters.
 2. The packed column and venturi scrubber shall be mounted on the recirculation tank.
 3. Materials shall be suitable for specified operating conditions. No aluminum components shall be used.
 4. The recirculation tank shall have the following flange connections: drain, recirculation pump suction, liquid sample port, makeup water, and caustic makeup.
 5. All connections on the venturi scrubber, packed tower, pumps, and recirculation tank shall be flanged.
 6. The base skid shall be constructed from carbon steel and epoxy coated.
 7. System shall include nozzles, bolts, gaskets, and any other materials needed to provide a complete working system.
- B. Performance Requirements - See Attachment A - Scrubber System Sizing and Performance Data.
- C. Pumps
1. Type: Centrifugal electric motor driven.
 2. Pumps shall have mechanical seals.
 3. Pumps shall have flanged suction and discharge connections, drain with plug, and base plate with drain, as appropriate.

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D. Design Loads

- 1. Equipment/structural design shall provide for loads as specified below:
 - a. Roof, live load: 20 psf.
 - b. Platforms and walkways, live load: 60 psf.
 - c. Wind load: Velocity pressure shall be calculated using equation 3 of ASCE 7-93, using $V = 80$ mph basic wind speed and $I = 1.07$. Design wind pressures and forces shall be in accordance with ASCE 7-93, Table 4.
 - d. Seismic load: Use provisions of the Uniform Building Code, using $Z = 0.13$, $c = 2.75$, $I = 1.25$, and $R_w =$ reduction factors from Table 16-P. W (total seismic load) shall include all normal operating contents, piping, and attachments.
 - e. Shop drawings shall state the vertical loads and lateral forces used (wind and seismic) in the design.

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2.3 ACCESSORIES

A. Control Requirements:

- 1. Refer to Section 13405.
- 2. Provide the following items for operation:
 - a. Sight flow glasses or flow indication for the recirculation line(s) and the air duct.
 - b. Sight glasses or indication for the level of the scrubber recirculation tank.

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B. Skid

- 1. The packed tower and venturi scrubber system, pump(s), motor(s), instrumentation, and controls shall be interconnected and skid mounted.
- 2. The skid assembly shall have provisions for handling via forklift, and lifting eyes for movement by crane.

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2.4 FABRICATION

- A. Prior to shipment, the scrubber system assembly shall be cleaned of all dirt, dust, grease, grime, weld spatter, and other foreign material. Any open end

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connections shall be sealed to prevent the entrance of foreign material. Equipment shall be primed and painted in accordance with manufacturer's standard finish.

2.5 LABELING

- A. Each item shall have a manufacturer's standard nameplate permanently attached at a location which is easily readable. The nameplate shall contain the following information, as applicable:
 - 1. Item description.
 - 2. Item number.
 - 3. Manufacturer's name.
 - 4. Purchase order number.
 - 5. Date of manufacture.
 - 6. Capacity.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

- A. The installation of the equipment shall be in accordance with the manufacturer's instructions and design drawings.
- B. A copy of the manufacturer's installation instructions and service manual for each piece of the equipment shall be provided.

3.2 QUALITY CONTROL

- A. Provide start-up service after completion of installation. Start-up service shall include verification of proper mechanical and electrical installation and conducting of acceptance tests.
- B. Tests: Acceptance operating tests shall be performed by the Contractor after installation to illustrate conformance to the removal efficiency requirements of this specification. If the results are unsatisfactory, the Contractor shall adjust or replace the equipment to

meet the specification requirements, and retest the equipment.

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3.3

DEMONSTRATION

- A. Demonstrate ability to meet specified performance. This testing shall be performed at the manufacturer's facility and witnessed by a FERMC0 representative. Test procedures and data sheets must be approved by FERMC0 prior to the test. The Contractor shall provide notice to FERMC0 prior to the test.

END OF SECTION

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ATTACHMENT A

SCRUBBER SYSTEM SIZING AND PERFORMANCE DATA

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SCRUBBER SYSTEM SIZING AND PERFORMANCE DATA

INLET FLUID CONDITIONS

(from Cyclone Off-gas)

Composition of Maximum Off-gas Flow (lb/hr)

Composition:

<u>Water Vapor</u>	<u>60.2 wt%</u>	<u>8447</u>
<u>Air</u>	<u>24.1 wt%</u>	<u>3376</u>
<u>NO₂</u>	<u>3850 ppm</u>	<u>54</u>
<u>CO₂</u>	<u>2924 ppm</u>	<u>41</u>
<u>HF</u>	<u>1212 ppm</u>	<u>17</u>
<u>NH₃</u>	<u>1141 ppm</u>	<u>16</u>
<u>Organic Vapors</u>	<u>71 ppm</u>	<u>1</u>
<u>Solids (Including Water & Organics)</u>	<u>9 wt%</u>	<u>1185</u>
<u>TOTAL</u>		<u>13,137</u>

Max Concentration Conditions

NO₂: 15,450 ppm @ 1400 acfm
 CO₂: 7365 ppm @ 2210 acfm
 HF: 4700 ppm @ 1400 acfm
 NH₃: 2850 ppm @ 2210 acfm
 Solids: 1185 lbs @ 2436 acfm (17.6 wt %)

Particle Size Distribution:

<u>Finest Distribution</u>		<u>Coarsest Distribution</u>	
<u>% finer</u>	<u>size (microns)</u>	<u>% finer</u>	<u>size (microns)</u>
100	100	100	100
98.6	60	96.8	50
84.4	20	93.6	30
70.7	10	81.3	20
56.9	6	56.6	10
27.5	2	49.4	6
19.6	1	14.5	2
		5.8	1
		2	1

Pressure: Approximately (-)8 inches wc

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EQUIPMENT PERFORMANCE REQUIREMENTS

Venturi Particulate Removal Requirements:

<u>Particle Size(microns)</u>	<u>Removal Efficiency</u>
>4	100%
3-4	100% (±0.5%)
2-3	98.8% (±0.5%)
1.5-2	96.5% (±0.5%)
1.0-1.5	92.8% (±1%)
0.5-1.0	83.8% (±2%)
0-0.5	65% (±5%)

Overall Venturi/Packed Tower Scrubbing Requirements:

<u>Contaminant</u>	<u>Removal Efficiency (minimum)</u>
NO ₂	93%
HF	99.5%
NH ₃	99.5%
CO ₂	98%

Recycle Fluid Service: Scrubber Sump Sodium Hydroxide Based Solution

Sumps from Venturi and Packed Tower to be integrated.

Bleed & Water Add Rate: To maintain solids in sump at ≤ 5 wt%

Materials of Construction, Wetted Parts: 316 stainless steel

Pressure Drop (estimated; TBD by Vendor) approximately 32 in. W.C.

Venturi Throat Adjustment Turndown Ratio: 4:1

Caustic Supply: 50 percent concentration NaOH

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ATTACHMENT B

SCRUBBER SYSTEM DATA SHEET

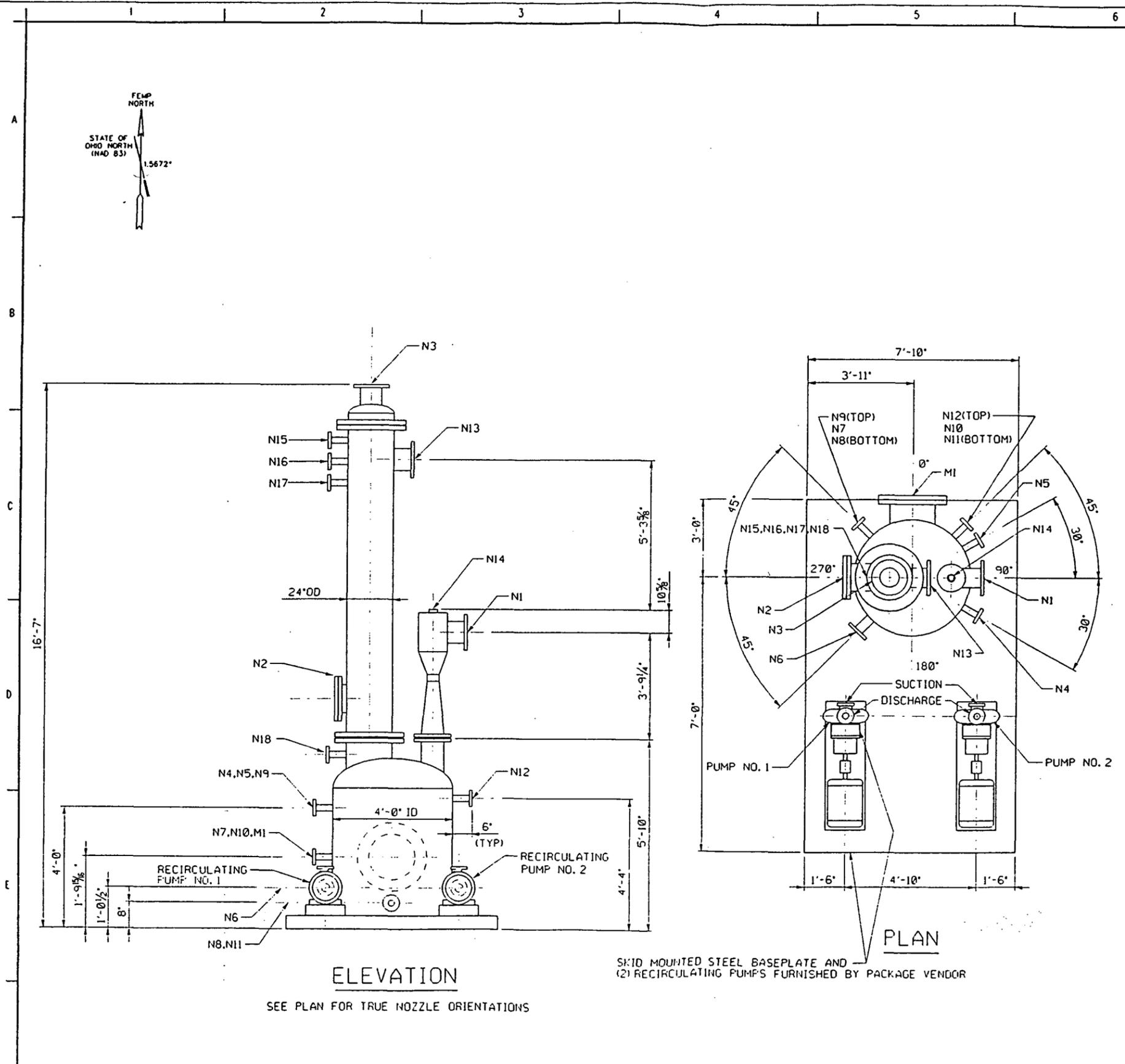
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SCRUBBER SYSTEM TANK DATA

GENERAL
 1. CODES AND STANDARDS: ASME SECTION VIII, DIV 1 1995, ASCE 7-93
 2. SERVICE: OFF-GAS

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VENTURI DESIGN DATA

FLOW CAPACITY:	MINIMUM		MAXIMUM	
	IN	OUT	IN	OUT
GAS:	1532 acfm 3516*/hr	1199 acfm	5177 acfm 11831*/hr	4513 acfm
SOLIDS ¹ :	123*/hr	3.9*/hr	1185*/hr	59.6*/hr
TEMPERATURE:	266 F	196 F	360 F	197 F

1. MAXIMUM (IN) SOLIDS @ 5565 lb/hr (2436 acfm)
 MINIMUM (IN) SOLIDS @ 11828 lb/hr (5176 acfm)

PACKED TOWER DESIGN DATA

FLOW CAPACITY:	MINIMUM		MAXIMUM	
	IN	OUT	IN	OUT
GAS:	1199 acfm 3083*/hr	1146 acfm	4549 acfm 11362*/hr	4457 acfm
SOLIDS ¹ :	3.9*/hr	2.3*/hr	59.6*/hr	35.1*/hr
TEMPERATURE:	196 F	195 F	197 F	195 F

1. MAXIMUM (IN) SOLIDS @ 8161 lb/hr (3207 acfm)
 MINIMUM (IN) SOLIDS @ 11524 lb/hr (4549 acfm)

INSPECTION AND TEST
 PER ASME B & PV CODE SECTION VIII

- NOTES:**
- THIS PACKAGE SHALL BE PROVIDED COMPLETE WITH ALL INTERCONNECTED PIPING, VENTS, DRAIN, INSTRUMENTATION, AND CONTROLS.
 - VENDOR SHALL PROVIDE LIFTING AND ANCHOR SYSTEMS PER CODE.
 - FOR DESIGN LOADS SEE SPECIFICATION SECTION 11501, ARTICLE 2.2D.

NOZZLE AND ACCESS WAY SCHEDULE

MARK	SIZE	CLASS	TYPE	SERVICE	REMARKS
N1	10"	150	RFSO	INLET	OFF-GAS
N2	8"	150	RFSO	CLEANOUT	WITH BLIND
N3	10"	150	RFSO	OUTLET	OFF-GAS
N4		150	RFSO	INLET	PROCESS WATER
N5		150	RFSO	INLET	SODIUM HYDROXIDE
N6		150	RFSO	OUTLET	PUMP SUCTION
N7		150	RFSO	LEVEL SWITCH	LSLL
N8		150	RFSO	LEVEL INST	TRANSMITTER
N9		150	RFSO	LEVEL SWITCH	LSHH
N10	1 1/2"	150	RFSO	TEMP INST	
N11	1 1/2"	150	RFSO	TEMP INST	
N12	1 1/2"	150	RFSO	PRESS INST	
N13		150	RFSO	INLET	CAUSTIC
N14	2"	3000	CPLG	INLET	CAUSTIC
N15	1 1/2"	150	RFSO	DIFF. PRESSURE	
N16	1 1/2"	150	RFSO	DIFF. PRESSURE	
N17	1 1/2"	150	RFSO	DIFF. PRESSURE	
N18	1 1/2"	150	RFSO	DIFF. PRESSURE	
M1	20"	150	RFSO	ACCESS	WITH BLIND

SKID MOUNTED STEEL BASEPLATE AND (2) RECIRCULATING PUMPS FURNISHED BY PACKAGE VENDOR

PARSONS ERA PROJECT

PROJECT NAME: OUI REMEDIATION SYSTEM DESIGN
 WBS: 1.1.1.1.3.1

TITLE: MECHANICAL PROCESS DATA SHEET
 ATTACHMENT B - SCRUBBER SYSTEM

SPECIFICATION NO. 11501
 CRU/PO WPRAP/145/OFFGAS
 SHEET NO. 1 OF 1
 SKETCH NO. SK-M-04183
 REV NO. 000300 B

SECTION 13205
TANKS AND IMMERSION HEATERS

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Carbon steel tanks (condensate transfer tank, wastewater transfer tank).
- B. Stainless steel tank (caustic day tank).
- C. Immersion heaters.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 15020 - Packaged Equipment.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

- A. American Petroleum Institute (API):
 - 1. API Std. 620-90 Design and Construction of Large, Welded, Low-Pressure Storage Tanks.
- B. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7-93 Minimum Design Loads for Buildings and Other Structures.
- C. Uniform Building Code (UBC), 1994 Edition.

1.5

SUBMITTALS

- A. Provide submittals per Section 01011. 3
- B. Shop Drawings: Indicate dimensions; sizes; weights; material thicknesses; and nozzle locations, sizes, and ratings. 4 5 6 7 8
- C. Design Data: Provide product literature, drawings, and calculations that indicate the tanks meet or exceed the specified requirements. 9 10 11 12
- D. Test Procedures: Submit written procedures for all required testing. Test procedures shall include criteria for acceptable performance. 13 14 15 16
- E. Test Reports: Provide inspection and test data. 17 18
- F. Welding Qualifications: Provide welder and inspector qualifications. 19 20 21
- G. Manufacturer's Instructions: Provide installation and support requirements. 24
- H. Certificates: Certify that equipment meets or exceeds specified requirements. 25 26 27

1.6 **DELIVERY AND HANDLING**

- A. Store in a clean, dry place and protect from weather prior to shipment. Provide protection from weather and from damage during transit. 28 29 30 31 32 33
- B. Loose items, if any, shall be tagged and delivered in a standard commercial package. 34 35 36

PART 2 PRODUCTS

2.1 **EQUIPMENT**

- A. Tanks (Condensate Transfer Tank, Wastewater Transfer Tank, Caustic Day Tank) 40 41 42
 - 1. Reference Attachment A - Data Sheets.

Date: 03/06/96

13205

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2 of 4

ERA/WPRAP/145/OFFGAS

- B. Electric Immersion Heaters
 - 1. Reference Attachment A - Data Sheets.

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2.2 MATERIALS

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- A. Reference Attachment A - Data Sheets.

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2.3 FABRICATION

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- A. Shop Assembly: Tanks shall be completely shop assembled, to the extent practical, and delivered as a single unit.

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- B. Prior to shipment, the equipment shall be cleaned of all dirt, dust, grease, grime, scale, oxides, weld spatter, and other foreign materials. All burrs and sharp edges shall be ground smooth. Exterior tank surfaces shall be primed and painted in accordance with the manufacturer's standard finish. Open end connections shall be sealed to prevent the entrance of foreign material.

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2.4 LABELING

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- A. Each tank shall have a manufacturer's standard nameplate in accordance with API Std. 620. In addition to the information required by the standard, the nameplate shall include the following information:

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- 1. Tank description.
- 2. Purchase order number.
- 3. Capacity (in gallons).

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- B. Each immersion heater shall have a manufacturer's standard nameplate permanently attached at a location which is easily readable. The nameplate shall contain the following information:

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- 1. Item Description.
- 2. Item Number.
- 3. Manufacturer's Name.
- 4. Purchase Order Number.
- 5. Date of Manufacture.
- 6. Capacity.

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PART 3

EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Tank installation shall be in accordance with the manufacturer's installation instructions and the applicable standard.

3.2 QUALITY CONTROL

A. Inspection: Each tank shall be visually inspected by the Subcontractor upon delivery to ensure that the tank has not been damaged during shipping.

B. Tests: Each tank shall be tested for leaks by filling with water and inspecting for leaks after the tank has been standing full for at least 1 hour. Any leakage will be cause for rejection. Leaks shall be corrected and the tank retested at no cost to FERMCO.

C. Notification: The Subcontractor shall notify FERMCO in advance of testing and inspection activities.

END OF SECTION

ATTACHMENT A

DATA SHEETS

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Date: 03/06/96
Rev.: A RE: KM

13205

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/145/OFFGAS

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Project Order <u>145</u>	Project Title: <u>OU1 Remediation System Design</u>				
General	Equipment Description: <u>Caustic Day Tank Immersion Heater</u> Quantity: <u>1</u> Service: <u>Maintaining fluid temperature in excess of 60°F.</u> Insertion Length: <u>less than 3 feet, 0 inches</u> Mounting: <u>3 inch Class 150 - RF steel flange for tank side mounting</u> Vessel Dimensions: <u>3 feet, 0 inches in diameter by 4 feet, 0 inches str. side</u> Top <u>Flat</u> Bottom <u>Flat</u>				
Mixture	Ingredient	Specific Gravity	Viscosity	Volume/Batch Flowrate	Other
	50% Sodium Hydroxide Solution			200 gallons	
Materials	Sheath: <u>Incoloy</u>				
Electrical	Capacity: <u>6 kW</u> Volts <u>480</u> Ph <u>3</u> Hz <u>60</u> Watt Density: <u>≤ 23 w/in²</u>				
Remarks	1. Outdoor installation				

ENG109

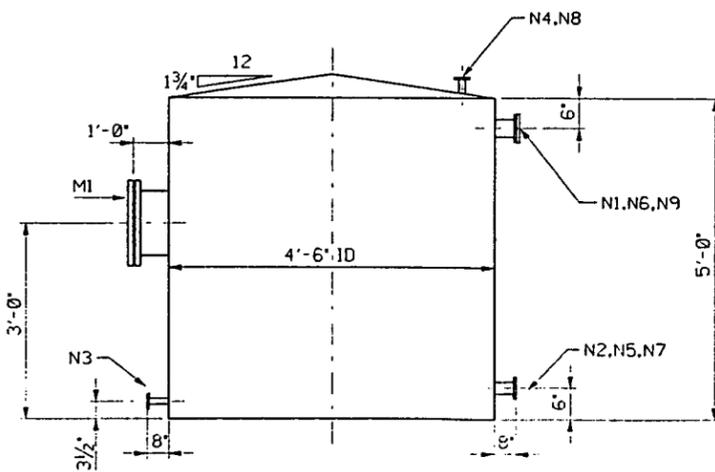
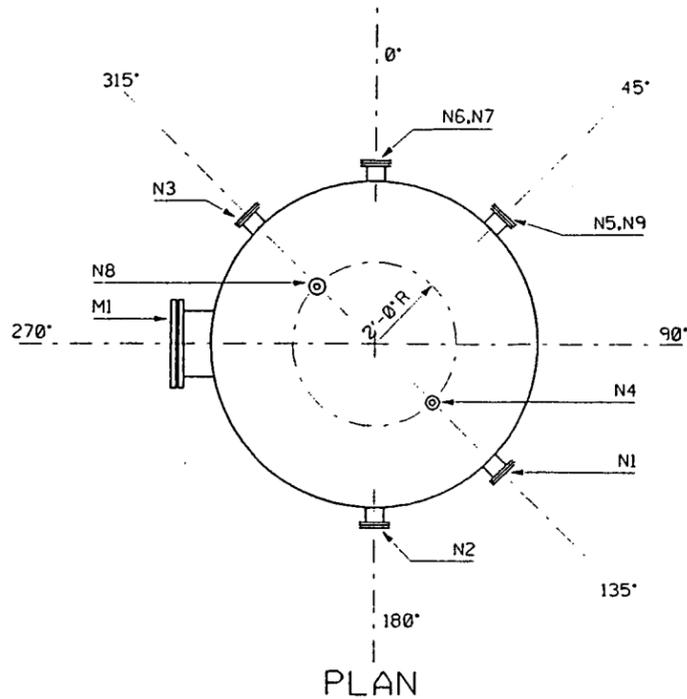
Date: 03/06/96
Rev.: A RE: KM

13205

WBS No.: 1.1.1.1.1.3.2
ERA/WPRAP/145/OFFGAS

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ELEVATION

FOR TRUE ORIENTATION SEE PLAN VIEW
NOT TO SCALE

TANK DATA

GENERAL

1. CODES AND STANDARDS: API 620, ASCE 7-93
2. NOMINAL CAPACITY: 500 GAL
3. SERVICE: CONDENSATE

233

DESIGN DATA

2039

1. FLUID TEMPERATURE: MAX AMBIENT °F, MIN AMBIENT °F
2. AMBIENT TEMPERATURE: MAX 95 °F, MIN -10 °F
3. INTERNAL PRESSURE: DESIGN ATM. PSIG, OPERATING PSIG
4. SPECIFIC GRAVITY OF PROCESS FLUID: 1.0 AT 60 °F
5. CORROSION ALLOWANCE: SHELL 1/16 IN, ROOF 1/16 IN
BOTTOM 1/16 IN, STRUCTURAL IN
6. FOUNDATION TYPE: STRUCTURAL STEEL SKID
7. WIND: IMPORTANCE FACTOR 1.07 TABLE 4 EXPOSURE C
BASIC WIND SPEED 80 MPH (MAX)
8. SNOW LOAD 25 PSF, ROOF LIVE LOAD: 20 PSF
9. SEISMIC: SEE NOTE 3

FABRICATION

1. ROOF TYPE: CONE ROOF JOINT TYPE: PER API 620
2. BOTTOM TYPE: FLAT BOTTOM TYPE JOINT: PER API 620
3. PAINTING: EXTERIOR PER SPECIFICATION 13205
4. COATING: INTERIOR N/A
5. INSULATION: NONE
6. MATERIAL: PLATE CS FORGING CS
PIPE AND TUBE CS GASKETS TEFLON
BOLTING ASTM

INSPECTION AND TEST

PER API 620

NOTES:

1. VENDOR SHALL PROVIDE LIFTING AND ANCHOR SYSTEMS PER CODE REQUIREMENTS.
2. PROVIDE MINIMUM TWO ELECTRICAL GROUNDING ATTACHMENT LUGS ON OPPOSITE SIDE OF TANK WITH 1/16" HOLE.
3. SEISMIC LOAD: USE PROVISIONS OF THE UNIFORM BUILDING CODE, USING Z=0.13, C=2.75, I=1.25 AND RW= REDUCTION FACTORS FROM TABLE 16-P. W SHALL INCLUDE ALL OPERATING CONTENTS, PIPING, AND ATTACHMENTS.
4. SUPPORTS/CONNECTIONS SHALL BE PROVIDED AT 30°, 120°, 210°, AND 300° FOR BOLTING THE TANK TO A STRUCTURAL STEEL SKID FOUNDATION.

NOZZLE AND ACCESS WAY SCHEDULE

MARK	SIZE	CLASS	TYPE	SERVICE	REMARKS
N1	1 1/2"	150	RF	INLET	CONDENSATE
N2	2"	150	RF	OUTLET	CONDENSATE
N3	2"	150	RF	DRAIN	
N4	2"	150	RF	VENT	
N5	2"	150	RF	LEVEL INSTR	TRANSMITTER
N6	2"	150	RF	LEVEL SWITCH	LSHH
N7	2"	150	RF	LEVEL SWITCH	LSLL
N8	2"	150	RF	SPARE	W/ BLIND FLANGE
N9	2"	150	RF	SPARE	W/ BLIND FLANGE
M1	20"	150	RF	MANWAY	W/COVER AND GASKET

PARSONS ERA PROJECT

PROJECT NAME
OUI REMEDIATION SYSTEM DESIGN
WBS 1.1.1.1.3.1

TITLE

**MECHANICAL PROCESS
TANK DATA SHEET
CONDENSATE TRANSFER TANK**

SPECIFICATION NO.

13205 ATTACHMENT A

CRU/PO

WPRAP/145/OFFGAS

SHEET NO.

SH 1 OF 1

SKETCH NO.

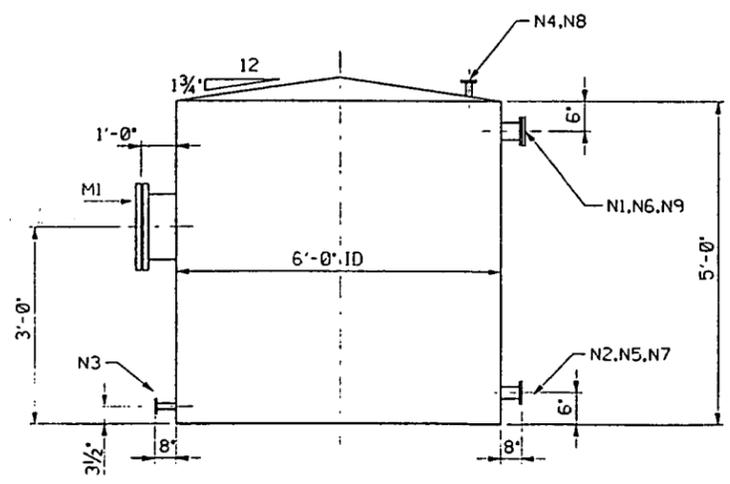
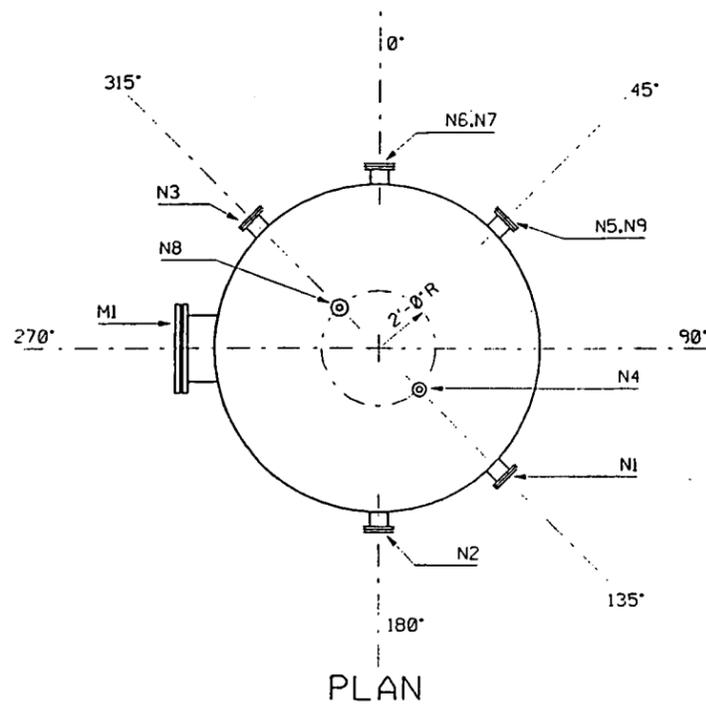
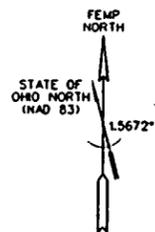
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ELEVATION
FOR TRUE ORIENTATION SEE PLAN VIEW
NOT TO SCALE

TANK DATA

GENERAL

1. CODES AND STANDARDS: API 620, ASCE 7-93

2. NOMINAL CAPACITY: 1,000 GAL

3. SERVICE: WASTE WATER

2039

DESIGN DATA

1. FLUID TEMPERATURE: MAX AMBIENT °F, MIN AMBIENT °F

2. AMBIENT TEMPERATURE: MAX 95 °F, MIN -10 °F

3. INTERNAL PRESSURE: DESIGN ATM. PSIG, OPERATING PSIG

4. SPECIFIC GRAVITY OF PROCESS FLUID: 1.0 AT 60 °F

5. CORROSION ALLOWANCE: SHELL 1/16" IN, ROOF 1/16" IN
BOTTOM 1/16" IN, STRUCTURAL IN

6. FOUNDATION TYPE: STRUCTURAL STEEL SKID

7. WIND: IMPORTANCE FACTOR 1.07 TABLE 4 EXPOSURE C
BASIC WIND SPEED 80 MPH (MAX)

8. SNOW LOAD 25 PSF, ROOF LIVE LOAD: 20 PSF:

9. SEISMIC: SEE NOTE 3

FABRICATION

1. ROOF TYPE: CONE ROOF JOINT TYPE: PER API 620

2. BOTTOM TYPE: FLAT BOTTOM TYPE JOINT: PER API 620

3. PAINTING: EXTERIOR PER SPECIFICATION 13205

4. COATING: INTERIOR N/A

5. INSULATION: NONE

6. MATERIAL: PLATE CS, FORGING CS
PIPE AND TUBE CS, GASKETS TEFLON
BOLTING ASTM

INSPECTION AND TEST

PER API 620

NOTES:

1. VENDOR SHALL PROVIDE LIFTING AND ANCHOR SYSTEMS PER CODE REQUIREMENTS.

2. PROVIDE MINIMUM TWO ELECTRICAL GROUNDING ATTACHMENT LUGS ON OPPOSITE SIDE OF TANK WITH 1/8" HOLE.

3. SEISMIC LOAD: USE PROVISIONS OF THE UNIFORM BUILDING CODE, USING Z=0.13, C=2.75, I=1.25 AND RW=REDUCTION FACTORS FROM TABLE 16-P. W SHALL INCLUDE ALL OPERATING CONTENTS, PIPING, AND ATTACHMENTS.

4. SUPPORTS/CONNECTIONS SHALL BE PROVIDED AT 30', 120', 210', AND 300' FOR BOLTING THE TANK TO A STRUCTURAL STEEL SKID FOUNDATION.

NOZZLE AND ACCESS WAY SCHEDULE

MARK	SIZE	CLASS	TYPE	SERVICE	REMARKS
N1	2"	150	RF	INLET	SCRUBBER BLEED
N2	2"	150	RF	OUTLET	WASTEWATER
N3	2"	150	RF	DRAIN	
N4	2"	150	RF	VENT	
N5	2"	150	RF	LEVEL INST	TRANSMITTER
N6	2"	150	RF	LEVEL SWITCH	LSHH
N7	2"	150	RF	LEVEL SWITCH	LSLL
N8	2"	150	RF	SPARE	W/BLIND FLANGE
N9	2"	150	RF	SPARE	W/BLIND FLANGE
M1	20"	150	RF	MANWAY	W/COVER AND GASKET

PARSONS ERA PROJECT

PROJECT NAME
OUI REMEDIATION SYSTEM DESIGN
WBS 1.1.1.1.3.1

TITLE
**MECHANICAL PROCESS
TANK DATA SHEET
WASTE WATER TRANSFER TANK**

SPECIFICATION NO. 13205, ATTACHMENT A

CRU/PO WPRAP/145/OFFGAS

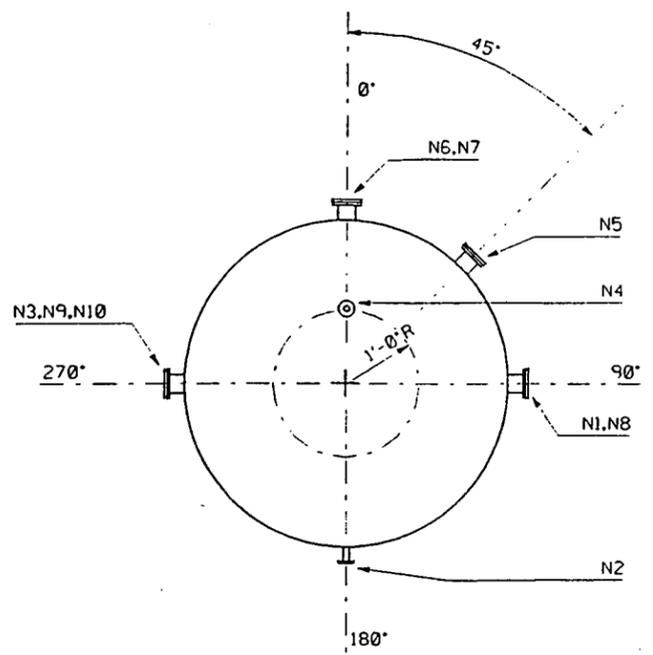
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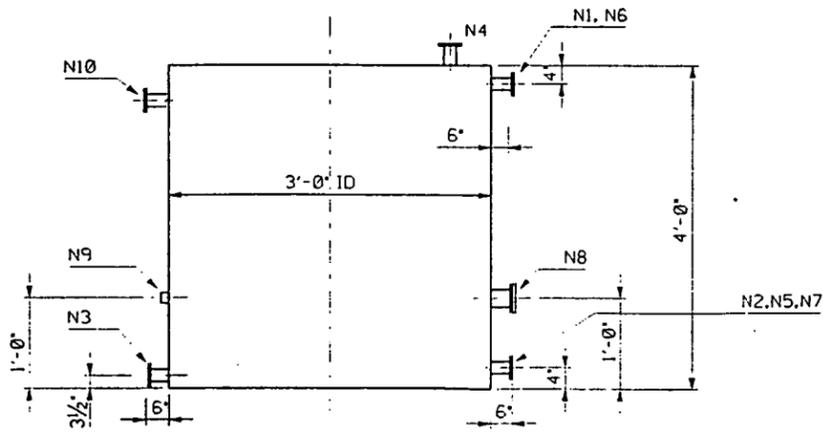
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PLAN



ELEVATION

FOR TRUE ORIENTATION SEE PLAN VIEW
NOT TO SCALE

TANK DATA

GENERAL

1. CODES AND STANDARDS: API 620, ASCE 7-93
2. NOMINAL CAPACITY: 200 GAL
3. SERVICE: 50% CAUSTIC SOLUTION

2039

DESIGN DATA

1. FLUID TEMPERATURE: MAX 120 °F, MIN AMBIENT °F
2. AMBIENT TEMPERATURE: MAX 95 °F, MIN -10 °F
3. INTERNAL PRESSURE: DESIGN ATM PSIG, OPERATING PSIG
4. SPECIFIC GRAVITY OF PROCESS FLUID: 1.0 AT 60 °F
5. CORROSION ALLOWANCE: SHELL N/A IN, ROOF N/A IN
BOTTOM N/A IN, STRUCTURAL IN
6. FOUNDATION TYPE: STRUCTURAL STEEL SKID
7. WIND: IMPORTANCE FACTOR 1.07 TABLE 4 EXPOSURE C
BASIC WIND SPEED 80 MPH (MAX)
8. SNOW LOAD 25 PSF, ROOF LIVE LOAD: 20 PSF
9. SEISMIC: SEE NOTE 3

FABRICATION

1. ROOF TYPE: FLAT ROOF JOINT TYPE: PER API 620
2. BOTTOM TYPE: FLAT BOTTOM TYPE JOINT: PER API 620
3. PAINTING: EXTERIOR PER SPECIFICATION 13205
4. COATING: INTERIOR N/A
5. INSULATION: NONE
6. MATERIAL: PLATE 316 SS, FORGING 316 SS
PIPE AND TUBE 316 SS, GASKETS TEFLON
BOLTING ASTM

INSPECTION AND TEST

PER API 620

NOTES:

1. VENDOR SHALL PROVIDE LIFTING AND ANCHOR SYSTEMS PER CODE REQUIREMENTS.
2. PROVIDE MINIMUM TWO ELECTRICAL GROUNDING ATTACHMENT LUGS ON OPPOSITE SIDE OF TANK WITH 1/8" HOLE.
3. SEISMIC LOAD: USE PROVISIONS OF THE UNIFORM BUILDING CODE, USING Z=0.13, C=2.75, I=1.25 AND RW=REDUCTION FACTORS FROM TABLE 16-P. W SHALL INCLUDE ALL OPERATING CONTENTS, PIPING, AND ATTACHMENTS.
4. SUPPORTS/CONNECTIONS SHALL BE PROVIDED AT 30°, 120°, 210°, AND 300° FOR BOLTING THE TANK TO A STRUCTURAL STEEL SKID FOUNDATION.

NOZZLE AND ACCESS WAY SCHEDULE

MARK	SIZE	CLASS	TYPE	SERVICE	REMARKS
N1	2"	150	RF	INLET	CAUSTIC
N2	1"	150	RF	OUTLET	CAUSTIC
N3	2"	150	RF	DRAIN	
N4	2"	150	RF	VENT	
N5	2"	150	RF	LEVEL INST	TRANSMITTER
N6	2"	150	RF	LEVEL INST	LSHH
N7	2"	150	RF	LEVEL INST	LSLL
N8	3"	150	RF	HEATER	ELEC. IMMERSION HEATER
N9	1 1/2"		THRD	THERMO WELL	HALF-COUPLING
N10	2"	150	RF	SPARE	W/ BLIND FLANGE

PARSONS ERA PROJECT

PROJECT NAME
OUI REMEDIATION SYSTEM DESIGN
WBS 1.1.1.1.1.3.1

TITLE
**MECHANICAL PROCESS
TANK DATA SHEET
CAUSTIC DAY TANK**

SPECIFICATION NO. 13205, ATTACHMENT A CRU/PO WPRAP/145/OFFGAS SHEET NO. SH 1 OF 1

SKETCH NO. SK-M-04192000309 REV NO. A

SECTION 14570
ROTARY AIRLOCK FEEDERS

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnishing and installation of two rotary feeders for transporting dried off-gas residue (90 to 99 percent solids) discharged from the cyclone to the dryer discharge conveyor.
- B. All tools, supplies, materials, equipment, and labor for shop fabrication, installation, inspection, testing, and placing into operation of the rotary feeder.
- C. All work shall be performed in accordance with the applicable drawings, references, codes, and standards contained herein.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 09900 - Painting.
- D. Section 13400 - Instruments and Equipment.
- E. Section 13404 - Installation of Instruments.
- F. Section 13402 - Instrumentation Tubing and Accessories.
- G. Section 13403 - Testing and Calibration of Instruments.
- H. Section 15060 - Pipe, Fittings, Valves, and Accessories.
- I. Section 15173 - Motors for Off-Gas Treatment System.

J. Section 16053 - Basic Electrical Materials and Methods for Off-Gas Treatment System.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES, CODES, AND STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME A13.1-81 Scheme for the Identification of Piping Systems (R1985).
2. ASME B16.5-88 Pipe Flanges and Flanged Fittings.
3. ASME B16.11-91 Forged Fittings, Socket Welding, and Threaded.

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

1. ASTM A307-94 Standard Specification for Carbon Steel Bolts and Studs 60,000 psi Tensile Strength.
2. ASTM A325-94 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

C. American Bearing Manufacturers Association (ABMA):

1. ABMA 9-90 Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11-90 Load Ratings and Fatigue Life for Roller Bearings.

D. American Gear Manufacturers Association (AGMA) Standards.

E. National Electrical Manufacturers Association (NEMA):

1. NEMA ICS 6-93 Industrial Controls and Systems Enclosures.

1.5 SUBMITTALS

A. Provide submittals as required per Section 01011.

Date: 03/06/96
Rev.: B RE: HPP

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2 of 7

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/145/OFFGAS

000311

- B. Shop drawings, including the following information:
 - 1. Rotary feeders' identification numbers and specification numbers. 1
 - 2. Assembly and installation drawings, including
 - a. Shaft size. 2
 - b. Seal. 3
 - c. Coupling. 4
 - d. Anchor bolt plan. 5
 - e. Parts nomenclature. 6
 - f. Materials list. 7
 - g. Outline dimensions. 8
 - h. Shipping weights. 9
 - 3. Drive and motors, in accordance with Section 15173. 10
 - 4. Design loadings to be transmitted to foundation or supports. 11
 - 5. Design calculations shall include dead, live, and dynamic loadings for normal and seismic conditions, unless otherwise specified. 12

- C. Technical manuals and spare parts lists, including operations and maintenance (technical) manuals and spare parts lists. 13

- D. Tools: Furnish special tools necessary for maintenance and repair of the equipment. 14

- E. Shop Procedures: Manufacturer's instructions for shop procedures for erection, adjustments, inspections, and testing shall be provided prior to installation. 15

1.6 **QUALITY ASSURANCE PROGRAM**

- A. Shop Tests
 - 1. The equipment shall be shop tested after installation to demonstrate satisfactory operation, without causing excessive noise, vibration, or overheating of the bearings. 16
 - 2. The shop testing shall be performed in the presence of an experienced field representative of the manufacturer of each major item of equipment, who shall supervise the following tasks and shall certify in writing that the equipment and controls 17

have been properly installed, aligned, lubricated, adjusted, and readied for operation:

a. Start up, check, and operate the equipment.

B. Environmental Requirements

1. Environment: Outdoor, low-level radiologically contaminated area.

2. Plant Conditions:

a. Location: Fernald, Ohio.

b. Elevation: Approximately 580 feet above sea level.

c. Ambient Temperature: -10 to 110 degrees F.

d. Barometric Pressure: 29.31 inches Hg absolute (mean at 70 degrees F).

e. Relative Humidity: 20 to 95 percent.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging

1. Packaging shall conform to acceptable industrial practices. Materials shall be cleaned to remove chips, slag, weld spatter, oil, grease, debris, and other foreign material prior to packaging for shipment.

B. Protect motors, shafts, rotors, and bearings from weather and construction dust or any other physical damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Smoot Co., or equal.

2.2 PRODUCTS/EQUIPMENT

A. Rotary Airlock Feeder

1. Basis of Design

a. The rotary feeder shall include a closed-end, eight-vane rotor capable of handling abrasive material at a capacity of 0.12 ft³/rev. The rotary feeder shall be a metering device

Date: 03/06/96
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WBS No.: 1.1.1.1.1.3.1
ERA/WORAP/145/OFFGAS

000313

which shall transfer dried off-gas residue (90 to 99 percent solids). The rotary feeder shall have a zero speed switch as described in these specifications. The rotary feeder shall have a design capacity of 1,450 lbs/hr of dried off-gas solids at a density of 30-35 lbs/ft³.

2. Design Requirements

- a. Each feeder shall be sized to meet the design solids flow rate. Each feeder drive unit shall be designed for 100 percent of rated capacity. All of the rotary feeder construction materials, including the seals, shall be rated for operating temperatures up to 300 degrees F.
- b. See Attachment A for data sheets.

3. Rotors

- a. The rotor shall be closed-end with adjustable and replaceable tips. The adjustable tips shall permit adjustment of radial clearances to compensate for wear, when it occurs. The rotor shall be designed to handle abrasive material. Section vanes shall be welded onto the shaft, stress relieved, and then machined. The work specified herein shall conform to ABMA 9-90, ABMA 11-90, ASME A13.1-81, ASME B16.5-88, ASME B16.11-91, ASTM A307-94, and ASTM A325-94.

4. Bearings and End Shaft

- a. Bearings shall be outboard of the end plates and shaft's seals. End bearings shall be anti-friction and shall be mounted outside the feeder end caps. Bearings shall be completely serviceable from outside the feeder. The bearing and seals shall be factory lubricated for the lifetime of the bearings. The bearings and seals shall be capable of supporting the applicable thrust loads by means of snap rings and shall prevent angular misalignment of the rotor. The shaft bearings shall have an L-10 life rating of 100,000 hours.

5. Air Purging

a. Shaft air purging shall be implemented for purging of any material near the shaft area packing. Air purge flow rate shall not exceed 12 scfm. Air purging is available at a maximum pressure of 90 psig and shall be reduced to 10 psig. Shaft air purge hardware shall be assembled to feeder and include air line filter, NEMA solenoid valve, and regulator, all in Type 4, NEMA ISC6.

6. Drive Unit

a. Each rotary feeder shall be driven by an electric gear motor. The gear motor shall be factory mounted, complete with chain drive and drive guard. Appropriate OSHA guards shall be provided for protection of personnel. The drive system shall be designed to start the feeder fully loaded. Drive size shall be as recommended by the manufacturer. The design of drive components shall be such that jamming of any components shall not cause damage to the equipment. Provisions shall be installed as required to protect the equipment.

7. Zero Speed Switch

a. Vendor shall provide a zero speed switch to detect equipment failure. The zero speed switch shall consist of magnetic pickup furnished and mounted on the rotor shaft by the Vendor and the amplifier in a Type 4 NEMA ICS6 enclosure, furnished loose. The Vendor shall test operation of the system before shipping the equipment. The test shall demonstrate consistent relay tripping when the rotating shaft rpm drops below the adjustable setpoint. The magnetic pickup and amplifier speed switch shall be Airpax or RedLion, or equal.

8. Gear Reducer

a. All gear reducers shall be commercially built, AGMA Class II single, double, or triple reduction, helical gear units with high-capacity roller bearings. Bearings

shall have an L-10 life rating of 30,000 hours. The reducers shall be standard air-cooled units with no auxiliary cooling allowed. Shaft seals shall be tripled lipseal with taconite packing designed for service conditions.

9. Accessories

a. The manufacturer shall supply slide gate valve that is dimensionally compatible with airlock feeder and rotary airlock adopter plate.

10. Protective Coating

a. Field and shop coatings shall conform to Section 09900.

2.3 LABELING

A. Instrument and Equipment Tagging: Instruments and equipment shall be tagged accordingly with a three-layer, laminated plastic plate 1 inch by 2-1/2 inches, having a minimum of 1/16-inch thickness.

- 1. Lettering shall be a minimum 1/4-inch high and boldly stamped.
2. Tags shall be secured to the instruments or equipment by a beaded SST chain or SST wire, 16 AWG minimum, so that they will remain attached to the instrument or equipment and not inhibit its operation.

PART 3 EXECUTION

3.1 TESTING

A. The feeder drive system shall be assembled and given no-load running tests at the manufacturer's plant before shipment.

B. Shop tests shall be conducted with the equipment in its installed position as described in Article 1.6.

END OF SECTION

APPENDIX A
DATA SHEETS

Date: 03/06/96
Rev.: B RE: HPP

14570

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/145/OFFGAS

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Appendix A - Data Sheets

Service Conditions

Material Handled	Off-gas dry solids, largely organic
Capacity	1,450 lb/hr max; 900 lb/hr min
Capacity	49 ft ³ /hr max; 30 ft ³ /hr min
Particle Size	200 mesh
Density	30-35 lbs/ft ³
Temperature	360°F max/ 280°F design
Abrasiveness	Mild
Corrosiveness	None
Solids Content	90 to 99 percent by weight
Flowability	Free flowing
Speed	Approximately 4-12 rpm*
Feeder Vane Rotary Capacity	0.12 ft ³ /rev*
Feed Operation	Continuous, 24 hrs/day
Internal Design Pressure, Feeder	10 psig
Inlet Operating Pressure	-2" w.c. max; -0.5" w.c. min
Outlet Operating Pressure	0 psig
Differential Pressure	2" w.c. max
Leakage Allowed	Zero or vendor shall specify maximum

* Information and calculation supplied by manufacturer.

Materials

Housing	International Nickle's Nihard
Follower Ring	Type 304 stainless steel
Pipe Plugs	Carbon steel
Shaft	Forged carbon steel
Gland	Cast iron
End Plate	Cast iron
Rotor	Carbon steel with 1/8" of stellite on wear surfaces
Adjustable Rotor Blade Tips	Mild carbon steel with stellite facing

Motor and Drive

Motor	HP TEFC non-ventilated
Power Supply	230/460 volts, three-phase, 60 Hz
Mechanical Drive	Variable speed belt drive with parallel shaft reducer (Dodge Reliance Reeves)
Speed	Approximately 4-12 rpm*

* Information and calculation supplied by manufacturer.

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Accessories

Material of Knife Gate Valve	
Type of Body	Knife gate
Body and Part Size	10 inches
Guiding	Gate guided
No. of Ports	1
End Conn. and Rating	ANSI 150# R.F.
Body Material	Carbon steel
Packing Material	DTFE
Trim Material	
Seat/Plug	316 stainless steel
Shaft Material	316 stainless steel
Required Seat Tightness	Class IV
Max. Allow Sound Level dBA	80
Operator	Chain wheel

SECTION 15060
PIPE, FITTINGS, VALVES, AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aboveground piping, fittings, valves, and accessories.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 15020 - Packaged Equipment.
- D. Section 15090 - Piping Supports and Anchors.
- E. Section 15250 - Insulation.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES, CODES, AND STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME A13.1-81 Scheme for the Identification of Piping Systems (R1985).
 - 2. ASME B16.5-88 Pipe Flanges and Flanged Fittings.
 - 3. ASME B16.21-92 Nonmetallic Flat Gaskets for Pipe Flanges.
 - 3. ASME B31.3-93 Chemical Plant and Petroleum Refinery Piping.
 - 4. ASME Boiler and Pressure Vessel Code (BPVC), Section IX-95.

B. American Society for Nondestructive Testing (ASNT):

- 1. ASNT-SNT-TC-1A-92 Personnel Qualifications and Certification Recommended Practice, December 1992 Edition.

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

- 1. ASTM-A53-95 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- 2. ASTM-A105/A105M-Rev. B-95 Standard Specification for Carbon Steel Forgings for Piping Applications.
- 3. ASTM A182/A182M-95 Standard Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
- 4. ASTM A193/A193M-95 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.
- 5. ASTM-A194/A194M-95 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
- 6. ASTM-A216/A216M-93 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
- 7. ASTM-A234/A234M-Rev. A-95 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- 8. ASTM A276-95 Standard Specification for Stainless Steel Bars and Shapes.
- 9. ASTM-A307-94 Standard Specification for Carbon Steel Bolts and Studs.
- 10. ASTM A312/ Standard Specification for



	312M-Rev. B-94	Seamless and Welded Austenitic	1
		Stainless Steel Pipes.	2
11.	ASTM A351/ 351M-Rev. A-94	Standard Specification for	3
		Castings, Austenitic,	4
		Austenitic-Ferritic (Duplex),	5
		for Pressure-Containing Parts.	6
12.	ASTM A403/ A403M-95	Standard Specification for	7
		Wrought Austenitic Stainless	8
		Steel Pipe Fittings.	9
13.	ASTM A515/ A515M-92	Standard Specification for	10
		Pressure Vessel Plates, Carbon	11
		Steel, for Intermediate- and	12
		Higher-Temperature Service.	13
14.	ASTM B61-93	Standard Specification for	14
		Steam or Valve Bronze	15
		Castings.	16
15.	ASTM-B62-93	Standard Specification for	17
		Composition Bronze or Ounce	18
		Metal Castings.	19

D.	Expansion Joint Manufacturer's Association (EJMA):	21
1.	EJMA-1976 EJMA Standards.	22

1.5 SYSTEM DESCRIPTION

A.	Design Requirements	26
1.	Double-Walled Piping: When the process requires	27
	secondary containment (as shown on the Piping and	28
	Instrumentation Drawings [P&IDs] and on the piping	29
	drawings) and piping is routed outside a process	30
	containment area, the piping installation shall be	31
	a double-walled piping system and shall be	32
	electric heat traced and insulated.	33

1.6 SUBMITTALS

A.	Provide submittals per Section 01011.	37
B.	Piping drawings, as required, if modified by vendor.	39
C.	P&IDs, as required, if modified by vendor.	41
D.	Product Data.	43

- E. Shop drawings, including spool piece drawings and construction isometric drawings.
- F. Certificates of Conformance: Manufacturer shall certify and provide data which indicates that all supplied products meet or exceed specification requirements.
- G. Test Procedures: Submit written procedures for all required testing. Test procedures shall include criteria for acceptable performance.
- H. Detailed description of packaging materials and procedures including cleaning and closure of all openings.
- I. Procedure for repair or replacement of piping failing pressure tests.
- J. Flushing procedure.
- K. Welder qualification, inspector qualifications, procedure qualification records, and welding procedure specification in accordance with the ASME BPVC, Section IX.
- L. Pressure test reports.
- M. Test reports for expansion joint pressure tests.

1.7 QUALITY ASSURANCE PROGRAM

- A. Except where more stringent requirements are specified or indicated, the work specified herein shall conform to ASME B31.3.
- B. Welding Procedures and Qualifications
 - 1. Welding procedures, welder qualifications, fabrication, assembly, and erection shall be in accordance with ASME B31.3, Chapter V and ASME BPVC, Section IX.
 - 2. Welder and inspector qualifications shall be made available to, and approved by, FERMCO.

- 3. Welding inspections shall be in accordance with ASME B31.3, Chapter VI. 1
- 4. Nondestructive testing personnel qualifications shall be in accordance with ASNT SNT-TC-1A. 2
- 5. All welding for expansion joints shall be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. 3

C. Testing 4

- 1. Shop testing shall be in accordance with ASME B31.3. 5

D. Inspection 6

- 1. Inspection shall be conducted in accordance with ASME B31.3. 7

1.8 DELIVERY, STORAGE, AND HANDLING 8

A. Packaging 9

- 1. Manufacturer's standard packaging shall be used. Materials shall be thoroughly cleaned to remove chips, slag, weld spatter, oil, grease, debris, and other foreign material prior to packaging for shipment. All openings shall be covered, capped, or plugged to prevent damage and the ingress of foreign materials during shipment and storage. Tape alone shall not be used for sealing openings. 10
- 2. Closures used for covering, capping, or plugging openings shall not be made of polyvinyl chloride (PVC) or other plastics that contain chloride. 11

B. Storage and Handling 12

- 1. Spool openings shall remain sealed. 13
- 2. Piping materials and prefabricated assemblies shall be stored off the ground and handled with care so that physical damage to the piping materials does not occur. End seals of pipe, flange covers, valve covers, and similar protection shall not be removed until necessary for cleaning, fabrication, inspection, and erection. 14
- 3. Piping materials shall be identified, inspected, controlled, and protected in a manner that will 15

assure conformance with the applicable codes and specifications.

4. Care shall be taken in the storage and handling of all piping materials and prefabricated assemblies so that contamination by grease, moisture, or other foreign matter does not occur.
5. Welding rods and electrodes shall be stored, handled, and identified at all times to ensure the use of the proper welding rod. Electrode ovens for the storage of low-hydrogen welding rods must be used at all times.
6. Austenitic stainless steel materials shall be stored separately from carbon steel materials.

PART 2 PRODUCTS

2.1 PRODUCTS/EQUIPMENT

A. Piping and Valve Specification

1. All piping and valve materials shall meet the requirements indicated on the attached piping material data sheets.

B. Double-Walled Piping

1. Double-walled piping shall be supplied in prefabricated assemblies that shall include anchors, guides, spacers, drip legs, and end closures. Internal anchors, guides, and spacers shall be in accordance with Section 15090.

C. Expansion Joints

1. Expansion joints shall be designed and manufactured in accordance with EJMA.
2. Bellows: Metallic bellows shall be formed from seamless tubing or tubing having longitudinal seam welds only. Longitudinal welds shall be planished and the finished weld shall be within plus 2 percent of the tube thickness. Maximum thinning in the bellows shall not exceed 15 percent. Bellows shall not be exposed to any stress relief or to any post-forming procedures. Where weld ends are specified, they shall be beveled for welding in accordance with ASME B31.3, Chapter V.

- 3. Flow Liners: Flow liners shall be long enough to extend past the bellows section through the full range of movement. Flow liners shall not restrict the bellows from any designed movements (i.e., lateral, axial, or rotation).
- 4. External Covers: External covers shall be removable and shall be capable of protecting the corrugations from accidental damage during shipment, installation, and operation. The covers shall not restrict the designed movements of the assembly.
- 5. Limit Rods: Limit rods shall be designed to limit overcompression and/or overextension and to absorb the full pressure thrust of the system in the event of anchor failure.
- 6. Control Rods: Control rods shall be used in universal type joints to prevent excessive displacement of one bellows relative to another. Control rods shall be designed to absorb the full pressure thrust of the system.
- 7. Flow Tags: A flow arrow indicating the direction of flow shall be permanently attached to the assembly and shall be clearly visible on the outside.
- 8. Temporary Tie Bars: Tie bars shall be provided to control the required installation dimensions and to prevent damage to the bellows. Tie bars shall be clearly marked as temporary and shall be designed for easy removal.
- 9. Testing: Expansion joint assemblies shall be pressure tested at the place of manufacture.

2.2 MATERIALS

A. Procurement

- 1. All piping materials shall be procured in accordance with the piping material data sheets.
- 2. Quarter turn valves shall be used to the maximum extent practical in the liquid and air piping services.
- 3. For slurry applications (including drains), quarter turn, full port valves shall be used, if practicable.

4. Expansion joint materials shall comply with Appendix A of ASME B31.3.

2.3 FABRICATION

A. Welding

1. All welding shall be in accordance with the applicable codes.
2. All socket welds shall be made by a shielded metal arc or gas tungsten arc welding process.
3. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1/16 inch and no more than 1/8 inch.

B. Shop Assembly

1. All parts made in a fabrication shop shall be completely shop assembled prior to shipment to the site.

C. Shop/Factory Finish

1. All carbon steel parts shall be prime coated after fabrication.

2.4 LABELING

A. Valve Identification

1. Each valve shall be identified with the unique valve number, as shown on the P&IDs, embossed on a stainless steel identification tag permanently attached to the valve by a stainless steel wire. Lettering shall be a minimum of 3/8 inch high. The tag shall not be attached to any part of the valve which may interfere with valve operation.
2. Valve identification tags on insulated valves shall be located outside the insulation jacketing and be easily accessible for inspection.

B. Pipe Identification

1. Identify the flow medium and the flow direction for all piping systems including insulated pipe by labeling adjacent to each valve, adjacent to abrupt pipe directional change, and at least once

on each skid. Pipes shall be labeled as indicated on the P&IDs and in accordance with ASME A13.1. 2. Content, size, material type, line number, and insulation requirements for each pipeline shall be identified on drawings as follows:

Example SL - 2" - A - 7000 - ET

<u>Medium Code</u>	<u>Size</u>	<u>Material Code</u>	<u>Line Number</u>	<u>Insulation</u>
SL*	2"	A	7000***	ET**

- * See attached piping material data sheet service index for medium codes.
- ** ET indicates that the pipeline is electric heat traced.
- *** A different number series is used for each service.

C. Product Marking

1. All piping materials, welding rods, and electrodes shall be marked and identified in accordance with the applicable codes.

D. Expansion Joints

- 1. Each expansion joint shall have manufacturer's standard nameplate permanently attached at a location which is easily readable. The nameplate shall contain the following information:
 - a. Item description.
 - b. Item number.
 - c. Manufacturer's name.
 - d. Purchase order number.
 - e. Date of manufacture.
 - f. Spring rates.
 - g. Rates movements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examination shall be in accordance with ASME B31.3.
- B. FERMCO will perform all field examination.

3.2

PREPARATION

A. Protection

- 1. All welding/fabricating activities shall be protected from inclement weather at all times.

B. Primer Application

- 1. All non-insulated carbon steel piping shall be prime coated after fabrication.

3.3

ERECTION/INSTALLATION/APPLICATION

A. Layout, Cutting, and Fitting Up

- 1. All piping, tubing, fittings, components, welding, bonding, fabrication, erection, and assembly shall be in accordance with ASME B31.3.

B. Flanged Joints

- 1. All flanged joints shall be assembled in accordance with ASME B31.3.
- 2. Where a raised-face flange mates with a flat-face flange, it shall be substituted with a flat-face flange of the material type specified on the attached Piping Material Data Sheet.
- 3. Flat ring-type gaskets shall be used between steel flanges equipped with raised serrated faces.
- 4. Where metallic flanges are bolted to non-metallic flanges, both shall be flat-faced flanges. Full-face gaskets shall be used.
- 5. When valves, fittings, or equipment having cast iron flanges are used, mating flanges shall be flat faced with full-faced gaskets.
- 6. Flange isolation kits shall be used between all dissimilar metal flanges.

3.4

QUALITY CONTROL

A. Inspections and Tests

- 1. Piping shall be hydrostatically or pneumatically pressure tested in accordance with ASME B31.3.
- 2. All pressure vessels, equipment, in-line instruments, gauge glasses, flow meters, and all other pressure parts of instruments shall not be

included in these tests if they will be damaged by the test pressure.

- 3. Equipment which is not to be subjected to the pressure test shall be disconnected from the piping and a pipe spool inserted in its place, or the equipment may be isolated by way of a single-line blind.

B. Hydrostatic Testing

- 1. Potable water or other approved fluids shall be used for hydrostatic pressure testing of piping systems in accordance with ASME B31.3.
- 2. The containment pipe (outer pipe) in double-walled piping systems shall be hydrostatically pressure tested at the same pressure as the carrier pipe (inner pipe).
- 3. All test pressures shall be maintained a minimum of 10 minutes before visual examination of joints begins. Hydrostatic test pressures shall be as shown in the following table:

SERVICE	MEDIUM CODE	DESIGN PRESSURE (psig)	TEST PRESSURE (psig)
Chilled Water	CHS, CHR	100	150
Condensate	LC	100	150
Drain	DR	100	150
Flush Water	FW	100	150
Process Water	TW	100	150
Recycle Water	RC	100	150
Scrubber Recycle	RSL	100	150
Slurry	SL	100	150
Sodium Hydroxide	NA	100	150
Sump Discharge	SU	100	150
Wastewater	WW	100	150

C. Pneumatic Testing

- 1. Pneumatic test pressures shall be as shown in the following table:

SERVICE	MEDIUM CODE	DESIGN PRESSURE	TEST PRESSURE
Plant Air	PA	100 psig	110 psig
Instrument Air	IA	100 psig	110 psig
Fuel Gas	FG	100 psig	110 psig
Off-Gas	OG	-80 in w.g./+10 in w.g.	15 psig
Blower Air	BA	20 in w.g.	15 psig

D. Hydrostatic/Pneumatic Test Reports

1. The Subcontractor shall provide a report for each piping system tested containing the following information:
 - a. Date of test.
 - b. Line designation number.
 - c. Test fluid.
 - d. Type of test.
 - e. Pressure applied.
 - f. Start time.
 - g. Completion time.
 - h. Total time at test pressure.
 - i. Certification by examiner of acceptability.
 - j. Calibration test gauge number and calibration date.
 - k. Comments, if any.

3.5 CLEANING

A. System Cleaning and Flushing

1. The interior and exterior of all pipe shall be kept clean at all times.

2. After erection and welding of piping, all lines
 except air and gas shall be flushed with potable
 water prior to leak testing or hydrostatic
 testing. Upon completion of flushing, lines shall
 be drained at all low points.

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END OF SECTION

ATTACHMENT A OF SECTION 15060

Date: 03/06/96
Rev.: B RE: KM

15060

WBS No.: 1.1.1.1.1.3.1
ERA/WPRAP/145/OFFGAS

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SERVICE: PIPING MATERIAL DATA SHEET (SEE SERVICE INDEX)	MAT'L CODE A (SPEC) PAGE 1 OF 4
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RATING: CLASS 150
FACING: RF
MATERIAL: CARBON STEEL

CORROSION ALLOWANCE: 0.125"
PRESSURE LIMIT: PER ASME/ANSI B16.5
TEMPERATURE LIMIT: -20°F TO 750°F

CODE NUMBER	ENCODER	SIZE FROM TO	DESCRIPTION	NOTES	REV
			PIPE		
		1/2" - 2"	SEAMLESS CARBON STEEL, ASTM A53 GRADE B, EXTRA STRONG, PLAIN ENDS		
		2-1/2" - LARGER	SEAMLESS CARBON STEEL, ASTM A53 GRADE B, STANDARD WEIGHT, BEVELED ENDS		
			FLANGES		
		1/2" - 2"	CLASS 150, CARBON STEEL, RF, ASTM A105, SOCKETWELD (XS BORE)		
		2-1/2" - LARGER	CLASS 150, CARBON STEEL, RFSF, ASTM A105, WELD NECK (STANDARD WEIGHT BORE)		
			ORIFICE FLANGES		
		2-1/2" - LARGER	CLASS 300, CARBON STEEL, ASTM A105, RF WITH 1/2" SCREWED TAPS AND JACK SCREWS, WELD NECK (STANDARD WEIGHT BORE)		
			FITTINGS		
		1/2" - 2"	CLASS 3000, CARBON STEEL, ASTM A105, SOCKETWELD		
		1/2" - 2"	CLASS 3000, SCREWED CARBON STEEL, ASTM A105; THREDOLET	1	
			PLUG, ROUNDHEAD	1	
			CAP	1	
			PLUG, HEX HEAD	4	
		2-1/2" - LARGER	SEAMLESS CARBON STEEL, BUTT WELD ENDS, ASTM A234 GRADE WPB		
			SWAGES		
		1/2" - 8"	SCHEDULE 80 CARBON STEEL, ASTM A234, GRADE WPB, PREPARE ENDS AS REQUIRED (BEVELED, PLAIN OR THREADED)	2	
			GASKETS		
		1/2" - LARGER	TEFLON, 1/16 INCH THICK		

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WBS No.: 1.1.1.1000336
ERA/WPRAP/145/OFFGAS

SERVICE: PIPING MATERIAL DATA SHEET (SEE SERVICE INDEX)			MAT'L CODE A (SPEC) OF 4 PAGE 2		
CODE NUMBER	ENCODER	SIZE FROM TO	DESCRIPTION	NOTES	REV
			<p align="center">BOLTING</p> <hr/> <p>STUD BOLTS WITH TWO HEAVY HEX NUTS, ASTM A193 GR B7/ASTM A194 GR 2H</p> <hr/> <p align="center">PIPING INSTRUMENT CONNECTIONS</p> <hr/> <p>PRIMARY INSTRUMENT CONNECTIONS TO PIPING:</p> <p>TEMPERATURE CONN. 1-1/2" FLANGED VALVE@ PRESS CONN. 3/4" SW/SCRD VALVE@ ORIFICE FLG. 1/2" SW/SCRD</p> <hr/> <p align="center">BALL VALVES</p> <hr/> <p>1/2" - 2" CLASS 600, CARBON STEEL, ASTM A105, THREE PIECE, SOCKETWELD, CHROME PLATED BALL, TFE SEATS, WRENCH OPERATOR 6</p> <p>2-1/2" - 4" CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF FLANGE, CHROME PLATED BALL, TFE SEATS, WRENCH OPERATOR 6</p> <p>6" - LARGER CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF FLANGE, CHROME PLATED BALL, TFE SEATS, GEAR OPERATOR 6</p> <hr/> <p align="center">BUTTERFLY VALVES</p> <hr/> <p>2" - LARGER CLASS 150, CARBON STEEL, ASTM A515, WAFER STYLE, 316 SS STEM AND DISC, 316SS SEAT, INTEGRAL FLANGE SEALS, LEVER HANDLE OPERATOR FOR 1-4", GEAR OPERATOR FOR 6" AND LARGER 6</p> <hr/> <p align="center">PLUG VALVES</p> <hr/> <p>1/2" - 2" CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, THREADED ENDS, REINFORCED PTFE SEATS 5,6</p> <p>2-1/2" - LARGER CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RF FLANGED ENDS, REINFORCED PTFE SEATS 5,6</p> <hr/> <p align="center">CHECK VALVES</p> <hr/> <p>1/2" - 2" CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF FLANGE, SWING TYPE 3</p> <p>2-1/2" - LARGER CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF, FLANGE, CHROME TRIM, BOLTED COVER, INTEGRAL SEAT, SWING TYPE 3</p>		
PARSONS ERA PROJECT			JOB NUMBER 7663-0145	DOCUMENT NO. 15060	REV B

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		GATE VALVES		
	1/2" - 2"	CLASS 150, CARBON STEEL, ASTM A105, CHROME TRIM, O S AND Y, SOCKETWELD ENDS		3,6
	2-1/2" - LARGER	CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF FLANGE, CHROME TRIM, O S AND Y, SOLID WEDGE DISC, INTEGRAL SEAT		3,6
		GLOBE VALVES		
	1/2" - 2"	CLASS 800, CARBON STEEL, ASTM A105, SOCKETWELD, BOLTED BONNET, 12% CHROME TRIM, HANDWHEEL OPERATOR		6
	2-1/2" - LARGER	CLASS 150, CARBON STEEL, ASTM A216 GRADE WCB, RF FLANGE, 12% CHROME TRIM, HANDWHEEL OPERATOR		6
		PIPE NIPPLES		
		CARBON STEEL, ASTM A53, GRADE B		
	1/2" - 2"	SCH 160, TBE, SMLS 3" LONG		
	1/2" - 2"	SCH 160, TBE, SMLS 6" LONG		
	1/2" - 2"	SCH 160, POE-TOE, SMLS 3" LONG		
	1/2" - 2"	SCH 160, POE-TOE, SMLS 6" LONG		
		STEAM TRAPS		
	1/2" - 2"	CLASS 600, SCREWED, DISC TYPE, INTEGRAL STRAINER, LOW CARBON CHROME-MOLY BODY, ASTM A182, GRADE F-11		
		DOUBLE WALLED CONTAINMENT PIPE		
	3" - 12"	CONTAINMENT (OUTER PIPE), SEAMLESS, CARBON STEEL, ASTM A53, GRADE B, STANDARD WEIGHT, BEVELED ENDS		
		DOUBLE WALLED (CONTAINMENT) FITTINGS		
	3" - 12"	CONTAINMENT (OUTER FITTING), SEAMLESS, CARBON STEEL, BUTT WELD ENDS, ASTM A234, GRADE WPB		

**PARSONS
ERA PROJECT**

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SERVICE: PIPING MATERIAL DATA SHEET (SEE SERVICE INDEX)		MAT'L CODE (SPEC) PAGE 4	A OF 4
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			NOTES	2039
			<ol style="list-style-type: none"> 1. USE FOR UNVALVED VENTS AND DRAINS. 2. USE SWAGES WHERE SMALL END IS 2" AND SMALLER. USE WELD REDUCER WHERE SMALL END IS 2-1/2" AND LARGER. 3. INSTALL IN HORIZONTAL POSITION OR WITH FLOW UP. 4. USE FOR PROCESS DRAINS. 5. USE FOR FUEL GAS ONLY, DEAD-TIGHT SHUTOFF IS REQUIRED. 6. EQUIP VALVE WITH LOCKING DEVICE WITH NOT LESS THAN 3/8" DIAMETER HOLE FOR LOCK. 	

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000339
 WBS No.: 1.1.1.1.1.3.1
 ERA/WPRAP/145/OFFGAS

RATING: CLASS 150 FACING: RF MATERIAL: GALVANIZED (2" AND SMALLER) CARBON STEEL	CORROSION ALLOWANCE: 0.0625" PRESSURE LIMIT: to 150 psig TEMPERATURE LIMIT: -20°F TO 250°F
--	--

CODE NUMBER	ENCODER	SIZE FROM TO	DESCRIPTION	NOTES	REV
			PIPE		
		1/2" - 2"	SEAMLESS GALVANIZED CARBON STEEL, ASTM A53, GRADE A, EXTRA STRONG, THREAD AND COUPLE ENDS		
		2-1/2" - LARGER	SEAMLESS CARBON STEEL, ASTM A53, GRADE A, STANDARD WEIGHT, BEVELED ENDS		
			FLANGES		
		1/2" - 2"	CLASS 150, GALVANIZED CARBON STEEL, RF, ASTM A105, SCREWED (XS BORE)		
		2-1/2" - LARGER	CLASS 150, CARBON STEEL, RFSF, ASTM A105, WELD NECK (STD WT BORE)		
			ORIFICE FLANGES		
		2-1/2" - LARGER	CLASS 300, CARBON STEEL, ASTM A105, RF WELD NECK WITH 1/2" SCREWED TAPS AND JACK SCREWS (STD WT BORE)		
			FITTINGS		
		1/2" - 2"	CLASS 3000, GALVANIZED CARBON STEEL, ASTM A105, SCREWED		
		1/2" - 2"	CLASS 3000, GALVANIZED CARBON STEEL, ASTM A105, SCREWED THREDOLET PLUG, ROUNDHEAD CAP PLUG, HEX HEAD	1 1 1 3	
		2-1/2" - LARGER	SEAMLESS CARBON STEEL, STANDARD WEIGHT, ASTM A234, GRADE WPB, BUTT WELD ENDS		

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PIPING MATERIAL DATA SHEET SERVICE: (SEE SERVICE INDEX)	MAT'L CODE W (SPEC) PAGE 2 OF 3
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RATING: CLASS 150 FACING: RF MATERIAL: GALVANIZED (2" AND SMALLER) CARBON STEEL	CORROSION ALLOWANCE: 0.0625" PRESSURE LIMIT: 150 psig TEMPERATURE LIMIT: -20°F TO 250°F
--	--

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			SWAGES		
	1/2" - 8"		SCHEDULE 80, CARBON STEEL, ASTM A234, GRADE WPB, PREPARE ENDS AS REQUIRED (BEVELED OR THREADED)	2	
			GASKETS		
	1/2" - LARGER		CLASS 150, RED RUBBER, 1/8" THICK		
			BOLTING		
	1/2" - LARGER		MACHINE BOLT WITH 1 HEAVY HEX NUTS, ASTM A307, GRADE B (CADMIUM PLATED)		
			PIPING INSTRUMENT CONNECTIONS		
			PRIMARY INSTRUMENT CONNECTIONS TO PIPING: TEMPERATURE CONN 1-1/2" FLG'D VALVE AT PRESS CONN'S 3/4" SCR'D VALVE AT ORIFICE FLGE 1/2" SCR'D		
			BALL VALVES		
	1/2" - 2"		200 WOG, BRONZE, THREADED ENDS, REINFORCED TFE SEATS, CHROME-PLATED BALL, WRENCH OPERATOR		
	2 1/2" - 4"		CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, TFE SEATS, CHROME-PLATED BALL, WRENCH OPERATOR		
	6" - LARGER		CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF, CHROME PLATED BALL, TFE SEATS, GEAR OPERATOR		
			CHECK VALVES		
	1/2" - 2"		CLASS 150, BRONZE, THREADED ENDS, ASTM B61, SWING TYPE, BRONZE TRIM		
	2 1/2" - LARGER		CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, CHROME TRIM, BOLTED COVER, INTEGRAL SEAT, SWING TYPE.		

<div style="border: 2px solid black; padding: 5px; display: inline-block;"> PARSONS ERA PROJECT </div>	JOB NUMBER 7663-0145	DOCUMENT NO. 15060	REV B
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PIPING MATERIAL DATA SHEET
 SERVICE: (SEE SERVICE INDEX)

MAT'L CODE W
 (SPEC)
 PAGE 3 OF 3

RATING: CLASS 150
 FACING: RF
 MATERIAL: GALVANIZED (2" AND SMALLER)
 CARBON STEEL

CORROSION ALLOWANCE: 0.0625"
 PRESSURE LIMIT: 150 psig
 TEMPERATURE LIMIT: -20°F TO 250°F

		GATE VALVES			
	1/2" - 2"	CLASS 150, BRONZE, THREADED ENDS, ASTM B62, BRONZE BONNET, HANDWHEEL OPERATOR			
	2 1/2" - LARGER	CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, O.S.& Y, CHROME TRIM, HANDWHEEL OPERATOR			
		GLOBE VALVES			
	1/2" - 2"	CLASS 150, BRONZE, THREADED ENDS, ASTM B62, BRONZE TRIM, HANDWHEEL OPERATOR			
	2 1/2" - LARGER	CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, O.S.&Y CHROME TRIM, HANDWHEEL OPERATOR			
		PIPE NIPPLES			
	1/2" - 2"	SCH 160, TBE, SMLS, 3" LONG			
	1/2" - 2"	SCH 160, TBE, SMLS, 6" LONG			
	1/2" - 2"	SCH 160, POE-TOE, SMLS, 3" LONG			
	1/2" - 2"	SCH 160, POE-TOE, SMLS, 6" LONG			
		NOTES			
		1. USE FOR UNVALVED VENTS AND DRAINS.			
		2. USE SWAGES WHERE SMALL END IS 2" AND SMALLER. USE WELD REDUCER WHERE SMALL END IS 2-1/2" AND LARGER.			
		3. USE FOR PROCESS DRAINS.			

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PIPING MATERIAL DATA SHEET SERVICE: (SEE SERVICE INDEX)	MAT'L CODE T3 (SPEC) PAGE 1 OF 1
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RATING: CLASS 150
 FACING: RF
 MATERIAL: 304L SS

CORROSION ALLOWANCE: 0.030"
 PRESSURE LIMIT: PER ASME/ANSI B16.5
 TEMPERATURE LIMIT: -20°F TO 750°F

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CODE NUMBER	ENCODER	SIZE FROM TO	DESCRIPTION	NOTES	REV
			PIPE		
		1/2" - larger	ELECTRIC RESISTANCE WELD (ERW), 304L STAINLESS STEEL, SCHEDULE 10S, ASTM A312, GRADE TP304L, BEVELED ENDS		
			FLANGES		
		1/2" - larger	CLASS 150, STAINLESS STEEL 304L, ASTM A182, GRADE F304L, RF WELD NECK, SCHEDULE 10S BORE		
			FITTINGS		
		1/2" - larger	304L STAINLESS STEEL, BUTT WELD, ASTM A403, GRADE WP304L, SCHEDULE 10S		
			GASKETS		
		1/2" - larger	FLAT RING PER ASME B16.21, REINFORCED FLEXIBLE GRAPHITE, 1/16" THICK		
			BOLTING		
		1/2" - larger	STUD BOLT, 304 STAINLESS STEEL, ASTM A193, GRADE B8, WITH 2 HEAVY HEX NUTS, ASTM A194, GRADE 8MN		
			BUTTERFLY VALVES		
		2" - larger	CLASS 150, STAINLESS STEEL 316, ASTM A351, GRADE CF8M, 316 SS DISC AND STEM, ASTM A276, TYPE 316, 316SS SEAT, LEVER HANDLE OPERATOR FOR 2-4", GEAR OPERATOR FOR 6" AND LARGER	1	
			NOTES		
			1. EQUIP VALVE WITH LOCKING DEVICE.		

PARSONS
ERA PROJECT

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SECTION 15090
PIPING SUPPORTS AND ANCHORS

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Design and location of piping supports and anchors for piping 2 inches in diameter and smaller.
- B. Design and location of piping supports and anchors for piping of all sizes when piping is supplied in combination with other equipment (i.e., "packaged systems").
- C. Furnishing and installing all piping system hangers, supports, clamps, rods, turnbuckles, bracing, rolls, plates, brackets, saddles, restraints, anchors, and other support elements as required.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 15020 - Packaged Equipment.
- D. Section 15060 - Pipe, Fittings, Valves, and Accessories.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES, CODES, AND STANDARDS

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A36/A36M-94 Standard Specification for Carbon Structural Steel.

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|--|---|---|--|
| 2. | ASTM A576
Rev. B-90 | Standard Specification
for Steel Bars, Carbon,
Hot-Wrought, Special
Quality. | 1
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| B. American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME): | | | |
| 1. | ANSI/ASME B31.3-93
1993 and 1994 Addenda | Chemical Plant and
Petroleum Refinery
Piping. | 24
25
26
27 |
| C. Manufacturers Standardization Society (MSS): | | | |
| 1. | MSS-SP-58-93 | Pipe Hangers and Supports
- Materials, Design, and
Manufacture. | 28
29 |
| 2. | MSS-SP-69-91 | Pipe Hangers and Supports
- Selection and
Application. | 30
31 |
| 3. | MSS-SP-89-91 | Pipe Hangers and Supports
- Fabrication and
Installation Practices. | 32
33
34
35
36
37
38
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41
42 |
| D. American Welding Society (AWS): | | | |
| 1. | AWS A5.1-91 | Specification for Carbon
Steel Electrodes for
Shielded Metal Arc
Welding. | 43
44
45
46
47 |
| 2. | AWS D1.1-94 | Structural Welding Code -
Steel. | 48
49
50 |

1.5 SYSTEM DESCRIPTION

- | | | | |
|------------------------|--|--|----------------------------------|
| A. Design Requirements | | | |
| 1. | All pipe anchors, guides, and auxiliary steel shall be of bolted or welded construction incorporating a design safety factor of five. | | 51
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| 2. | Anchors and guides shall be used to prevent excessive forces or moments on pipe or equipment caused by hydraulic surges. | | 54
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| 3. | Hangers and support types for all process lines shall be selected to withstand all static and dynamic load conditions and shall take into consideration limitations imposed by the | | 57
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surrounding structures, equipment, adjacent piping, ductwork, and electrical trays. Consideration shall be given to the following loads:

- a. Weight of the pipe, valves, fittings, insulation materials, hanger components, and normal fluid contents.
- b. Weight of the hydrostatic test fluid or cleaning fluid, if normal operating fluid density is less than test or cleaning fluid.
- c. Loads imposed during erection.

4. Support Spacing:

- a. Hangers and supports shall be spaced in accordance with ASME B31.3; Table I for Schedule 10 steel pipe; and Attachment A for Schedule 40 and Schedule 80 steel pipe. The pipe span chart is applicable to both single- and double-walled piping systems. Due consideration shall be given to ensure that the sag of the pipe between supports is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads.

Table I - Maximum Support Spacing (feet) for Schedule 10 Steel Pipe

Nominal Pipe Size (inches)	1/2	3/4	1	1-1/2	2	2-1/2	3	4	5	6	8	10
Maximum Clear Span (feet)	5	6	7	9	10	11	12	14	16	17	19	21

5. Restrictions:

- a. Pipe support assemblies shall be used only for supporting pipelines. Electrical trays, instrument trays, cable, or tubing shall be supported from separate assemblies unless written approval has been received from FERMC0. Pipe hanger rods or supports shall not pass through heat or ventilating ducts nor through electrical or instrument trays.

6. Pipe shoes:
 - a. Pipe shoes shall be 12 inches long, attached to the longitudinal run of pipe, and centered on the structural member.
7. Heat-Traced Pipe:
 - a. Electric-traced pipe lines shall rest on support steel, adjustable roller hangers, or an adjustable pipe roll and base attached to a horizontal steel member. Insulation shall be cut away at support to facilitate installation.
8. Combination Supports:
 - a. Where the piping design incorporates multiple horizontal pipelines with the bottom of all the pipelines at the same elevation, rack type supports shall be used. Where multiple pipelines are supported on a single support member, consideration shall be given to the difference in expansion of the pipelines and possible resultant misalignment of the support during normal operation.
9. Unit Support:
 - a. Where single horizontal pipelines are to be supported, the selection of the pipe attachment shall be based on the application, considering workability, function, strength, and economics. This attachment may be a pipe clamp, clevis, U-bolt, double-rod roll, or other pipe attachment best suited for the condition. The movement of the pipe due to hydraulic surges and other sources shall be considered. The attachments between the pipe and the supporting structure (usually hanger rod) shall be able to swivel at the ends to accommodate a 4-degree movement of the pipe.
10. Structural Integrity:
 - a. The supports shall be designed and installed so that they cannot become disengaged by movements of the supported pipe. A lock nut shall be used to prevent turning and disengagement.

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1.6 SUBMITTALS

- A. Provide submittals per Section 01011. 2
- B. Certificate of Conformance: Manufacturer shall certify and provide data which indicate that all products supplied meet or exceed specification requirements. 3, 4, 5, 6, 7, 8
- C. Product data. 9, 10
- D. Shop drawings which indicate support type and location, arrangement, dimensions, materials, weld details, and anchor details. 11, 12, 13, 14
- E. Manufacturer's installation instructions and catalog data. 15, 16, 17
- F. Welder and inspector qualifications, procedure qualification records, and welding procedure specifications in accordance with AWS D1.1. 18, 19, 20, 21

1.7 QUALITY ASSURANCE PROGRAM

- A. All pipe anchors, guides, and auxiliary steel shall be of bolted or welded construction. Welded construction shall comply with AWS D1.1. 22, 23, 24, 25, 26, 27

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaging 28, 29, 30
 - 1. Materials shall be cleaned to remove chips, slag, weld spatter, oil and grease, debris, and other foreign matter prior to packing for shipment. 31, 32, 33, 34
- B. Storage and Handling 35
 - 1. Piping support materials and piping hanger systems shall be stored off the ground and handled with care so that physical damage or contamination of the materials does not occur. 36, 37, 38, 39
 - 2. Welding rods and electrodes shall be stored, handled, and identified at all times to ensure the use of proper welding rod. Electrode ovens for 40, 41, 42

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the storage of low-hydrogen welding rods must be used at all times.

PART 2 PRODUCTS

2.1 PRODUCTS/EQUIPMENT

A. Product Shipping Requirements

1. All job-related materials and/or equipment shall be delivered to the job site.

2.2 MATERIALS

- A.** Hangers and component parts shall be constructed of galvanized carbon steel and comply with MSS-SP-58 and MSS-SP-69.

- B.** Pipe clamps shall comply with ASTM A576 and be constructed of galvanized carbon steel.

- C.** ASTM A36 steel shall be used for all plate and structural shape support components.

2.3 FABRICATION

A. Welding

1. All welding shall be in accordance with the applicable codes as specified and referenced in Article 1.3.

B. Shop Assembly

1. Any parts made in the fabricator's shop shall be completely shop assembled, as far as practical, prior to shipment to the site.

C. Shop/Factory Finish

1. All carbon steel parts shall be shop prime coated after fabrication.

2.4 LABELING

A. Product Marking

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- 1. All welding rods and electrodes shall be identified with at least one imprint per rod showing an AWS classification number in accordance with AWS A5.1.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Installation

- 1. Hanger and support components shall be installed in accordance with MSS-SP-89.

B. Structural Connections for Pipeline Supports

- 1. Locations: Pipeline supports and/or hangers shall be attached to structural members. The supports shall be located at the following places and at intermediate points so that the maximum support spacing described in Article 1.4 is not exceeded:
 - a. For changes in direction on horizontal or sloped lines, refer to the attached allowable pipe spans chart.
 - b. Both sides of flanged flow meter joints on horizontal or sloped lines.
 - c. Within 2 feet on one side of valves on horizontal or sloped lines.
 - d. The underside of floor or platform steel on vertical lines that pass through the floor or platform.
- 2. Cold Lines: Hanger rods supporting cold pipelines, or lines whose point of support does not move, may be bolted directly to angle, beam, or supporting members.
- 3. Prohibited Attachments: Pipelines shall not be attached to the following:
 - a. Floor opening pipe sleeves.
 - b. Grating or floor plate.
 - c. ASME coded vessels.
 - d. Other pipe hangers or other pipes.
- 4. Supports shall be provided to avoid the need for temporary supports in the following cases:
 - a. Where regular maintenance necessitates the removal of equipment.

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- b. Where flanged connections must be broken to remove or insert spectacle blinds.
5. Anchors and guides shall be designed and installed at the locations shown.

3.2 ADJUSTING

- A. At Pumps: Where required, the suction piping and discharge piping adjacent to pumps shall be supported with an adjustable support.
- B. Riser Guides: All risers that may sway or vibrate from pump pulsations or mechanical equipment operation shall be guided. The guides/braces shall prevent movement resulting from equipment operation/vibration, but shall not limit or restrain movement of pipe due to thermal expansion. On overflow lines, a brace or restraint shall be installed near the discharge.
- C. Vertical Adjustment
1. All rod-type hangers shall be provided with a means of vertical adjustment after erection. If a turnbuckle is used, the right hand thread shall be at the top, so that turning to the right will raise the pipe.
- D. Riser Piping
1. Where practical, riser piping shall be supported independently of the connected horizontal piping. Pipe support attachments to riser piping shall be by riser clamps and/or lugs welded to the pipe.

END OF SECTION

ATTACHMENT A

ALLOWABLE PIPE SPANS

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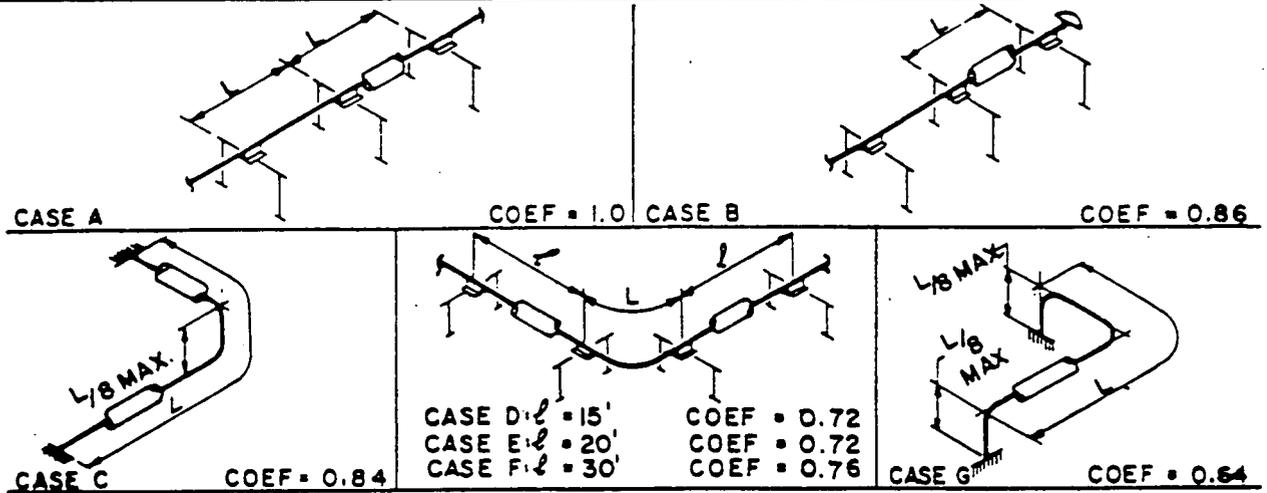
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Subject

ALLOWABLE PIPE SPANS

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Notes:

1. The limiting factors are deflection and weight stress. Pipe span not entered if weight stress of 6,000 pounds per square inch (psi) is exceeded.
2. The pipe spans are based on carbon steel pipe with modulus of elasticity of 30×10^6 psi. This chart can be applicable to alloy pipe.
3. Deflection is based on a compromise between a beam with fixed-ends and for a free-ended beam, $d = 17.1 (wL^4/EI)$.
4. This chart is adequate for standard-wall and extra-strong walled pipe.
5. Boxed figures represent Parsons standard. Job instructions may allow deviation.
6. When using Cases B, C, D, E, F, and G, multiply pipe span by their coefficient.
7. These spans are the maximum to be used under American National Standards Institute B31.3, Piping. Design conditions and other codes should be investigated before using these spans.

PIPE SIZE	1	1½	2	3	4	6	8	10	12	14	16	18	20	24	DEF'L
BARE PIPE	-	-	-	-	-	-	-	36	38	42	45	47	50	54	1/4
	14	17	19	24	27	33	38	43	46	49	52	55	58	64	1/2
	15	18	21	25	29	35	40	46	49	52	55	58	62	68	5/8
	16	19	22	26	30	37	42	48	52	55	58	62	65	71	3/4
	17	21	23	28	32	40	45	-	-	-	-	-	-	-	1
BARE PIPE + WATER	-	-	-	-	-	-	-	31	33	35	36	37	39	42	1/4
	14	17	19	22	25	29	33	36	39	40	42	44	46	48	1/2
	14	18	20	23	26	31	35	39	41	43	45	47	48	52	5/8
	15	19	21	24	27	33	37	41	43	45	47	49	51	-	3/4
PIPE + 2" INSUL.	-	-	-	-	-	-	-	34	36	39	42	44	47	52	1/4
	12	15	17	22	25	31	36	41	42	46	50	52	56	61	1/2
	13	16	18	23	26	33	38	43	45	49	53	56	59	65	5/8
	13	17	19	24	27	35	40	45	47	52	55	58	62	68	3/4
PIPE + 2" INSUL. + 0.6 WATER	-	-	-	-	-	-	-	31	33	35	36	37	39	42	1/4
	12	15	16	20	23	29	33	36	39	40	42	44	46	48	1/2
	12	16	17	22	25	31	35	39	41	43	45	47	48	52	5/8
	13	17	18	23	26	32	36	41	43	45	47	49	51	-	3/4
	14	18	20	25	28	34	39	-	-	-	-	-	-	-	1

SECTION 15160
PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Base-mounted horizontal centrifugal pumps.
- B. Chemical feed pumps.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 15173 - Motors for Off-Gas Treatment System.
- D. Section 15020 - Packaged Equipment.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES, CODES, AND STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B73.1M-91 Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process.
 - 2. ASME B15.1-92 Safety Standard for Mechanical Power Transmission Apparatus.
- B. Hydraulic Institute Standards - 1995.
 - 1. Requirements for Pump Testing.

1.5 SUBMITTALS

- A. Submittals shall be in accordance with Section 01011.

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- B. Shop drawings for pumps and baseplate including anchor settings, sizes, and locations.
- C. Product Data: Certified pump curves for each pump model supplied, showing performance characteristic with pump and system operating point plotted. Include net positive suction head curve.
- D. Certificates: Alignment certification, certificates of conformance to specification requirements from manufacturer, and certificates guaranteeing performance at design point.
- E. Installation instructions, start-up and troubleshooting instructions, operational and maintenance data, lubrication instructions, and spare parts list.
- F. Shop testing procedures.
- G. Test reports.

1.6 QUALITY ASSURANCE PROGRAM

- A. Each pump shall be tested in the manufacturer's shop in accordance with Hydraulic Institute Standards.
- B. The Subcontractor shall submit shop testing procedures to FERMCO for approval a minimum of 10 working days prior to the start of testing. Testing shall not start until the testing procedure has been approved by FERMCO.
- C. FERMCO shall have the option of witnessing all tests. The Subcontractor shall provide notice to FERMCO.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry place and protect from weather prior to shipment. Provide protection from weather and from damage during transit.
- B. Loose items shall be tagged and delivered in a standard commercial package. The package shall be protected

from the weather, from climate conditions including temperature and humidity variations, and from dirt, dust, and other contaminants that could adversely affect assembly and operation of the pumps.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. General Construction Requirements

- 1. The balancing of the rotating parts, statically and dynamically, shall be in accordance with the manufacturer's standards.
- 2. All blades, pulleys, belts, pumps, motors, and other like equipment shall be complete with "guarding" of any possible "nip points." This guarding shall be in accordance with ASME B15.1.
- 3. Horizontal centrifugal pumps shall meet the requirements of ASME B73.1M.

B. Pumps

- 1. See Attachment A, Pump Data Sheets.

2.2 FABRICATION

A. Prior to shipment, the pump/motor assemblies shall be cleaned of all dirt, dust, grease, grime, weld spatter, and other foreign material. Pumps shall be primed and painted in accordance with manufacturer's standard finish. Any open end connections shall be sealed to prevent the entrance of foreign material.

2.3 LABELING

A. Equipment Identification: All pumps shall be provided with a permanently attached stainless steel nameplate indicating equipment name, number, model number, and rated capacity. Lettering shall be a minimum of 3/8 inch high and shall be stamped. Nameplates shall be located for unobstructed viewing when equipment is installed.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

- A. The installation of the equipment specified and shown on the drawings shall be in accordance with the manufacturer's instructions.
- B. A copy of the manufacturer's installation instructions, start-up and troubleshooting instructions, operation and maintenance data, lubrication instructions, and spare parts list shall be available at the site.
- C. Alignment: For pumps requiring alignment, final alignment after piping connections shall be performed and certified by a qualified millwright prior to commissioning and startup.

3.2 QUALITY CONTROL

- A. Tests: Acceptance operating tests shall be performed by the Subcontractor after installation. If the results are unsatisfactory, the Subcontractor shall adjust or replace the equipment to meet the specification requirements and retest the equipment.
- B. Inspection: The Subcontractor shall notify FERMCO of testing and inspection activities prior to the start of all tests and/or inspections.

3.3 DEMONSTRATION

- A. Demonstrate ability to meet full range of operating flow rates and operating point as shown on pump curves. Vibration shall be within manufacturer's acceptable range.
- B. Pump manufacturer shall provide services of Service Engineer during pump installation, start-up, and testing.

END OF SECTION

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ATTACHMENT A

PUMP DATA SHEETS

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PUMP DATA SHEET

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Wastewater Transfer Tank Pumps

PROJECT TITLE: WPRAP Remediation System Design	PROJECT ORDER: 145
PROJECT NO.: ERA/WPRAP/145/OFFGAS	QUANTITY: 2
TYPE PUMP: Horizontal Centrifugal - ANSI	REVISION: B
TYPE DRIVER: Electric Motor (see Note 1)	SUPPLY W/PUMP: X YES NO
MANUFACTURER AND MODEL NO:	

OPERATING CONDITIONS

FLUID PUMPED: Water	AT A PUMPING TEMPERATURE OF: 150 °F	
SPECIFIC GRAVITY: 1.0 AT 60° F	AT P.T.	VISCOSITY: AT P.T.
SOLIDS IN FLUID: <1.0 WT. %	DENSITY:	SIZE: ABRASIVE: YES X NO
NATURE OF SOLIDS:	FLUID VAPOR PRESSURE: FT. of FLUID @ P.T.	
DESIGN CAPACITY: 40 GPM AT 100 FT. at P.T.	DESIRED RANGE: 20 GPM TO 60 GPM	
SUCTION PRESS: FT. PSIG	DISCHARGE PRESS: 100 FT. PSIG	NPSH AVAIL: Flooded FT. at P.T.

PUMP SPECIFICATIONS

TYPE PUMP: Horizontal, Centrifugal - ANSI	NO. STAGES: 1	RPM: 3500
TYPE IMPELLER: Open	SIZE: IN.	MAX SIZE: IN.
EFFICIENCY AT DESIGN CAPACITY: 50 (min) %	BHP @ DESIGN CAPACITY: --	MAXIMUM BHP: --
TYPE BEARINGS: Ball		
TYPE COUPLING: Flexible	LUBRICATION: Flooded oil	
TYPE OF SEAL: Mechanical		

CONNECTIONS - SIZE & RATING

SUCTION: 1 1/2 IN. 150 LB. Flange	DISCHARGE: 1 IN. 150 LB. Flange
VENT: IN. LB	DRAIN: IN. LB.

CONSTRUCTION MATERIALS

RESTRICTIONS:	
CASING: Cast Iron	IMPELLER: Stainless steel
SHAFT: Stainless steel	SHAFT SLEEVE: 316 Stainless Steel
CASE RING:	IMP. RING:
BASE PLATE: Cast Iron	RELIEF VALVE:

ELECTRIC MOTOR

VOLTS	PHASE	HERTZ	H.P.	NON-OVERLOAD	CLASS	GROUP	RPM	TYPE
460	3	60	5 max.	YES			3500	TEFC

REMARKS: Provide pump casing with drain plug and baseplate with drain rim.

Note 1: See Section 15173 for electric motor requirements.

PUMP DATA SHEET

Condensate Transfer Pumps

PROJECT TITLE:	WPRAP Remediation System Design	PROJECT ORDER:	145
PROJECT NO.:	ERA/WPRAP/145/OFFGAS	QUANTITY:	2
TYPE PUMP:	Horizontal Centrifugal-ANSI	REVISION:	B
TYPE DRIVER:	Electric Motor (see Note 1)	SUPPLY W/PUMP:	X YES NO

MANUFACTURER AND MODEL NO:

OPERATING CONDITIONS

FLUID PUMPED:	Water	AT A PUMPING TEMPERATURE OF:	140 °F
SPECIFIC GRAVITY:	1.0 AT 60° F	1.0 AT P.T.	VISCOSITY: AT P.T.
SOLIDS IN FLUID:	< 1.0 WT. %	DENSITY:	SIZE: ABRASIVE: YES X NO
NATURE OF SOLIDS:		FLUID VAPOR PRESSURE:	FT. of FLUID @ P.T.

DESIGN CAPACITY:	16 GPM AT 100 FT. at P.T.	DESIRED RANGE:	2 GPM TO 25 GPM
SUCTION PRESS:	FT. PSIG	DISCHARGE PRESS:	100 FT. PSIG NPSH AVAIL: Flooded FT. at P.T.

PUMP SPECIFICATIONS

TYPE PUMP:	Horizontal, Centrifugal-ANSI	NO. STAGES:	1	RPM:	3500
TYPE IMPELLER:	Open	SIZE:	IN.	MAX SIZE:	IN.
EFFICIENCY AT DESIGN CAPACITY:	50 (min) %	BHP @ DESIGN CAPACITY:	--	MAXIMUM BHP:	--
TYPE BEARINGS:	Ball				
TYPE COUPLING:	Flexible	LUBRICATION:	Flooded oil		
TYPE OF SEAL:	Mechanical				

CONNECTIONS - SIZE & RATING

SUCTION:	1 - 1/2 IN.	150 LB.	Flange	DISCHARGE:	1 IN.	150 LB.	Flange
VENT:	IN.	LB		DRAIN:	IN.		LB.

CONSTRUCTION MATERIALS

RESTRICTIONS:			
CASING:	Cast iron	IMPELLER:	Stainless steel
SHAFT:	Stainless steel	SHAFT SLEEVE:	316 Stainless Steel
CASE RING:		IMP. RING:	
BASE PLATE:	Cast iron	RELIEF VALVE:	

ELECTRIC MOTOR

VOLTS	PHASE	HERTZ	H.P.	NON-OVERLOAD	CLASS	GROUP	RPM	TYPE
460	3	60	2 max.	YES			3500	TEFC

REMARKS: Provide pump casing with drain plug and baseplate with drain rim.
 Note 1: See Section 15173 for electric motor requirements.

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PUMP DATA SHEET

Caustic Supply Pump

PROJECT TITLE:	WPRAP Remediation System Design	EQUIP. NO.	PROJECT ORDER:	145
PROJECT NO.:	ERA/WPRAP/145/OFFGAS		QUANTITY:	2
TYPE PUMP:	Plunger (See Note 2)		REVISION:	B
TYPE DRIVER:	Electric Motor (see Note 1)	SUPPLY W/PUMP:	X	YES NO
MANUFACTURER & MODEL NO:	--			

OPERATING CONDITIONS

FLUID PUMPED:	Caustic soda solution (50 percent NaOH)	AT A PUMPING TEMPERATURE OF:	Ambient	*F
SPECIFIC GRAVITY:	1.22 AT 60° F	AT P.T.	VISCOSITY:	-- AT P.T.
SOLIDS IN FLUID:	-- WT.%	DENSITY:	--	SIZE: -- ABRASIVE: YES X NO
NATURE OF SOLIDS:	--	FLUID VAPOR PRESSURE:	--	FT. of FLUID @ P.T.
DESIGN CAPACITY:	0.8 GPM AT 100 psig	at P.T.	DESIRED RANGE:	0.1 GPM TO 1 GPM
SUCTION PRESS:	FT. PSIG	DISCHARGE PRESS:	FT. 100 PSIG	NPSH AVAIL: FT. at P.T.

PUMP SPECIFICATIONS

TYPE PUMP:	Plunger	NO. STAGES:		RPM:
TYPE IMPELLER:	Diaphragm	SIZE:	IN.	MAX SIZE: IN.
EFFICIENCY AT DESIGN CAPACITY:	-- %	BHP @ DESIGN CAPACITY:	--	MAXIMUM BHP: --
TYPE BEARINGS:	steel ball			
TYPE COUPLING:	N/A	LUBRICATION:	oil bath	
TYPE OF SEAL:	N/A			

CONNECTIONS - SIZE & RATING

SUCTION	1/2 IN.	threaded LB.	DISCHARGE:	1/2 IN.	threaded LB.
VENT:	N/A	IN. LB.	DRAIN:	N/A	IN. LB.

CONSTRUCTION MATERIALS

RESTRICTIONS:	Wetted parts: 316 stainless steel				
CASING:	--	DIAPHRAGM:	Teflon		
SHAFT:	--	SHAFT SLEEVE:	--		
CASE RING:	--	IMP. RING:	--		
BASE PLATE:	--	RELIEF VALVE:	--		

ELECTRIC MOTOR

VOLTS	PHASE	HERTZ	H.P.	NON-OVERLOAD	CLASS	GROUP	RPM	TYPE
115	1	60	1/2 (max)	X YES NO			1,800	TEFC

REMARKS: Note 1: See Section 15173 for electric motor requirements.
 Note 2: Pump shall have internal relief valve.

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SECTION 15173
MOTORS FOR OFF-GAS TREATMENT SYSTEM

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- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE 112-91 Standard Test Procedure for Polyphase Induction Motors and Generators.

- C. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA MG 1-93 Motors and Generators.
 - 2. NEMA MG 13-84 Frame Assignments for AC Integral-Horsepower Induction Motors.

- D. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code, 1996 Edition.

1.5 SYSTEM DESCRIPTION

- A. Provide electric motors as required for the Off-Gas Treatment System. Each motor shall be selected especially for its respective driven equipment. Each motor shall be adequate for the full range of the driven equipment's performance.

1.6 SUBMITTALS

- A. Provide submittals as required by Section 01011.
- B. Motor Data Sheets: Provide completed motor data sheet (Attachment 1) for each motor provided.
- C. Test Reports: Indicate satisfactory completion of required tests and inspections. Submit results verifying performance in accordance with IEEE 112.

1.7 QUALITY ASSURANCE

- A. Conform to NFPA 70 and NEMA MG 1.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Reliance Electric.

- B. U. S. Motors. 1
- C. General Electric. 2

2.2 **EQUIPMENT** 3

A. General Construction and Requirements 4

1. Electrical Service: Refer to related sections of the specifications and the drawings for required characteristics. 5
2. Motors: Design for continuous operation at a temperature of 40 degrees C ambient, and for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type. Motors to be controlled by variable frequency drives shall be of a design suitable for this type of operation. 6
3. Visible Nameplate: Nameplate to indicate motor horsepower, voltage, phase, frequency, rpm, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, serial number, and bearing numbers. Nameplate shall be stainless steel, permanently attached to the motor frame. 7
4. Electrical Connection: Conduit connection boxes, threaded for conduit and designed to allow for 90 degree step rotation of the conduit entrance. Oversize conduit boxes shall be provided. 8
5. Motor Service Factor: Furnish motors with service factors required here by table in Paragraph D. Motor size in hp shall be selected to serve the driven equipment over its full performance range as though the service factor is 1.0. 9
6. Motor voltage shall be 115 V, single-phase for motors 1 hp or less. Other motors shall be 460 V, three-phase. 10
7. Motors drawing less than 250 W that are intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications. 11

B. Three Phase - Squirrel Cage Induction Motors 12

1. Motors shall be 460 V, three phase, 60 Hz. 13

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2. The motor connection diagram shall be stainless steel, permanently stamped and attached to the motor either inside the conduit box or on the same side as the conduit box.
3. Starting Torque: To be matched to the driven equipment.
4. Starting Current: Not to exceed six times full-load current.
5. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics or as required by the driven equipment.
6. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
7. Insulation System: Non-hygroscopic NEMA Class F or better.
8. Testing Procedure: In accordance with IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and for compliance with performance data.
9. Motor Frames: NEMA MG 13 standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
10. Bearings: Grease lubricated, anti-friction ball bearings with housings equipped with plugged provision for prelubrication, rated for minimum ABMA 9 and 11, L-10 life of 20,000 hours.
11. Sound Power Levels: To NEMA MG 1.
12. Motors shall be high efficiency type.
13. Motors shall be totally enclosed fan cooled (TEFC).
14. Nominal Efficiency: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.
15. Nominal Power Factor: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.

C. Performance Schedule: Three Phase - Energy efficient, TEFC.

HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor	
1	1200	145T	81	72	1
1-1/2	1200	182T	83	65	2
2	1200	184T	85	68	3
3	1200	213T	85	63	4
5	1200	215T	86	66	5
7-1/2	1200	254T	89	68	6
10	1200	256T	89	75	7
15	1200	284T	90	72	8
20	1200	286T	90	76	9
25	1200	324T	90	71	10
30	1200	326T	91	79	11
40	1200	364T	92	78	12
50	1200	365T	92	81	13
60	1200	404T	92	83	14
75	1200	405T	92	80	15
100	1200	444T	93	83	16
125	1200	445T	93	85	17
1	1800	143T	82	84	18
1-1/2	1800	145T	84	85	19
2	1800	145T	84	85	20
3	1800	182T	87	83	21
5	1800	184T	88	83	22
7-1/2	1800	213T	89	85	23
10	1800	215T	90	84	24
15	1800	254T	91	86	25
20	1800	256T	91	85	26
25	1800	284T	92	84	27
30	1800	286T	93	86	28
40	1800	324T	93	83	29
50	1800	326T	93	85	30
60	1800	364T	93	87	31

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HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
75	1800	365T	93	87
100	1800	405T	94	86
125	1800	444T	94	87
150	1800	445T	94	88
200	1800	447T	95	87
1-1/2	3600	143T	82	85
2	3600	145T	82	87
3	3600	182T	82	87
5	3600	184T	85	88
7-1/2	3600	213T	86	86
10	3600	215T	86	86
15	3600	254T	88	91
20	3600	256T	89	89
25	3600	284T	90	92
30	3600	286T	91	92
40	3600	324T	91	91
50	3600	326T	90	92
60	3600	364T	91	93
75	3600	365T	91	91
100	3600	405T	92	92

D. Service Factor Schedule

HP	3600 rpm	1800 rpm	1200 rpm	900 rpm
1/6 - 1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
>1 - 150	1.15	1.15	1.15	1.15

E. Single phase motors shall conform to the following respective requirements. The driven equipment supplier

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- shall furnish motor starter, motor type, and motor enclosure type suitable for the application.
- 1. Single Phase Power - Split Phase Motors
 - a. Starting Torque: Less than 150 percent of full load torque.
 - b. Starting Current: Up to seven times full load current.
 - c. Breakdown Torque: Approximately 200 percent of full load torque.
 - d. Drip-Proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
 - e. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.
- 2. Single Phase Power - Permanent-Split Capacitor Motors
 - a. Starting Torque: Exceeding 1/4 of full load torque.
 - b. Starting Current: Up to six times full load current.
 - c. Multiple Speed: Through tapped windings.
 - d. Open Drip-Proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.
- 3. Single Phase Power - Capacitor Start Motors
 - a. Starting Torque: Three times full load torque.
 - b. Starting Current: Less than five times full load current.
 - c. Pull-Up Torque: Up to 350 percent of full load torque.
 - d. Breakdown Torque: Approximately 250 percent of full load torque.
 - e. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
 - f. Drip-Proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated bearings.
 - g. Enclosed Motors: Class A (50 degrees C temperature rise).

PART 3 EXECUTION

Not used.

END OF SECTION

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ATTACHMENT 1

MOTOR DATA SHEET

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MOTOR DATA SHEET

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Submit for each motor. Mark N/A if not applicable.

- 1. Driven Equipment Number _____
- 2. Driven Equipment Name _____
- 3. Motor Manufacturer _____
- 4. Quantity _____
- 5. Horsepower (hp) _____
- 6. RPM _____
- 7. Voltage _____
- 8. Enclosure Type _____
- 9. Frame _____
- 10. Phase/Frequency _____
- 11. 40 degree C ambient insulation _____
- 12. Service Factor _____
- 13. NEMA Design _____
- 14. Space Heaters _____
- 15. Full Load Amperes (FLA) _____
- 16. Locked Rotor Amperes (LRA) _____
- 17. Efficiency:
 - 1/2 Load _____
 - 3/4 Load _____
 - Full Load _____
- 18. Power Factor:
 - 1/2 Load _____
 - 3/4 Load _____
 - Full Load _____

SECTION 15250
INSULATION

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PART I GENERAL

1.1 SECTION INCLUDES

- A. Labor, materials, and equipment required for installing pipe and equipment insulation as specified herein.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 15060 - Pipe, Fittings, Valves, and Accessories.
- D. Section 15090 - Piping Supports and Anchors.
- E. Section 16856 - Heating Cables and Panel for Off-Gas Treatment Systems.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES, CODES, AND STANDARDS

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM B209-95 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. ASTM C533-85 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 3. ASTM C552-91 Standard Specification for Cellular Glass Thermal Insulation.

4. ASTM C795-92 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

1.5 SUBMITTALS

- A. Provide submittals per Section 01011.
- B. Certificate of Conformance: Manufacturer shall certify and provide data which indicate that all products supplied meet or exceed specification requirements.
- C. Product data.
- D. Installation instructions.
- E. Material safety data sheets.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Insulation Materials
 - 1. Insulation materials shall be identified, inspected, controlled, and protected in a manner that will ensure conformance with the referenced codes and standards.
 - 2. Care shall be taken in the storage and handling of all insulation material so that contamination by grease, moisture, or other foreign matter does not occur. Insulation materials shall be stored off the ground, protected from the weather, and handled so that physical damage to the insulation material does not occur.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cellular glass: Board and molded (rigid), inorganic, maximum 'k' value of 0.345 Btu-inch/hour per square foot per degree F at 75 degrees F, conforming to ASTM C552 (Type II) and to ASTM C795 when installed on

stainless steel pipe. To be used for temperatures below 400 degrees F.

- B. Calcium Silicate: Preformed pipe covering, flat block or curved block, in accordance with ASTM C533 (Type I). To be used for temperatures above 400 degrees F.
- C. Jacketing Aboveground: Aluminum, Alloy 3003, H14 temper, 0.020 inches thick, embossed, conforming to ASTM B209.
- D. Jacketing - Underground Heat Trace Applications: Wrapping consisting of polymer modified bituminous compound with a 4-mil, high-density, cross laminate, polyethylene top film and release paper backing, total thickness of 40 mils.
- E. Elbow insulation covers: Aluminum, Alloy 1100, H14 temper, embossed.
- F. Bedding Compound: Non-volatile, 0.008 perm inch; service temperature range of -60 degrees F to 180 degrees F; application temperature 40 degrees F to 100 degrees F, sealant.
- G. Reinforcing Cloth: White open-weave, asbestos free, glass cloth, 10 by 10 weave-set mesh with nonasphaltic binder.
- H. Mastic Vapor Barrier: Non-toxic fire resistant vapor-retarder type for outdoor service.

2.2 ACCESSORIES

- A. Insulation Bands:
 - 1. Piping: 1/2-inch wide (minimum) by 0.015-inch thick (minimum), 304 stainless steel bands.
 - 2. Equipment: 3/4-inch wide (minimum) by 0.015-inch thick (minimum), 304 stainless steel bands.
- B. Screws: Number 8, by 1/2-inch, sheet metal type 302 or 304 stainless steel.

- C. Adhesives: Fire-resistant adhesive shall be compatible with insulation.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

- A. Piping, valves, fittings, and flanges, shall be insulated and jacketed when the suffixes "I," "ET," or "P" appear in the pipe line number as indicated on the drawings. Equipment shall be insulated when required on the drawings.
- B. Install materials in accordance with the manufacturer's instructions. Maintain temperatures and conditions required by the manufacturer for installation.
- C. Manholes and flanges shall have removable insulation and aluminum jacketing to permit servicing of take-down joints. Removable covers may be fabricated from segments of block insulation or from preformed sectional pipe covering and premolded components. A removable cover shall be of the same material as the adjoining pipe insulation.
- D. Fill joints and seams with bedding compound to form a smooth surface.
- E. All insulation, except for insulation on chilled water piping, shall be stopped at a sufficient distance from flanges to permit ease of bolt removal. Insulation shall be beveled at a 45-degree angle at this point.
- F. Install jacketing with screws on 3-inch centers on all fittings and valves where banding is not possible.
- G. Where aluminum insulation covers are not available, coat exterior surfaces of equipment and piping component insulation with caulking mastic to protect insulation from mechanical damage. Do not depend on caulking mastic to seal open cracks and improperly made joints.

H. Mastic Coating Application

1. Apply mastic coating by palming, troweling, or spraying. Install glass fiber cloth embedded in mastic to conceal dry weave of cloth.
2. Lap cloth joints a minimum of 2 inches and apply with a smooth unbroken surface with a minimum finished dried thickness of 1/16 inch.
3. When applying mastic coatings by spraying, protect adjacent surfaces that are not to be coated.
4. Before applying mastic coating, apply a heavy fillet of caulking mastic to inside corners of insulation and junctions of insulation and metal.
5. Apply double layer of reinforcing cloth in mastic to outside corners of insulation. Round outside corners of insulation.

I. Labels indicating "asbestos-free" shall be attached to the outside of all insulation jacketing, adjacent to all piping and equipment identification labels.

J. Pipe Insulation

1. All piping and heat tracing shall be tested in accordance with Sections 15060 and 16856 before installing insulation.
2. Piping shall be insulated and jacketed as follows:

Piping	Insulation Material	Minimum Thickness**	Jacketing
Aboveground Piping <400°F			
Up to 1-1/2"	Cellular Glass	1"*	Aluminum
2" through 4"	Cellular Glass	1-1/2"	Aluminum
6" through 8"	Cellular Glass	2"	Aluminum
10" and over	Cellular Glass	2-1/2"	Aluminum
Aboveground Piping > 400°F	Calcium Silicate	4"	Aluminum
Below Grade Piping	Cellular Glass	1-1/2"	Polymer Modified Bituminous Compound

* All electric heat traced piping shall be provided with 1-1/2 inches minimum insulation thickness.

** Insulated skin temperature shall not exceed 140 degrees F. Contractor shall determine actual insulation thickness required, but thicknesses shall not be less than those listed above.

3. Insulation shall be applied in a single layer with joints tightly butted, and shall be secured in place with bands on 12-inch centers.
4. Aluminum jacketing shall be applied directly over insulation (except below grade applications). Minimum lap for longitudinal joints shall be 1 inch, and minimum lap for circumferential joints shall be 2 inches. The jacketing shall be secured in place with bands on 9-inch centers.
5. Premolded elbow insulation and aluminum elbow covers shall be installed at all elbows. Aluminum jacketing shall be used for all other fittings, valves, flanges, etc.
6. Lap all seams against weather.
7. Finish insulation at supports, protrusions, and interruptions. At pipe supports, remove only enough insulation to provide a snug fit.
8. Inserts shall be of the same thickness, material, and contour as adjoining piping insulation. For intersection at tees or other equipment, use block or curved segments. Miter cut to fit neatly on the surface, with joints tightly butted.
9. Seal jacketing below ground per manufacturer's recommendation.
10. All insulated valves and piping systems shall be labeled in accordance with Section 15060.

K. Equipment Insulation

1. Apply insulation board directly to equipment surfaces with all joints staggered and tightly butted. Secure insulation in place with stainless steel bands on 18-inch centers.
2. Board insulation shall be cemented to irregular surfaces and all voids shall be filled with bedding compound.
3. Apply aluminum jacketing over insulation with 3-inch minimum lap on longitudinal and circumferential joints.

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4. Equipment shall be insulated as follows:

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Equipment Design Temperature	Insulation Material	Minimum Thickness*
<400°F	Cellular Glass	2-1/2"
>400°F	Calcium Silicate	4"

* Insulation skin temperature shall not exceed 140 degrees F. Contractor shall determine actual insulation thickness required, but thicknesses shall not be less than those listed above.

- 5. Insulation shall be cut away from all equipment identification nameplates and beveled at a 45-degree angle.
- 6. All equipment and heat tracing shall be tested before installing insulation.
- 7. All insulation shall be stopped at a sufficient distance from flanged nozzles to permit ease of the bolt removal and to allow installation of flange covers. Insulation shall be beveled back at a 45 degree angle at this point.

END OF SECTION

SECTION 15755
HEAT EXCHANGERS

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B.	Heat economizer (air-to-gas heat exchanger).	12
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1.3	REFERENCE DRAWINGS	28
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A.	See Section 01012 for Schedule of Drawings.	30
		31
1.4	REFERENCES, CODES, AND STANDARDS	32
		33
A.	Tubular Exchanger Manufacturers Association (TEMA):	34
	1. TEMA Standards - 1989.	35
		36
1.5	SYSTEM DESCRIPTION	37
		38
A.	The condensers shall provide cooling of the off-gas to condense water vapor. The cooling medium shall be chilled water. Two condensers shall be used in parallel to provide this cooling process.	39
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- B. The heat economizer shall provide heating of outside air. The outside air shall be used for indirect dryer sweep air. The heating medium shall be the dryer off-gas.
- C. The electric off-gas reheater shall provide heating of the scrubbed off-gas to reduce the relative humidity.

1.6 SUBMITTALS

- A. Submittals shall be in accordance with Section 01011.
- B. Shop Drawings: Indicate dimensions, sizes, weights, and material thicknesses; and nozzle locations, sizes, and ratings.
- C. Product Data: Provide data on ratings and dimensions for accessories.
- D. Design Data: Provide product literature, drawings, and calculations that indicate heat exchangers meet or exceed specified requirements.
- E. Test and Inspection Reports.
- F. Certificates of Conformance: Certify that heat exchangers and components meet or exceed specified requirements.
- G. Manufacturer's Instructions: Indicate installation and support requirements.
- H. Operation and Maintenance Data: Include start-up and shutdown instructions, assembly drawings, and spare parts lists.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry place and protect from weather prior to shipment. Provide protection from weather and from damage during transit.

B. Loose items, if any, shall be tagged and delivered in a standard commercial package. 1
2

PART 2 PRODUCTS 3
4

2.1 OFF-GAS CONDENSER 5
6

A. Manufacturers: 7
1. Bell and Gossett. 8
2. Hughes-Anderson. 9
3. Berdell Industries. 10
4. ITT Standard. 11
12
13

B. Design: Gas stream in tubes and cooling water in shell. 14
Heat exchanger components shall be in conformance with 15
TEMA standards. 16
17

C. Performance: See Attachment A - Off-Gas Condenser Data 18
Sheets. 19
20

D. Heat exchangers shall be provided with: 21
1. Shell: Pressure gauge connection and pressure 22
gauge with pigtail siphon, vacuum breaker. 23
2. Tube-Side Inlet: Thermometer well, pressure gauge 24
connection including pressure gauge and ball 25
valved drain. 26
3. Tube-Side Outlet: Thermometer well for temperature 27
regulator sensor, ASME rated pressure and 28
temperature relief valve, thermometer well, 29
pressure gauge connection including pressure 30
gauge, and valved drain connection. 31
4. For instruments and equipment, see Section 13400. 32
33

2.2 HEAT ECONOMIZER 34
35

A. Heat exchangers shall be of shell and tube heat 36
recovery design. 37
38

B. Performance: See Attachment A - Heat Economizer Data 39
Sheets. 40
41
42

C.

The requirements of Article 2.1 shall apply, with the following exception:

- 1. The air stream shall be in the shell and the gas stream in the tubes.

- D. Materials of construction shall be suitable for the service described in the data sheets.

2.3 ELECTRIC OFF-GAS REHEATER

- A. Heater shall be electric and of the duct insertion type.
- B. Performance: See Attachment A - Electric Heater Data Sheet.
- C. Materials of construction shall be suitable for the service described in the data sheet.

2.4 FABRICATION

- A. Prior to shipment, the equipment shall be cleaned of all dirt, dust, grease, grime, scale, oxides, weld spatter, and other foreign materials. All burrs and sharp edges shall be ground smooth. Exterior surfaces shall be primed and painted in accordance with the manufacturer's standard finish. Open end connections shall be sealed to prevent the entrance of foreign material.

2.5 LABELING

- A. Each item shall have a manufacturer's standard nameplate permanently attached at a location which is easily readable. The nameplate shall contain the following information, as applicable:
 - 1. Item description.
 - 2. Item number.
 - 3. Manufacturer's name.
 - 4. Purchase order number.
 - 5. Date of manufacture.
 - 6. Capacity.

2.6 EXTRA MATERIALS

- A. Provide all special tools required to perform maintenance and repair work.
- B. Provide two sets of replacement gaskets.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION

- A. Install in accordance with manufacturer's instructions and design drawings.
- B. Install to permit removal of tube bundle with minimum disturbance to installed equipment and piping.
- C. Pitch shell to completely drain condensate.

3.2 QUALITY CONTROL

- A. The Seller shall perform and provide a written report of the standard mechanical inspection of the heat exchangers and their components, including hydrostatic test of all pressure parts in accordance with TEMA standards.
- B. Tests: Acceptance operating tests shall be performed by the Subcontractor after installation. If the results are unsatisfactory, the Subcontractor shall adjust or replace the equipment to meet the specification requirements, and retest the equipment.
- C. Inspection: The Subcontractor shall notify FERMCO of testing and inspection activities prior to the start of all tests and/or inspections.

END OF SECTION

ATTACHMENT A

DATA SHEETS

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OFF-GAS CONDENSER SIZING AND PERFORMANCE DATA

Tubeside - Inlet:

Off-Gas from Packed Tower Scrubber

<u>Composition of Off-Gas Maximum Flow (lb/hr)</u>		
Water Vapor	69.9 wt%	8000
Air	29.7 wt%	3400
NO ₂	350 ppm	4
HF	90 ppm	1
CO ₂	90 ppm	1
Organic Vapors	90 ppm	1
Solids	0.0031 wt%	35
TOTAL		11,442*

Maximum Concentration Conditions

NO₂: 1300 ppm @ 1146 acfm
 CO₂: 175 ppm @ 1855 acfm
 HF: 250 ppm @ 1146 acfm
 Solids: 35 lbs @ 3115 acfm (0.4 wt %)

Temperature (°F, design): 195

Pressure: (in. W.C.) approximately -40

Volume Flow Rate (acfm min-max): 1150-5000

Tubeside - Outlet:

Off-Gas to Reheater

Temperature (°F, design): 50

Pressure Drop (in. W.C., max): 4

Chilled Water Service (Shellside, counterflow)

Inlet Temperature Range (°F): 40-50, design at 42

Temperature Rise (°F, max): 15

Flow: 1,000 gpm

* This flow shall be split equally between two condensers.

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Materials of Construction

Tubeside:

Heads

316 stainless steel

Tubes, tube sheets

316 stainless steel, 3/4" O.D. (minimum) for
100 psi/full vacuum working pressure

Tube bundle

Removable for inspection and cleaning

Shellside, Baffles:

Carbon Steel

Number of Condensers

2-in parallel @ 50% capacity each

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HEAT ECONOMIZER SIZING AND PERFORMANCE DATA

Process: Hot gas on tube side
 Cold air on shell side
 Assume fouling factor of 0.0001 Btu/ft²-hr-F on both sides
 Allowable pressure drop:
 10" W.C. for hot side
 5" W.C. for the cold side
 Quantity: one (1)

	<u>Max. (Pit 5)</u>	<u>Min. (Pit 6)</u>	<u>Moderate (Pit 4)</u>
Cold Gas, in(lb/hr)	3,425	3,425	3,425
Hot Gas, in(lb/hr)	5,172	6,342	3,020
Available Flow (lb/hr)	34,481	12,685	20,133
% bypass	85	50	85
Hot T, in	929°F	632°F	799°F
Hot T, out	571°F	550°F	519°F
Cold t, in	1°F	1°F	1°F
Cold t, out	600°F	600°F	600°F
Shellside DP, psi	0.13	0.08	0.04
Tubeside DP, psi	0.07	0.03	0.08
Overall U	4.10	3.84	2.54
Eff. Delta T	420°F	135°F	320°F
Duty, MMBtu/hr	0.5081	0.1405	0.2293
% Overdesign	11.0	20.6	15.5

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**PARSONS
ERA PROJECT**

ELECTRIC HEATER DATA SHEET

Project Order <u>145</u>	Project Title: <u>Remediation System Design - Electric Off-Gas Reheater</u> Quantity: <u>1</u> Revision: <u>B</u>				
General	Equipment No. _____ Vessel No. _____ Dwg. No. _____ Service: <u>Heating 3408 lb/hr off-gas flow at 50°F to 95°F</u> Insertion Length: <u>24 inches (max)</u> Mounting: <u>Class 150 RF pipe flanges</u> Duct Dimensions: <u>6" Schedule 40 pipe</u> Outlet Temperature: <u>100° F (max)</u> Allowable Pressure Drop: <u>5" w.c. (max)</u>				
Mixture	Ingredient	Specific Gravity	Viscosity	Flow Rate	Inlet Temp
	Off-Gas Solids			3408 lb/hr 35 lb/hr	50°F
Materials	Sheath: <u>Incoloy</u> ; elements: <u>filled with magnesium oxide insulation</u>				
Electrical	Capacity: <u>18 kW</u> Volts <u>480</u> Ph <u>3</u> Hz <u>60</u> Watt Density: <u>26 w/in²</u>				
Remarks	<ol style="list-style-type: none"> 1. Conform to NFPA 70. 2. Terminal Enclosure UL approved, NEMA 4 type. 3. Element supports shall be stainless steel. 4. Provide insulation to protect wiring and reduce heat loss through enclosure. 				

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SECTION 15860
FANS

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish all labor, materials, equipment components, and services necessary to design, construct, and install the equipment as defined in the specification.
- B. Centrifugal fans.
- C. Industrial pressure blowers.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 15173 - Motors for Off-Gas Treatment System.
- D. Section 15245 - Vibration Isolation.
- E. Section 15890 - Ductwork.
- F. Section 16053 - Basic Electrical Material and Methods for Off-Gas Control System.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

- A. American Bearing Manufacturers Association (ABMA):
 - 1. ABMA 9-90 Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11-90 Load Ratings and Fatigue Life for Roller Bearings.

- B. American Welding Society (AWS):
 - 1. AWS D1.1-94 Structural Welding Code - Steel.
 - 2. AWS D9.1-90 Sheet Metal Welding.

- C. Air Movers and Controllers Association (AMCA):
 - 1. AMCA 99-86 Standards Handbook.
 - 2. AMCA 210-85 Laboratory Methods of Testing Fans for Rating Purposes.
 - 3. AMCA 300-96 Test Code for Sound Rating Air Moving Devices.
 - 4. AMCA 301-90 Method of Calculating Fan Sound Ratings from Laboratory Test Data.

- D. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.5-88 Pipe Flanges and Flanged Fittings. 1992 Addenda

- E. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA MG 1-93 Motors and Generators.

- F. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code - 1996 Edition.

- G. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 1. SMACNA-85 HVAC Duct Construction Standards - Metal and Flexible.

1.5 **SYSTEM DESCRIPTION**

- A. Performance Requirements
 - 1. The fans shall be capable of producing and maintaining a volume flow rate at the temperature and pressure shown on the data sheets. The design shall allow for non-overloading of fan or drive specified on the data sheet.
 - 2. The rotating unit of the fan shall be statically and dynamically balanced at the factory for vibration-free performance through maximum catalog rated speed.

- 3. The fan speed shall not exceed 80 percent of the first critical speed of any component when operating at maximum speed. 1
- 4. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal. 2
- 5. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal. 3
- 6. Fabrication: Conform to AMCA 99. 4
- 7. Performance Base: At 580 feet elevation. 5

1.6 SUBMITTALS 11

- A. Provide submittals as per Section 01011. 12
- B. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. 13
- C. Product Data: Provide data on centrifugal fan and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements. 14
- D. Certificates of Conformance: Manufacturer shall certify and provide data indicating that all products supplied meet or exceed this specification. 15
- E. Maintenance Data: Include instructions for lubrication, motor and drive replacement, and spare parts list. 16
- F. Submit manufacturer's installation instructions. 17
- G. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, and accessories. Include troubleshooting guide. 18

1.7 QUALITY ASSURANCE PROGRAM 19

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum of 3 years documented experience. The manufacturer 20

shall be capable of issuing catalog and technical data on the total product being supplied.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's installation instructions for the rigging, unloading, and transporting of units.
- B. Store in a clean dry place protected from weather and construction traffic.

1.9 PROJECT CONDITIONS

- A. Combustion gas exhaust fan: 400 degrees F.
- B. Off-gas exhaust fan: 95 degrees F.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. New York Blower Company.
- B. Hartzell Fan Incorporated.
- C. Twin City Company.
- D. Buffalo Forge Company.

2.2 EQUIPMENT

- A. Industrial Pressure Blowers - Off-gas exhaust fan
 - 1. Radial blade wheel shall be fabricated from heavy gage steel plate, continuously welded. A tapered bore shall ensure the integrity of the wheel-shaft connection.
 - 2. The housing shall be constructed of welded steel. Welding shall be in accordance with AWS D1.1. and AWS D9.1.
 - 3. The fan shaft shall be turned stock, ground, and polished to correct tolerance to prevent slipping or shaft cutting by fan wheel. The fan wheel shall be keyed to shaft and secured with minimum

- of two set screws. A fan shaft seal shall be provided. 1
- 2
- 4. The fan bearings shall be self-aligning, anti-friction, taper-lock, double spherical roller type and shall have a minimum ABMA 11, L-10 bearing life based on 100,000 hours. All bearings shall be split pillow block mounted, and with external grease fittings with dust excluding seals. 3 4 5 6 7 8
- 5. Provide frame-type common mounting base for fan and motor. 9 10
- 6. The fan shall be high pressure industrial type and constructed in accordance with AMCA Class IV Standard. 11 12 13
- 7. The manufacturer shall supply a nameplate attached to the housing in an accessible position. The nameplate shall have the following permanently embossed on it: Manufacturer's name and address, equipment number, cfm, rpm, static pressure in w.g., bhp, purchase order number, and model and serial numbers. 14 15 16 17 18 19 20
- 8. The fan accessories shall be as specified on the data sheet. 21 22 23

B. Centrifugal Fans - Air supply and combustion gas fans 24

- 1. Backward inclined wheel and inlet: Steel construction with smooth curved inlet flange, back plate, backwardly curved blades continuously welded to flange and back plate; hub welded to back plate and keyed to the shaft. 25 26 27 28 29
- 2. Housing: Steel, spot welded for AMCA 99 Class I and II fans, and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut-off. Factory finish before assembly with enamel or prime coat. 30 31 32 33 34 35
- 3. Air supply fan bearings: ABMA 9, L-50 life at 100,000 hours heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, or ABMA 11, L-50 life at 200,000 hours pillow block type, self-aligning, grease-lubricated roller bearings. 36 37 38 39 40 41
- 4. Combustion gas exhaust fan bearings: ABMA 11, L-50 life at 200,000 hours pillow block type, 42 43



self-aligning, high temperature grease-lubricated roller bearings.

5. Shafts: Hot rolled steel, ground and polished, with key-way, protectively coated with lubricating oil and shaft guard. The combustion air fan shaft shall be provided with a galvanized steel cooling disc mounted between the inboard bearing and the fan shaft seal.
6. The manufacturer shall supply a nameplate attached to the housing in an accessible position. The nameplate shall have the following permanently embossed on it: Manufacturer's name and address, equipment number, cfm, rpm, static pressure in w.g., bhp, purchase order number, and model and serial numbers.
7. The fan accessories shall be as specified on the data sheet.

C. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 10 hp and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for over 10 hp, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

- D. Electrical Characteristics and Components (see attached data sheet)
1. Motor: Shall conform to Section 15173, NEMA MG 1.
 2. Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized according to NFPA 70.
 3. Wiring terminations shall be sized to conform to NFPA 70 and shall conform to Section 16053.

2.3 ACCESSORIES

- A. Variable frequency drive: Provide in accordance with Section 16053.
- B. Belt and shaft guard: Fabricate to SMACNA 85; 12 gage thick, 3/4 inch diamond mesh wire screen welded to

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steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

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C. Access Doors: Shaped to conform to scroll, with quick opening latches and gaskets.

D. Scroll Drain: 1/2 inch steel pipe coupling welded to low point of fan scroll.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Install in accordance with manufacturer's written installation instructions. Maintain the manufacturer's recommended clearances.

B. Provide for connection to electrical service. Refer to Section 16053. Verify that the electrical wiring installation is in accordance with manufacturer's wiring submittal. Do not proceed with equipment start-up until the wiring installation is acceptable to the manufacturer and the equipment installer.

C. Install units on vibration isolators. Refer to Section 15245.

D. Provide flexible connections to ductwork in accordance with section 15890.

E. Start up fans in accordance with manufacturer's start-up instructions and in the presence of a manufacturer's technical representative. Test the controls and demonstrate compliance with the requirements of the specifications.

3.2 QUALITY CONTROL

- A. Fan operation testing shall only occur when filters are in place, bearings are lubricated, and ductwork is complete and cleaned.
- B. The acceptance operating tests shall be performed by the Contractor after installation.
- C. FERMCO shall be notified of the testing and inspection activities prior to the start of all tests and inspections.

3.3 ADJUSTING

- A. Adjust, repair, or replace the equipment if the results of the acceptance operating tests are unsatisfactory. The equipment shall then be tested again to ensure that the equipment meets the specification requirements.
- B. The fans shall not be placed in sustained operation until the rest of the mechanical systems interfacing with the fans have been successfully performance tested.

END OF SECTION

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APPENDIX A

FAN DATA SHEETS

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DESIGN OPERATING CONDITIONS

Elevation ASL 580 feet Installation Indoors Outdoors Ambient Temp Min 1 °F Max 92 °F
 Application SUPPLY AIR TO ECONOMIZER
 Gas Temp Design 70 °F Min 1 °F Max 92 °F Vol 850 cfm Static Pressure +8 in. WG(1)
 Fan Inlet Density _____ lb/cu ft. Design Outlet Vel 3150 fpm (± 10%) Allow Noise Level 85 db(2)
 Service Continuous Intermittent Environment Rel Clean Dusty Corrosive Other _____

FAN PHYSICAL DATA

Rotation CW CCW Inlet Single Double Discharge Single Width Double Width
 Arrangement 10
 Drive Direct V-Belt (3)(4)(5) Other _____ Motor (6) Position _____

CONSTRUCTION AND ACCESSORIES

Fan Housing- Standard Other _____ Bearings(8) Pillow Block Roller Sleeve Ball
 Connection - Inlet Flanged Slip-on Split Housings Solid Housings
 Disch Flanged Slip-on Grease Lube Oil Lube Other _____
 Drain Flanged Thd Pipe Cplg Discharge Damper - Opposed Blade Req Yes No
 Access Door Bolted Plate Quick Release Parallel Blade Req Yes No
 Wheel(7) Type Backward Incl Forward Curved Vaned Inlet Damper Required Yes No
 Other _____ Drive Direct Rigid Coupling Direct Coupling
 Const Standard Other _____ V-Belt Fixed Adjustable(4)
 Spark Resistant Req'd Yes No Guard(5) Required Yes No
 Type A B C Vibration - Isolators Required Yes No
 Shaft Standard Other _____ Isolation Base Required Yes No
 Seal Required Yes No Painting - Mfr Standard Yes No
 Heat Slinger Required Yes No Other _____
 Insulation Clips Required Yes No Motor and Drive Weather Cover Required Yes No
 Screen Req'd - Inlet Yes No Outlet Yes No

- (1) At Design Temperature and Elevation.
- (2) Performance ratings shall be based on tests made in accordance with the latest AMCA codes.
- (3) V-belt drive shall have a minimum of two belts and shall be rated 1.5 times rated motor horsepower.
- (4) Adjustable V-belt drive shall be adjustable 10% above and 10% below design fan rpm.
- (5) V-Belt Drive guard shall have a 3-inch diameter tachometer test hole at drive and driven shafts.
- (6) Refer to Standard Motor Specifications for motor characteristics.
- (7) Wheel and shaft shall be statically and dynamically balanced as a unit.
- (8) Bearings shall be self-aligning. Grease fittings shall be of the extended hydraulic type.

TO BE COMPLETED BY VENDOR

Fan Mfr _____ Model _____ Size _____ Class _____
 Fan rpm @ Design Conditions _____ Mfr Max _____ Sound (re: 10⁻² W) Pressure (db re: 0.0002 Microbar)
 Brake hp @ Design Conditions _____ Min Temp _____ Band 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___
 @10% Above Design rpm _____ Weights Fan Wheel _____ lb Shaft _____ lb
 Motor hp _____ No. Drive Belts _____ hp/Belt _____ Fan Excluding Motor and Drive _____ lb
 Design Outlet Velocity _____ fpm Tip Speed _____ fpm Fan Including Motor and Drive _____ lb
 WR² _____ lb ft² Blade Frequency _____ Hz Housing Material _____ Thickness _____ in

Does the proposed equipment meet all requirements as specified on this Data Sheet? Yes No
 If not, have all deviations been identified and alternates proposed? Yes No

Notes: Motor requirements: 3 HP, 460V, 3-phase, 60 HZ, 3,600 rpm

<u>Variable-frequency drive</u>	Tag No.
<u>Attachment to Specification 15860</u>	

DATA SHEET PARSONS	SUPPLY AIR FAN- CENTRIFUGAL	Sheet of	Job Number
		1 3	WPRAP/PO143/OFFOAS
		Document Number	Rev
		15860	B

R	NO.	DATE	BY	CK	APP	DESCRIPTION	R	NO.	DATE	BY	CK	APP	DESCRIPTION
E							E						
V							V						
S							S						

DESIGN OPERATING CONDITIONS

Elevation ASL 580 feet - Installation Indoors Outdoors Ambient Temp Min 1 °F Max 92 °F
 Application COMBUSTION GAS EXHAUST
 Gas Temp Design 400°F Min _____°F Max _____°F Vol 35,500 cfm Static Pressure -14 in. WG(1)
 Fan Inlet Density _____ lb/cu ft. Design Outlet Vel 2,491 fpm (± 10%) Allow Noise Level 85 db(2)
 Service Continuous Intermittent Environment Rel Clean Dusty Corrosive Other _____

FAN PHYSICAL DATA

Rotation CW CCW Inlet Single Double Discharge Single Width Double Width
 Arrangement 10
 Drive Direct V-Belt (3)(4)(5) Other _____ Motor (6) Position _____

CONSTRUCTION AND ACCESSORIES

Fan Housing - Standard Other _____ Bearings(8) Pillow Block Roller Sleeve Ball
 Connection - Inlet Flanged Slip-on Split Housings Solid Housings
 Disch Flanged Slip-on Grease Lube Oil Lube Other HIGH TEM
 Drain Flanged Thd Pipe Cplg Discharge Damper - Opposed Blade Req Yes No
 Access Door Bolted Plate Quick Release Parallel Blade Req Yes No
 Wheel(7) Type Backward Incl Forward Curved Vaned Inlet Damper Required Yes No
 Other _____ Drive Direct Rigid Coupling Direct Coupling
 Const Standard Other _____ V-Belt Fixed Adjustable(4)
 Spark Resistant Reqd Yes No Guard(5) Required Yes No
 Type A B C Vibration - Isolators Required Yes No
 Shaft Standard Other _____ Isolation Base Required Yes No
 Seal Required Yes No Painting - Mfr Standard Yes No
 Heat Slinger Required Yes No Other _____
 Insulation Clips Required Yes No Motor and Drive Weather Cover Required Yes No
 Screen Reqd - Inlet Yes No Outlet Yes No

- (1) At Design Temperature and Elevation.
- (2) Performance ratings shall be based on tests made in accordance with the latest AMCA codes.
- (3) V-belt drive shall have a minimum of two belts and shall be rated 1.5 times rated motor horsepower.
- (4) Adjustable V-belt drive shall be adjustable 10% above and 10% below design fan rpm.
- (5) V-Belt Drive guard shall have a 3-inch diameter tachometer test hole at drive and driven shafts.
- (6) Refer to Standard Motor Specifications for motor characteristics.
- (7) Wheel and shaft shall be statically and dynamically balanced as a unit.
- (8) Bearings shall be self-aligning. Grease fittings shall be of the extended hydraulic type.

TO BE COMPLETED BY VENDOR

Fan Mfr _____ Model _____ Size _____ Class _____
 Fan rpm @ Design Conditions _____ Mfr Max _____ Sound (re: 10⁻² W) Pressure (db re: 0.0002 Microbar)
 Brake hp @ Design Conditions _____ Min Temp _____ Band 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___
 @10% Above Design rpm _____ Weights Fan Wheel _____ lb Shaft _____ lb
 Motor hp _____ No. Drive Belts _____ hp/Belt _____ Fan Excluding Motor and Drive _____ lb
 Design Outlet Velocity _____ fpm Tip Speed _____ fpm Fan Including Motor and Drive _____ lb
 WR² _____ lb ft² Blade Frequency _____ Hz Housing Material _____ Thickness _____ in

Does the proposed equipment meet all requirements as specified on this Data Sheet? Yes No
 If not, have all deviations been identified and alternates proposed? Yes No

Notes: Motor requirements: 150 HP, 460V, 3-phase, 60 HZ, 1,800 rpm
Variable-frequency drive
Attachment to Specification 15860

Tag No. _____

DATA SHEET PARSONS	COMBUSTION GAS EXHAUST FAN- CENTRIFUGAL	Sheet 2 of 3	Job Number
		Document Number 15860	Rev B

R	NO.	DATE	BY	CK	APP	DESCRIPTION	R	NO.	DATE	BY	CK	APP	DESCRIPTION
E							E						
V							V						
S							S						2039

DESIGN OPERATING CONDITIONS

Elevation ASL 580 feet Installation Indoors Outdoors Ambient Temp Min 1 °F Max 92 °F
 Application OFF-GAS EXHAUST FAN
 Gas Temp Design 95 °F Min 95 °F Max 120 °F Vol 850 cfm Static Pressure -80 in. WG(1)
 Fan Inlet Density _____ lb/cu ft Design Outlet Vel 3,550 fpm (± 10%) Allow Noise Level 85 db(2)
 Service Continuous Intermittent Environment Rel Clean Dusty Corrosive Other _____

FAN PHYSICAL DATA

Rotation CW CCW Inlet Single Double Discharge Single Width Double Width
 Arrangement 10
 Drive Direct V-Belt (3)(4)(5) Other _____ Motor (6) Position _____

CONSTRUCTION AND ACCESSORIES

Fan Housing - Standard Other _____ Bearings(8) Pillow Block Roller Sleeve Ball
 Connection - Inlet Flanged Slip-on Split Housings Solid Housings
 Disch Flanged Slip-on Grease Lube Oil Lube Other _____
 Drain Flanged Thd Pipe Cplg Discharge Damper - Opposed Blade Req Yes No
 Access Door Bolted Plate Quick Release Parallel Blade Req Yes No
 Wheel(7) Type Backward Incl Forward Curved Vaned Inlet Damper Required Yes No
 Other _____ Drive Direct Rigid Coupling Direct Coupling
 V-Belt Fixed Adjustable(4)
 Const Standard Other _____ Guard(5) Required Yes No
 Spark Resistant Req'd Yes No Vibration - Isolators Required Yes No
 Type A B C Isolation Base Required Yes No
 Shaft Standard Other _____ Painting - Mfr Standard Yes No
 Seal Required Yes No Other _____
 Heat Slinger Required Yes No Motor and Drive Weather Cover Required Yes No
 Insulation Clips Required Yes No
 Screen Req'd - Inlet Yes No Outlet Yes No

- (1) At Design Temperature and Elevation.
- (2) Performance ratings shall be based on tests made in accordance with the latest AMCA codes.
- (3) V-belt drive shall have a minimum of two belts and shall be rated 1.5 times rated motor horsepower.
- (4) Adjustable V-belt drive shall be adjustable 10% above and 10% below design fan rpm.
- (5) V-Belt Drive guard shall have a 3-inch diameter tachometer test hole at drive and driven shafts.
- (6) Refer to Standard Motor Specifications for motor characteristics.
- (7) Wheel and shaft shall be statically and dynamically balanced as a unit.
- (8) Bearings shall be self-aligning. Grease fittings shall be of the extended hydraulic type.

TO BE COMPLETED BY VENDOR

Fan Mfr _____ Model _____ Size _____ Class _____
 Fan rpm @ Design Conditions _____ Mfr Max _____ Sound (re: 10⁻² W) Pressure (db re: 0.0002 Microbar)
 Brake hp @ Design Conditions _____ Min Temp _____ Band 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___
 @10% Above Design rpm _____ Weights Fan Wheel _____ lb Shaft _____ lb
 Motor hp _____ No. Drive Belts _____ hp/Belt _____ Fan Excluding Motor and Drive _____ lb
 Design Outlet Velocity _____ fpm Tip Speed _____ fpm Fan Including Motor and Drive _____ lb
 WR² _____ lb ft² Blade Frequency _____ Hz Housing Material _____ Thickness _____ in

Does the proposed equipment meet all requirements as specified on this Data Sheet? Yes No
 If not, have all deviations been identified and alternates proposed? Yes No

Notes: Motor requirements: 25 HP, 460V, 3-phase, 60 HZ, 3,600 rpm
 Variable-frequency drive
 Attachment to Specification 15860
 Connection Flanges 150 lb, slip-on per ASTM B16.5

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Rev B

DATA SHEET PARSONS

OFF-GAS EXHAUST FAN-PRESSURE BLOWER

SECTION 15883
CYCLONE

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cyclones with electric heating jacket.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 13400 - Instruments and Equipment.
- D. Section 14570 - Rotary Airlock Feeder.
- E. Section 15020 - Packaged Equipment.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for Schedule of Drawings.

1.4 REFERENCES, CODES, AND STANDARDS

- A. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7-93 Minimum Design Loads for Buildings and Other Structures.
- B. American Society of Mechanical Engineers (ASME):
 - 1. ASME Boiler and Pressure Vessel Code (BPVC), Section IX-95.
- C. American Society for Testing and Materials (ASTM):
 - 1. ASTM A36/A36M-94 Standard Specification for Structural Steel.

- D. American Welding Society (AWS):
 - 1. AWS A5.1-91 Carbon Steel Electrodes for Shielded Metal Arc Welding.
- E. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electric Code, 1996 Edition.
- F. Uniform Building Code, 1994 Edition.

1.5 SYSTEM DESCRIPTION

- A. Design Requirements
 - 1. The cyclones shall remove solid particulates from the dryer off-gas. The cyclones shall operate in parallel; one at low flow and, as flow increases, the other shall be brought into service.

1.6 SUBMITTALS

- A. Submittals shall be in accordance with Section 01011.
- B. Shop Drawings: Indicate dimensions; sizes; weights and point loadings; material thickness; and locations, sizes, and ratings of nozzles.
- C. Product Data: Provide data indicating rated capacities and accessories.
- D. Manufacturer's Installation Instructions: Indicate assembly and installation instructions.
- E. Design Calculations: For material thickness and supports (including seismic, wind, and snow loads).
- F. Operation and Maintenance Data: Include operation and maintenance instructions, and spare parts list.
- G. Certificate: Certify that equipment meets or exceeds the requirements of this specification section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry place and protect from weather prior to shipment. Provide protection from weather and from damage during transit.
- B. Loose items, if any, shall be tagged and delivered in a standard commercial package.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Manufacturers
 - 1. Cyclone (Quantity - 2):
 - a. Ducon Environmental Systems, Inc.
 - b. MAC Environmental.
 - c. Andersen 2000, Inc.
 - 2. Electric Heat for Each Cyclone:
 - a. Watlow.
 - b. Heatron, Inc.
 - c. Technical Heaters, Inc.
- B. Cyclone dust collector consisting of heated cyclone incorporating airtight dust discharge (see Attachment B).
- C. Dust Discharge: Rotary airlock feeder (see Section 14570).
- D. Materials: Manufacturer's standard hardened steel for abrasive dust service. Round end connections shall be flanged - 150 lb class. Square or rectangular end connections shall be duct type flanges and 1/4 inch thick, minimum. Structural steel supports shall be in accordance with ASTM A36/A36M.
- E. Welding: Shall be in accordance with ASME BPVC Section IX and AWS A5.1.
- F. Performance Requirements (see Attachments A and B):
 - 1: Suitable for continuous operation.

2. Electrical Requirement:- To be determined by manufacturer.
 3. Available Power Supply: 480 V, three phase, 60 Hz; or 120 V, single phase, 60 Hz.
- G. Equipment shall be provided with lifting and support ring hold down lugs.
- H. Provide pressure taps where required to test the pressure drop across the cyclone.
- I. Equipment/structural design shall provide for loads as specified below:
1. Roof: live load - 20 psf; snow load - 25 psf.
 2. Platforms and walkways, live load: 60 psf.
 3. Wind load: Velocity pressure shall be calculated using equation 3 of ASCE 7-93, using $V = 80$ mph basic wind speed and $I = 1.07$. Design wind pressures and forces shall be in accordance with ASCE 7-93, Table 4.
 4. Seismic load: Use provisions of the Uniform Building Code, using $Z = 0.13$, $c = 2.75$, $I = 1.25$, and $R_w =$ reduction factors from Table 16-P. W (total seismic load) shall include all normal operating contents, piping, and attachments.
 5. Shop drawings shall state the vertical loads and lateral forces used (wind and seismic) in the design.

2.2 FABRICATION

- A. Prior to shipment, the equipment shall be cleaned of all dirt, dust, grease, grime, weld spatter, and other foreign materials. All burrs and sharp edges shall be ground smooth. Exterior surfaces of steel components shall be primed and painted in accordance with the manufacturer's standard finish. Open-end connections shall be sealed to prevent the entrance of foreign material.

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2.3 LABELING

- A. Each item shall have a manufacturer's standard nameplate permanently attached at a location which is easily readable. The nameplate shall contain the following information, as applicable:
 - 1. Item description.
 - 2. Item number.
 - 3. Manufacturer's name.
 - 4. Purchase order number.
 - 5. Date of manufacture.
 - 6. Capacity.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

- A. Install equipment in accordance with manufacturer's instructions and design drawings.

3.2 QUALITY CONTROL

- A. Tests: Perform leak testing to ensure that there are no air leaks in the cyclone system. Perform pressure drop and solids removal testing across the cyclone to ensure conformance with this specification. Verify electrical heating performance. If the results are unsatisfactory, the Subcontractor shall adjust or replace the equipment to meet the specification requirements and retest the equipment.

END OF SECTION

ATTACHMENT A

CYCLONE SIZING AND PERFORMANCE DATA

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CYCLONE DESIGN AND PERFORMANCE DATA

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INLET FLUID CONDITIONS

(from Dryer Off-gas)

Composition:

Composition of Maximum Flow (lb/hr)

Water Vapor	60.2 wt%	8,447
Air	24.1 wt%	3,376
NO ₂	3850 ppm	54
CO ₂	2924 ppm	41
HF	1212 ppm	17
NH ₃	1141 ppm	16
Organic Vapors	71 ppm	1
<u>Solids (Including</u>		
<u>Water & Organics)</u>	14.8 wt%	2,072
TOTAL		14,024

Max Concentration Conditions

NO₂: 15,450 ppm @ 1400 acfm
 CO₂: 7365 ppm @ 2210 acfm
 HF: 4700 ppm @ 1400 acfm
 NH₃: 2850 ppm @ 2210 acfm
 Solids: 2072 lbs @ 1393 acfm (37.1 wt %)

Particle Size Distribution:

<u>Finest Distribution</u>		<u>Coarsest Distribution</u>	
<u>% finer</u>	<u>size (microns)</u>	<u>% finer</u>	<u>size (microns)</u>
100	100	100	100
83	50	83	70
63	20	67	40
47	10	50	25
33	6	33	12
17	3	25	9
6	1	17	5
		8	2.5
		2	1

Outlet Fluid Service:

Off-Gas to Venturi Scrubber

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ATTACHMENT B
CYCLONE DATA SHEET

Date: 03/06/96
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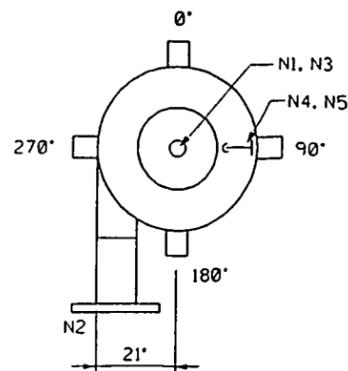
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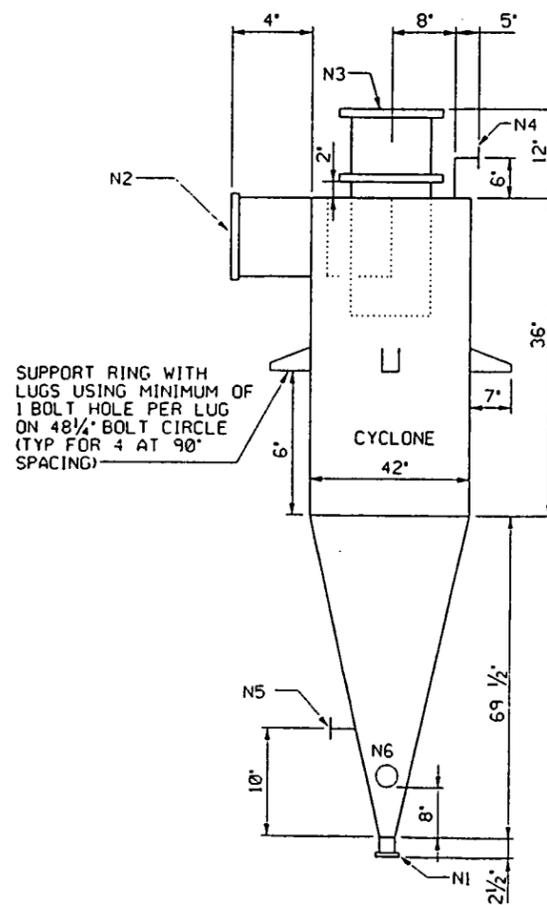
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PLAN VIEW
NO SCALE



ELEVATION
NO SCALE

DESIGN DATA

- | | MINIMUM | | MAXIMUM | |
|-----------------------|-----------------------|-----------|------------------------|-----------|
| 1. FLOW CAPACITY: | IN | OUT | IN | OUT |
| GAS: | 1393 acfm
3516*/hr | 1532 acfm | 5130 acfm
11831*/hr | 5177 acfm |
| SOLIDS ⁶ : | 300*/hr | 123*/hr | 1883*/hr | 1077*/hr |
2. TEMPERATURE⁷: 198 F 266 F 272 F 350 F
3. PRESSURE DROP: ~ 5' W.C. (SUPPLIER TO DETERMINE ACTUAL PRESSURE DROP). **2039**
4. SOLID PROPERTIES: SEE ATTACHMENT A
5. DESIRED EFFICIENCY
 PARTICLE SIZE > 40 MICRONS - 95% REMOVAL
 PARTICLE SIZE BETWEEN 20 AND 40 MICRONS - 75% REMOVAL
 PARTICLE SIZE BETWEEN 5 AND 20 MICRONS - 50% REMOVAL
6. 70% OF TOTAL SOLIDS ARE > 40 MICRONS
 MAXIMUM (IN) SOLIDS @ 3516 lb/hr (1393 acfm)
 MINIMUM (IN) SOLIDS @ 11820 lb/hr (5082 acfm)
7. ELECTRIC HEATING REQUIRED TO RAISE TEMPERATURE FROM 198 F TO 266 F (PREVENT CONDENSATION OF DRYER OFF-GAS)
 ELECTRIC (FLEXIBLE) HEATERS SHALL BE THERMOSTATICALLY CONTROLLED. ONE THERMOSTAT PER CYCLONE SHALL BE PROVIDED. HEATERS AND THEIR INSTALLATION SHALL BE IN ACCORDANCE WITH NFPA 70.
8. SUPPORT TYPE: 4 LUGS AT 90° SPACING, STRUCTURAL STEEL.
9. QUANTITY: TWO (2)
10. SEE ARTICLE 2.1-1 OF SPECIFICATION SECTION 15883 FOR DESIGN LOADS.

FABRICATION

1. MANUFACTURER'S STANDARD HARDENED STEEL FOR ABRASIVE DUST AND CORROSION RESISTANT SERVICE.

NOTES:

NOZZLE SCHEDULE - CYCLONE

MARK	SIZE	CLASS	TYPE	SERVICE	REMARKS
N1	10"	150	RF	SOLIDS OUTLET	
N2	12"x12"	-	-	INLET	1/4" THICK, DUST FLANGE
N3	28"	-	-	OUTLET	1/4" THICK, DUST FLANGE
N4	1"	150	RF	WASHOUT	
N5	2"	150	RF	LEVEL SWITCH	
N6	8"	-	-	INSPECTION	1/4" THICK BOLTED COVER

PARSONS ERA PROJECT

PROJECT NAME
OUI REMEDIATION SYSTEM DESIGN
 WBS 1.1.1.1.1.3.1

TITLE

MECHANICAL PROCESS
ATTACHMENT B
CYCLONE SEPARATOR DATA SHEET

SPECIFICATION NO.
15883

CRU/PG
WPRAP/145/OFFGAS

SHEET NO.
1 OF 1

SKETCH NO.

SK-M-04184000409 B

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SECTION 15885
AIR CLEANING DEVICES

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Design, fabrication, testing, and shipping of an all welded, stainless steel, bag-in/bag-out, side-loading air filter housing.
- B. Items specified herein shall be furnished and installed complete with all fittings and accessories unless otherwise noted.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 15891 - Ductwork - Stainless Steel - Welded.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI B16.5-88, Pipe Flanges and Flanged Addenda B-16.5A-92 Fittings.
 - 2. ANSI/ASME N509-89 Nuclear Power Plant Air-Cleaning Units and Components.
 - 3. ANSI/ASME N510-89 Testing of Nuclear Air-Cleaning Systems.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A240-94 Specification for Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

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2.	ASTM A276-95	Standard Specification for Stainless Steel Bars and Shapes.	1 2 3
3.	ASTM A480/A480M-94c	General Requirements for Flat Rolled Stainless Steel and Heat-Resisting Steel Plate Sheet and Strip.	4 5 6 7 8 9
C.	Energy Research and Development Administration (ERDA):		10
1.	ERDA 76-21-76	Nuclear Air Cleaning Handbook.	11 12 13
D.	American Society of Civil Engineers (ASCE):		14
1.	ASCE 7-93	Minimum Design Loads for Buildings and Other Structures.	15 16 17 18
1.5	SYSTEM DESCRIPTION		19
A.	Pressures and Temperature		20 21
1.	Maximum operating pressure:	-80 inch w.g.	22
2.	Leak test pressure:	per Article 3.4, Paragraph E.	23
3.	Maximum design pressure:	-90 inch w.g.	24
4.	Operating Temperature:	95 degrees F.	25 26
1.6	QUALITY ASSURANCE PROGRAM		27
A.	The manufacturer shall set up and operate a quality control/sampling system which will ensure a 99 percent confidence limit in the elements meeting specification.		28 29 30 31 32
B.	A FERMCO representative shall be provided the opportunity to witness all tests and has the right to inspect and approve all material prior to shipping to site. Notice shall be provided to FERMCO for all off-site testing.		33 34 35 36 37 38
1.7	SUBMITTALS		39
A.	Provide submittals as per Section 01011.		40 41 42

- B. Submit the following documentation prior to the start of fabrication. For approval, submit the following documentation and receive written approval on each item prior to start of fabrication.
 - 1. Dimensional equipment drawings indicating joint design and material identification.
 - 2. Housing and sealing surface leak test procedures.
 - 3. Drawings of HEPA filter clamping device.
 - 4. Weld procedure specifications.

- C. Certified data of the following shall be mailed under separate cover and shipped with order.
 - 1. Test, welding, and inspection reports.
 - 2. Equipment drawings stamped by a certified professional engineer.
 - 3. Installation/assembly procedures, parts list, and maintenance instructions.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Housing shall be shipped to the site in factory-fabricated protective container, with factory-installed shipping skid. Shipping container shall prevent damage to the housing during shipment and handling. Damaged housing shall be repaired or replaced at no cost to FERMCO. Housing shall be stored in a clean, dry place and protected from weather and construction traffic. Housing shall be handled carefully to avoid damage to components, enclosures, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Flanders Filters, Inc.
- B. Charcoal Service Corporation.
- C. American Air Filter.

PRODUCT/EQUIPMENT

- A. The HEPA filter housing shall be supplied with, in the direction of airflow, a prefilter section, test section, HEPA filter section, and a test section (see Attachment A). Inlet and outlet transitions shall be provided as an integral part of the filter housing.
- B. The MEPA filter housing shall consist of only a MEPA filter section. Inlet and outlet transitions shall be provided as an integral part of the filter housing.
- C. HEPA/MEPA filter housings shall be positive seal side access bag-in/bag-out type housing. Test sections shall be upstream and downstream types. Filter sections shall be prefitted and HEPA/MEPA filter type.
 - 1. Filter Housing
 - a. Filter housings shall be constructed of 316 stainless steel and fitted for installation in an exterior location. Housings shall be all welded construction. Housing sides, top, and bottom shall be constructed from a single sheet of material.
 - b. HEPA/MEPA filter housings shall be all welded construction.
 - c. Cracks and crevices in the interior of the housing's pressure boundary weld joints shall be eliminated by continuously welding the joints and grinding the welds to the same finish as the adjacent material. Other welded joints on the interior of the housings shall be continuously welded and the welds ground to the same finish as the adjacent material, eliminating cracks and crevices in the weld joint.
 - d. The exterior of the housings shall be fabricated to prevent water accumulation and freeze damage based on the intended installed orientation of the housing.
 - e. Housings shall be provided with lifting lugs sufficient to lift the entire filter train when assembled.

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- f. Housings shall be provided with 150-pound stainless steel weld neck flat face flanges. Bolt pattern shall comply with ANSI B16.5. Flange bolt holes shall straddle major center lines.
 - g. Removable fasteners shall not penetrate the process air flow. All fasteners shall be stainless steel.
 - h. Mounting frames and filter sealing mechanisms shall be fabricated per ANSI/ASME N509, Section 5.6.3. Filter sealing surfaces shall be machined in accordance with Table 4-2 of ERDA 76-21.
 - i. Full-face 1/4-inch-thick Hypalon rubber gaskets shall be provided for the flanged connections. Gaskets shall have a durometer Shore A reading of 60 ±5. Gaskets shall be dimensioned in accordance with ANSI B16.5 unless otherwise noted on the attached sketches.
 - j. Housing's structural design shall be in accordance with ERDA 76-21, Section 6.2.2, and Article 1.4 of this section.
 - k. Housings transition sections shall be constructed in accordance with Section 15891 of this specification.
2. Housings Construction
- a. Configuration: Filter housings shall be constructed according to the configurations and dimensions identified in the attached sketch. Dimensions shown on the sketches are a maximum and shall not be exceeded.

HEPA FILTER HOUSING

Flow Rate (scfm)	ID No.	No. of Prefilters, Size (in.)	Number of HEPA Filters, Size (in.)	No. of Test Sections
850		1, 24 x 24 x 11½	1, 24 x 24 x 11½	2

MEPA FILTER HOUSING

Flow Rate (scfm)	ID No.	No. of Prefilters, Size (in.)	Number of MEPA Filters, Size (in.)	No. of Test Sections
850		NONE	1, 24 x 24 x 11½	NONE

- b. Filter Arrangement: Filter housings shall be positive seal, side access, bag-in/bag-out type. Filters used in the housings shall have the following efficiencies:
 - 1) HEPA: 99.97 percent at 0.3 micron particle size.
 - 2) MEPA: 85 percent standard efficiency.
 - 3) Prefilter: 95 percent standard efficiency.
- 3. Filter Housing Ports
 - a. Static Pressure Ports: One 1/2-inch NPT stainless steel half coupling with brass plug shall be provided for each location identified in Attachment A to monitor pressure drop for each filter housing unit in the filter train.
 - b. Drain Ports: Provide 3/4-inch half coupling on HEPA/MEPA filter housings. Drain valves shall be stainless steel ball valves, threaded ends, 3/4-inch size, Grinnell Figure No. 3933 or approved equal, as a minimum. Provide a brass plug in coupling during shipping and handling.
 - c. DOP Test Ports: DOP test sections shall be fabricated as an integral part of the HEPA filter housing train and shall incorporate the proper apparatus to meet the intent of ANSI/ASME N510. The upstream injection test section shall include one injection port and one sampling port. The outlet test section shall include a hinged diffuser and one sample port.
 - d. Filter Access Ports (Doors): Ports shall be fabricated in accordance with Drawing No. BAG RING-101 that is part of this specification.

Doors shall be a minimum of 14 gage, 316 series stainless steel. Doors shall be deep enough to allow for the installation of 2 inches of insulation on the inside of the door. Insulation shall be installed by others. Door fittings shall be pressure clamp type for a leakproof fit of door to housing. Door latch shall be fabricated on non-galling material. Door latch assembly shall not deform. One door shall be provided for each filter. The access door opening shall permit storage of one changeout bag within each filter module when the access door is closed.

- 4. Filter Sealing Mechanisms and Shaft Seal
 - a. HEPA/MEPA filter sealing mechanism shall be fabricated per ANSI/ASME N509, Section 5.6.3. Filter sealing surface shall be machined in accordance with Table 4.2 of ERDA 76-21.
 - b. A minimum of 5/8 inch shall be provided between filter and full release position.
 - c. Sealing mechanisms shall be located downstream of the HEPA/MEPA filter it retains.
 - d. Sealing mechanism operator shall be located on the access port side of housing and shall be operable with the access port in place.
 - e. Sealing mechanisms shall be replaceable.
 - f. The drive bolt and threaded adjustment block shall be 316 stainless steel and points of rotational contact between stainless steel items shall be coated with anti-sieze compound. A Nitronic Series 60 drive bolt and 316 threaded adjustment block is an acceptable alternative.
 - g. The sealing mechanisms shall be located downstream of the filters with the filter gaskets located upstream of the filters.
 - h. Sealing mechanisms shaft seal shall be replaceable from the exterior of the housing. Shaft seal material shall be silicone rubber.

5. Bagging Ring
 - a. Bagging ring shall be constructed per the attached sketch. The maximum roughness for all surfaces in contact with the PVC changeout bag shall be 64 RMS finish.
6. Changeout Bag
 - a. The changeout bag shall be a textured, non-self-sticking, 8-mil-thick polyvinyl chloride bag with at least two glove sleeves, one bag sleeve, and a 1/4-inch-diameter elastic cord hemmed into the bag mouth. One changeout bag and one nylon/neoprene laminated security strap shall be provided with each bagging ring.
7. Housing Identification
 - a. A clearly visible, stainless steel nameplate shall be welded to each housing in the filter train (see Drawing No. NAMEPLATE-101 [attached]). The following information shall be electro-etched or engraved on the nameplate, as applicable:
 - b. Filter size; dust spot efficiency; and quantity for prefilter, MEPA, and HEPA.
 - c. Air flow direction (see sketches).
 - d. Equipment number.
 - e. Seller's model number, serial number, ID number, and name.
 - f. Exhaust fan number.
 - g. Design airflow scfm.
 - h. Stores stock number.
 - i. Filter change differential pressure prefilter, MEPA, and HEPA filter (as required by operations).
8. Design Loads
 - a. Equipment/structural design shall provide for loads as specified below:
 - 1) Live load: 20 psf.
 - 2) Wind load: Velocity pressure shall be calculated using equation 3 of ASCE 7, using $V = 80$ mph basic wind speed and $I = 1.07$. Design wind pressures and forces shall be in accordance with ASCE 7, Table 4.

- 3) Seismic load: Use provisions of the Uniform Building Code, using $z = 0.13$, $c = 2.75$, $I = 1.25$, and $R_w =$ reduction factors from Table 16-P. W (total seismic load) shall include all normal operating contents, piping, and attachments.
- 4) Shop drawings shall state the vertical loads and lateral forces used (wind and seismic) in the design.

2.3 MATERIALS

- A. Sheet Material and Shapes: All welded stainless steel sheets and shapes exposed to the process air flow or welded to the housing shall be 316 stainless steel. Each sheet shall be continuously line marked with the heat run number along one edge. Shapes shall be tagged and color coded on the ends. Marking and material test report and certification shall be in accordance with ASTM A480/A480M.
 - 1. Sheet material shall be 316 stainless steel in accordance with ASTM A240, with 2B finish per ASTM A480.
 - 2. Structural shapes shall be 316 stainless steel in accordance with ASTM A276.

PART 3 EXECUTION

3.1 SITE CONDITIONS

- A. Environmental Conditions: Outdoor, low-level radioactive, contaminated area.

3.2 PREPARATION

- A. Material failures such as laminations occurring during component fabrication shall require replacing the material at no cost to FERMCO.

3.3

ERECTION/INSTALLATION/APPLICATION

- A. Prefilters and HEPA/MEPA filters will be provided by FERMCO at the project site.
- B. All welding requirements shall be in accordance with ANSI/ASME 509, Paragraph 7.3.
- C. All welding inspection requirements shall be in accordance with ANSI/ASME 509, Paragraph 7.3.

3.4

QUALITY CONTROL

- A. Each filter housing shall be visually inspected. The Seller shall document visual inspection of the following applicable items as listed in Section 5.5.1 of ANSI/ASME N510. A checklist shall be prepared for the following specific items:
 - 1. Items c, d, e, g, i, n, o, p, u, and v of Section 5.5.1.1.
 - 2. Items a and b of Section 5.5.1.2.
 - 3. All items of Section 5.5.1.4.
 - 4. All items of Section 5.5.1.5.
 - 5. All items of Section 5.5.1.12.
- B. FERMCO will, at its option, witness all tests and have the right to inspect and approve all equipment prior to shipping to the site. A 2-week notice shall be provided to FERMCO for all off-site testing. FERMCO, at its option, will select at random a representative sample of completed test reports and witness, at the Seller's facility, the actual test procedure on the unit to verify the accuracy of the test results documented in the reports. Housing shipped prior to approval of the test reports will be returned to the Seller at the Seller's expense.
- C. Material failure such as laminations occurring after fabrication of the filter housing shall require the defective housing to be repaired or replaced, at FERMCO's discretion. The Seller, at no additional charge, shall comply with FERMCO's decision within 20

repeated until all components pass the 25-cycle operation test.

2. After the 25-cycle sealing mechanism test, the final acceptance shall be contingent upon each assembly passing the in-place test per ANSI/ASME N510, Section 10, using DOP aerosol at the normal system flow with the filter housings installed in their respective systems. Acceptable requirement is 0.03 percent maximum penetration. A defective housing shall be repaired or replaced, at FERMCO's discretion, by the Seller at no additional charge to FERMCO within 20 days from notification to the Seller by FERMCO of the unacceptable unit.

END OF SECTION

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ATTACHMENT A

AIR CLEANING DEVICES

Date: 03/06/96
Rev.: B RE: KM

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WBS No.: 1.1.1.1.1.3.1.
ERA/WPRAP/145/OFFGAS

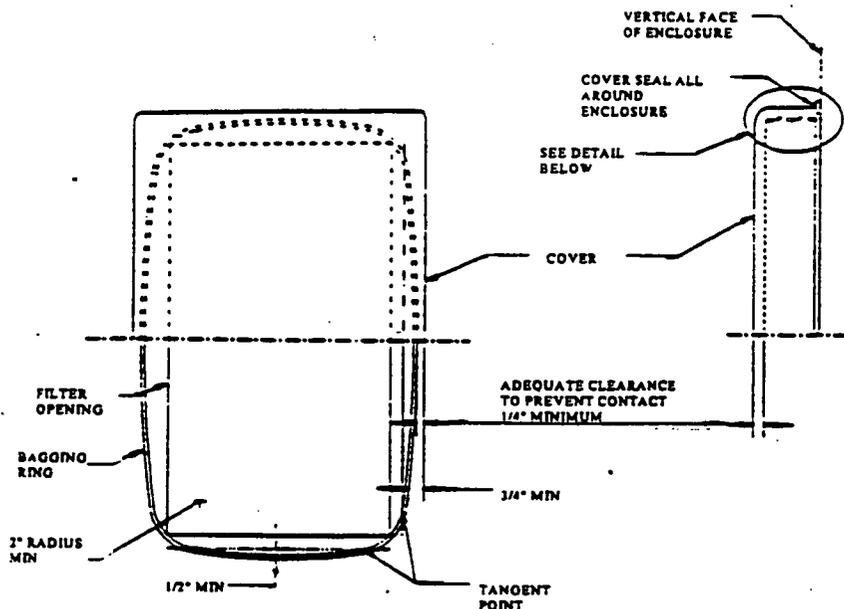
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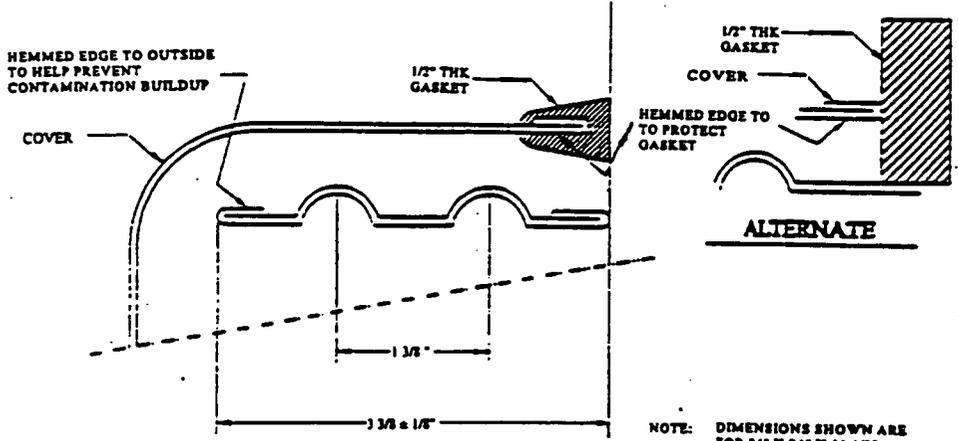
BAG-IN/BAG-OUT HEPA FILTER HOUSING

VENDOR'S NAME

Housing Model No. XXXX	XXXX-XXXX-
Housing Serial No.	XXXX-XXXX-XXXX
HEPA Filter Stores Stock No.	XX-XXX-XXXX
HEPA Filter Efficiency	XX.XX%
HEPA Filter Quantity	XXX
Prefilter Stores Stock No.	XX-XXX-XXXX
Prefilter Efficiency	XX.XX%
Prefilter Quantity	XXX
Roughing Filter Stores Stock No.	XX-XXX-XXXX
Roughing Filter Efficiency	XX.XX%
Roughing Filter Quantity	XXX
Equipment Specification No.	XXXXXX-XX-XXXX
Exhaust/Supply System Fan Equipment No.	XXXXXX-XX- XXX
Air Flow Direction	[↑] [↓] [→] [←]



ELEVATION



DETAIL

ALTERNATE

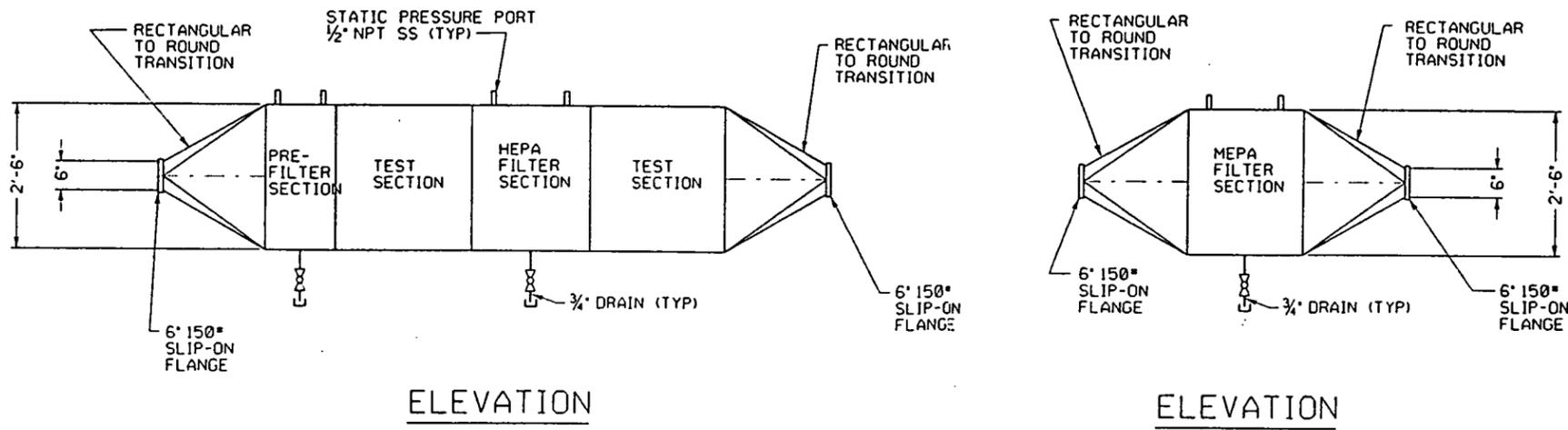
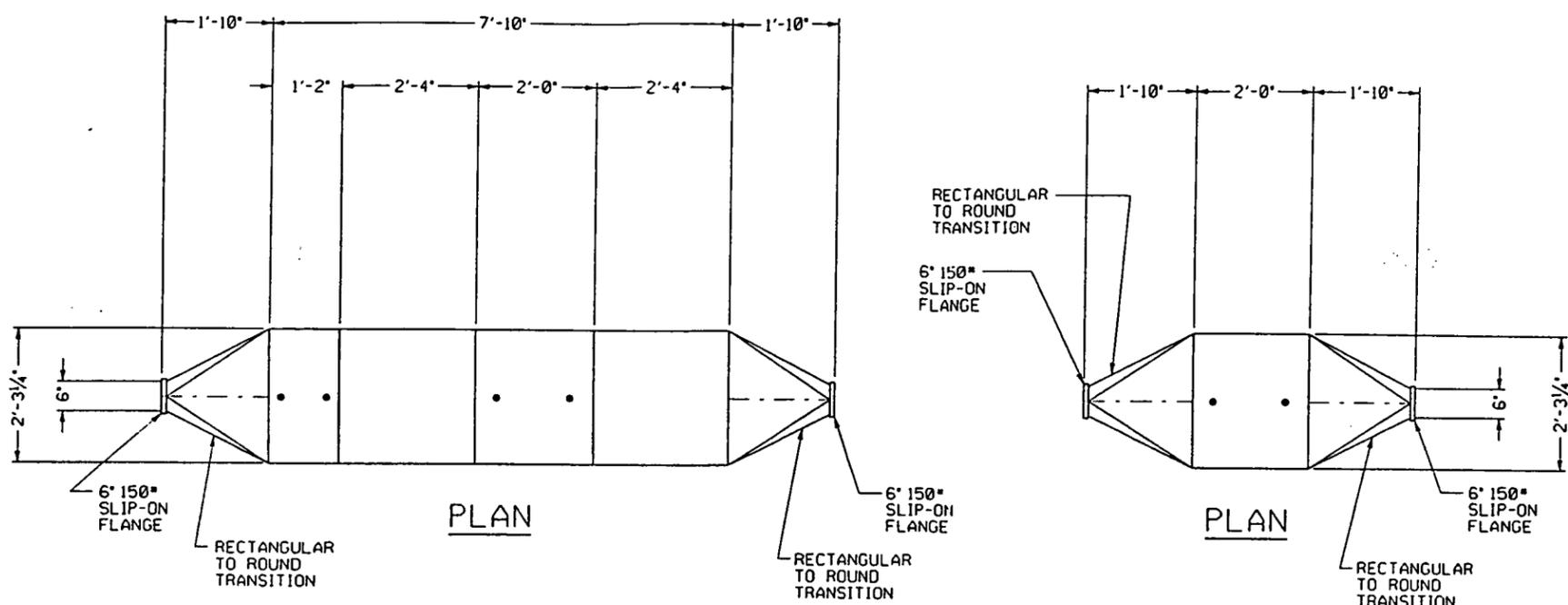
NOTE: DIMENSIONS SHOWN ARE FOR 24" X 24" X 11 1/2" OR LARGER FILTERS. SMALLER FILTERS REQUIRES SCALED DOWN DIMENSIONS.

BAG RING-101

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HEPA FILTER HOUSING

MEPA FILTER HOUSING

PARSONS ERA PROJECT	
PROJECT NAME	OUI REMEDIATION SYSTEM DESIGN
	WBS 1.1.1.1.3.1

TITLE	MECHANICAL UTILITIES HEPA/MEPA FILTER HOUSING DATA SHEET
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SPECIFICATION NO. 15885	CRU/PO WPRAP/145/OFFGAS	SHEET NO. ATTACHMENT A
SKETCH NO.	REV NO.	
SK-H-0419900425	A	

SECTION 15890
DUCTWORK

2039

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. All labor, materials, equipment, and services necessary to construct, install, and test the complete and operable ductwork systems and accessories as defined in this specification and as shown on the drawings referenced in Article 1.3.
- B. Design, furnish, and install stack, stack guy wire supports, and deadman.
- C. Items furnished by others but installed under this contract:
 - 1. Isokinetic sampler.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 09900 - Painting.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI N13.1-69 Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities.
 - 2. ANSI N510-89 Testing of Nuclear Air Cleaning Systems.

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B.	American Society for Testing and Materials (ASTM):	1
1.	ASTM A36/A36M-94 Structural Steel.	4
2.	ASTM A307-94 Carbon Steel Externally and Internally Threaded Standard Fastener.	5
3.	ASTM A569/A569M-91a Steel, Carbon, (0.15 maximum percent) Hot Rolled Sheet and Strip, Commercial Quality.	6
	(Reapproved 1993)	7
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C.	American Welding Society (AWS):	10
1.	AWS D1.1-94 Structural Welding Code.	11
2.	AWS D1.3-94 Structural Welding Code-Sheet.	12
3.	AWS D9.1-94 Sheet Metal Welding.	13
		14
D.	Sheet Metal and Air Conditioning Contractors National Association (SMACNA):	15
1.	SMACNA-75 Accepted Industrial Practice for Industrial Duct Construction.	16
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2.	SMACNA-77 Round Industrial Duct Construction Standard.	20
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3.	SMACNA-80 Rectangular Industrial Duct Construction Standards.	22
		23
4.	SMACNA-85 HVAC Duct Construction Standards.	24
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E.	Building Officials and Code Administrations International (BOCA):	27
1.	Ohio Basic Building Code (OBBC 95).	28
		29
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F.	American Society of Civil Engineers (ASCE):	31
1.	ASCE 7-93 Minimum Design Loads for Buildings and Other Structures.	32
		33
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G.	Energy Research and Development Administration (ERDA):	36
1.	ERDA 76-21-76 Nuclear Air Cleaning Handbook.	37
		38
		39
1.5	SYSTEM DESCRIPTION	40
A.	Performance Requirements	41
1.	The system has been designed for optimum performance. Any subsequent alterations to the	42
		43

design must be submitted for approval prior to
fabrication and show that the proposed alterations **2039**
will still provide the original design volume.

1.6 SUBMITTALS

- A. Provide submittals as per Section 01011.
- B. Shop drawings shall include, but not be limited to, the following:
 1. Overall two-line duct layout, dimensioned with respect to the structure and equipment, and connections to equipment.
 2. Elevations and sections as required to show clearances, methods of support, and details of installation.
 3. Distance from bottom of ducts to concrete pad or skid.
 4. Design, calculation, and drawing of stack and stack supports.
 5. Dimensions of each duct section.
 6. Location of duct and stack supports, and the loads imposed on each fastener or anchor.
 7. Details of duct supports, including hanger locations, types, connections to duct, and connections to auxiliary steel.
 8. Location and details of auxiliary equipment, including but not limited to: isolation valves, test ports, instrument ports, duct drains, and clean-outs.
 9. Prior to submitting shop drawings, check all duct layouts against FERMCO's final equipment drawings to ensure there is no conflict between the equipment drawings and the ductwork, stack, supports, platforms, and required access space. Submit, in writing, verification that the above-coordination has been completed.
 10. Shop drawings shall be on sheets no larger than 24 inches by 36 inches and not less than 1/4 inch equal to 1 foot scale to clearly show required data.

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- C. Submit documentation on welding procedures, list of welders, and welding operator's certifications in accordance with AWS D1.1 and AWS D1.3.
- D. Submit certificates of conformance: Manufacturer shall certify and provide data which indicates that all supplied products meet or exceed requirements of this specification.
- E. Submit all test procedures for approval prior to performance of test.
- F. Submit all ventilation system testing results and air balancing reports.

1.7 QUALITY ASSURANCE PROGRAM

- A. All shop drawings shall be approved by FERMCO.
- B. FERMCO shall be provided the opportunity to witness any and all tests specified herein. FERMCO shall be provided notice for all tests at the job-site.
- C. Perform work in accordance with SMACNA construction standards listed in Article 1.4.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Duct sections shall be wrapped with heavy plastic film or equivalent at the ends, or capped completely with a minimum of 3/4-inch plywood boards secured to the flanges to ensure the flange integrity and to avoid damage and/or potential intrusion of dirt/debris and rain water.
- B. Ensure that the total integrity of the ductwork and stack is maintained, particularly the roundness/shape of every duct section. Provide all the necessary internal/external support for protection of material during handling, shipping, and unloading.
- C. The duct sections shall be provided with suitable attachments to facilitate off-loading and erection

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without bending, scuffing, and/or denting of the finished product.

- D. Use of chain or metal straps for lifting or holding down the ductwork shall be prohibited. Only plastic or cloth material that will not damage or scratch/indent the duct surface finish shall be used.

PART 2 PRODUCTS

2.1 EQUIPMENT/PRODUCTS

A. Ductwork

- 1. Service material: Economizer all Air Streams Carbon Steel ASTM A569.

B. Stack and Stack Supports

- 1. Stack and stack supports shall be designed and fabricated in accordance with, but not limited to, the following requirements:
 - a. Basic wind speed of 80 mph (per OBBC [1995]). I = Importance factor = 1.07 (exposure C).
 - b. Determine the design wind loads using factors and coefficients as stipulated in ASCE 7.
 - c. Base design from the combination of loads and strength requirements as stipulated in the OBBC.
 - d. Calculations and drawings shall be checked, signed, and stamped by a licensed Professional Engineer registered in the State of Ohio.
- 2. Stack shall be constructed from no thinner than 10-gage steel, all welded construction, except that for the isokinetic sampler connections shall be 6-inch 150 pound flanged. Flanged joints shall be sealed by gaskets suitable for 500 degrees F minimum.
- 3. Stack shall be fabricated by butt welding using the gas tungsten arc welding (GTAW) methods in accordance with AWS D9.1 or D1.3.
- 4. Welding procedures, welders, and welding operators shall be qualified in accordance with AWS D1.1 and AWS D1.3. In addition, unless otherwise

- specified, samples of typical longitudinal, girth, and 45-degree branch-outlet welds, in the thinnest material that will be used for the ductwork, shall be prepared to demonstrate the welder's ability to make such welds in this material.
5. All surfaces shall be cleaned of rust and mill scale, and applied with prime coat and finish coats of high temperature, corrosion-resistant, lead-free paint to all exposed surfaces in accordance with the manufacturer's standard or Section 09900, as applicable.
 6. Guy wires and associated hardware
 - a. Seven-wire strand, high-strength grade.
 - b. Minimum wire breaking strength: 10,800 pounds.
 - c. Turnbuckle, clevises, and bearing swivels must have a minimum capacity of 10,800 pounds.
 - d. Guy wires to be located so that no interference occurs with the process equipment.
 - e. Locate and design expanding or cone anchors.
 - f. The stack shall be constructed so that it remains functional following a design basis earthquake, severe natural phenomenon, or man-made event.
 7. Isokinetic air sampling system connections shall be installed in compliance with ANSI N13.1. The sampling position along the stack shall be a minimum of eight diameters downstream from the point of air stream entering the stack.
 8. The stack sampling station will require a well-lit access platform for inspections and/or service. It shall consist of suitable structural steel platforms, handrails, ladders, walkways, etc. This station shall be accessible for sample filter changing 24 hours per day, 365 days per year, and should be weather protected, accessible, and located where shown on the drawings. This sampling station shall also be designed to accommodate US EPA Method 5 compliance testing and comply with all OSHA requirements.

2.2 ACCESSORIES

- A. Flexible Connections: Flexible connection fabric shall be 16 ounces per square yard minimum, finished weight, glass cloth coated with silicone rubber. Fabric shall be suitable for operation up to 500 degrees F.
- B. Fasteners: All fasteners for carbon steel ductwork shall comply with ASTM A307.
- C. Reinforcing bars and angles shall be of the same material as the ducts on which they are used.

2.3 FABRICATION

- A. Fabricate duct and duct supports in accordance with SMACNA industrial duct construction standards listed in Article 1.4 and level 4 duct construction requirements stipulated in ERDA 76-21. Sheet metal thickness shall be a minimum of 16 gage to ensure the reliability of the weld.
- B. Longitudinal seams in all ducts 16 gage and heavier shall be full penetration continuous butt-welded in accordance with AWS D1.3. All weld material shall be removed from inside ductwork, leaving a smooth surface at all seams.
- C. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on center line unless shown otherwise on the drawings. All changes in duct size or elevation, tee connections, and branch laterals shall be made with separate fittings of all-welded construction. All 90-degree tees and 45-degree branch laterals shall have a smooth entrance into the tap. Welded seams must be ground free of any weld build up, burrs, or irregularities, and coated with a corrosion resistant paint.
- D. Transform duct sizes gradually, not exceeding 30 degrees divergence and 45 degrees convergence.

- E. Flanged joints shall be sealed by gaskets suitable for operation at duct temperature shown on the drawings. 1
- F. Welding procedures, welders, and welding operators shall be qualified in accordance with AWS D1.1 and D1.3. In addition, unless otherwise specified, workmanship samples of typical longitudinal, girth, and 45-degree branch-outlet welds in the thinnest material that will be used for ductwork shall be prepared to demonstrate the welder's ability to make such welds in this material. 4
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- G. Exterior duct and duct supports shall be designed and fabricated in accordance with, but not limited to, the following requirements: 13
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1. Basic wind speed of 80 mph (per OBBC [1995]).
I = Importance factor = 1.07 (exposure C). 16
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 2. Determine the design wind loads using factors and coefficients as stipulated in ASCE 7. 18
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 3. Base design from the combination of loads and strength requirements as stipulated in the OBBC. 20
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 4. Calculations and drawings shall be checked, signed, and stamped by a licensed Professional Engineer, registered in the State of Ohio. 22
 5. Snow Load: 25
 - a. The ground snow load shall be 25 psf, per OBBC Section 1112.2. 26
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 - b. Snow loads, including balanced and unbalanced loads, shall be determined in accordance with ASCE 7. The importance factor for snow loads shall be 1.0. 28
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 6. Seismic Load: Use provisions of the Uniform Building Code, using $Z = 0.13$, $c = 2.75$, $I = 1.25$, and $R_w =$ reduction factors from Table 16.P. W (total seismic load) shall include all normal operating contents, piping, and attachments. 32
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- H. Ductwork Testing 38
1. Acceptability criteria for welds shall be in accordance with Section 10 of AWS D1.1. 39
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 2. The duct shall be pressure leak tested in accordance with ANSI N510. 41
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- 3. The end (blank-off testing) flanges shall be used on the pressure leak test. Plate thickness shall be 8 gage or heavier with the required reinforcement. 1
- 4. The maximum permissible leak rates shall be established in accordance with the recommendations given/noted in the ERDA 76-21, Table 5.6 for "Level 4" Duct Class Construction. 2
- 5. Duration of testing shall be 15 minutes. Ductwork shall be tested at the pressure shown on the drawings. 3
- 6. The complete setup for the pressure leak test shall be the responsibility of the supplier. The test shall be performed in the supplier's shop/facility. 4

I. All surfaces shall be painted after cleaning with prime coat and finish coats of high temperature, corrosion-resistant, lead-free paint to all exposed surfaces in accordance with the manufacturer's standard or Section 09900, as applicable. 5

PART 3 EXECUTION

3.1 SITE CONDITIONS

- A. Inspection of the ductwork and stack will be made at the ductwork fabrication site by FERMC0 for the following stages of fabrication:
 - 1. At some established midpoint to check materials of construction and welding during fabrication. 6
 - 2. At completion of fabrication to witness pressure leak testing and to check dimensions, cleanliness, and shipping preparation. 7
- B. Visual inspection of the exterior weld joints, and the interior surface texture of all welded joints in the ductwork and stack shall be performed in accordance with AWS D9.1 by FERMC0. 8

A. Ductwork Installation

1. Hangers and supports for ductwork and stack shall be rigidly attached to the structural steel, concrete, or to outside grade. Additional steel for duct supports shall be furnished and installed where required. Material shall be in accordance with ASTM A36 and ASTM A307.
2. Hangers for ducts shall be in accordance with SMACNA Industrial Duct Construction Standards listed in Article 1.4.
3. Vertical ducts shall be supported with knee braces or hanger rods hung from knee braces. Knee braces shall be welded to a vertical support member perpendicular to the airstream to support the ducts.
4. Ducts passing through exterior walls shall be counterflashed as described in the architectural specifications.
5. Ductwork shall not leak as detected by auditory inspection.

B. Inspection After Installation - After the ductwork is installed, FERMCO shall inspect it to verify that:

1. All flexible connections are supplied and are of the construction specified.
2. All isolation valves are installed with the adjustment devices per the appropriate specifications.
3. All instrument ports and test ports are installed, in the correct positions, and opening through duct wall is full inside port dimension, per the appropriate specifications.
4. All ducts are of the size and in the location shown on the drawings.
5. All fittings are of the type and size shown on the drawings.
6. All ducts are supported as shown in SMACNA Industrial Duct Construction Standards listed in Article 1.4 and/or on the drawings.

7. All ducts are free of obstructions as evidenced by air flow through each intake or discharge opening, detected by sight, sound, or feel.

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3.3 ADJUSTING

A. Test the duct system for leaks using the procedures of ANSI N510.

3.4 CLEANING

A. After fabrication, the exterior and interior surfaces shall be cleaned for removal of weld flux, scale, oil, grease, shop soil, visible rust, or other foreign matter.

B. Interior surfaces shall be tested for presence of contaminants and shall be cleaned thoroughly for removal of embedded iron, organics, weld flux, slag, residual oil, and visible rust.

END OF SECTION

SECTION 16053
BASIC ELECTRICAL MATERIALS AND METHODS FOR OFF-GAS TREATMENT
SYSTEM

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical equipment, material, and services required for the off-gas treatment system:
 - 1. Disconnect switches.
 - 2. Motor starters.
 - 3. Selector switches.
 - 4. Enclosures for electrical equipment.
 - 5. Molded case circuit breakers.
 - 6. Variable frequency drives.
 - 7. Conduit.
 - 8. Wire and cable.
 - 9. Instrument cable.
 - 10. Nameplates.
 - 11. Wire markers and cable tags.
 - 12. Splicing and termination components.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 11501 - Scrubber System.
- D. Section 14570 - Rotary Airlock Feeder.
- E. Section 15060 - Pumps.
- F. Section 15173 - Motors for Off-Gas Control System.
- G. Section 15681 - Water Chillers.
- H. Section 15712 - Induced Draft Cooling Towers.
- I. Section 15755 - Heat Exchangers.

- J. Section 15860 - Fans.
- K. Section 15883 - Cyclone.
- L. Section 15885 - Air Cleaning Devices.
- M. Section 16170 - Grounding and Bonding for Off-gas Treatment System.
- N. Section 16856 - Heating Cables and Panel for Off-gas Treatment System.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for Schedule of Drawings.

1.4 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 70-96 National Electrical Code.
- B. American National Standards Institute (ANSI):
 - 1. ANSI C80.1-90 Rigid Steel Conduit-Zinc Coated.
- C. Underwriters Laboratories, Inc. (UL):
 - 1. UL 360-86 Liquid-Tight Flexible Steel Conduit.
 - 2. UL 486A-91 Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - 3. UL 510-94 Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
- D. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA AB 1-93 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA ICS 1-93 Industrial Controls and Systems General Requirements.

3.	NEMA ICS 2-93	Industrial Controls and Systems, Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.	1 2 3 4 5
4.	NEMA ICS 3.1-90	Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.	6 7 8 9 10
5.	NEMA ICS 6-93	Industrial Controls and Systems Enclosures.	11 12
6.	NEMA KS 1-90	Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).	13 14 15
7.	NEMA 250-91	Enclosures for Electrical Equipment (1000 Volts Maximum).	16 17 18

1.5 SYSTEM DESCRIPTION

- A. Design Conditions: As noted in Section 11501. Ambient shall be 40 degrees C. 22
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- B. Design Criteria: As noted in Section 11501. 25
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- C. Electrical starters and variable frequency drives, controls, wiring, and conduit required to operate the off-gas treatment system specified and as indicated on drawings. Where these electrical items are mounted on the same shipping section, they shall be electrically connected using wire or cable and conduit as specified herein. For items not mounted on the same shipping section, electrical interconnection diagrams shall be furnished, conveying clearly how these items are to be wired. Disregard requirements herein for material or equipment not required for the off-gas treatment system. 27
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1.6 SUBMITTALS

- A. Provide submittals as required by Section 01012. 38
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1.7 QUALITY ASSURANCE

- A. All products and services performed shall conform to the requirements of NFPA 70.
- B. Certifications: All items shall be tested and listed for the purpose intended by Underwriters Laboratories or Factory Mutual, Inc., with label attached.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Disconnect Switches
 - 1. Nonfusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
 - 2. Fusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: FS W-F-870. Designed to accommodate Class R fuses.
- B. Motor Starters
 - 1. Magnetic Motor Controllers: NEMA ICS 1 and ICS 2, AC general purpose, circuit breaker, combination, Class A magnetic controller for induction motor. Each controller shall have a control power transformer with two primary fuses, one secondary fuse with other secondary lead grounded.
 - 2. Coil Operating Voltage: 120 volts, 60 hertz.
 - 3. Overload Relay: NEMA ICS 2 bimetal, ambient compensated.
 - 4. Enclosure: NEMA ICS 6, type 4.
 - 5. Selector Switch: Cover mounted, rotary type, on-off.

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- 6. Minimum Size Contactor: Size 1. 1
- 7. Circuit Breaker: Instantaneous trip only, minimum 22 kA symmetrical interruption. 2
- 8. Pilot Lights: Two push-to-test, industrial type with nameplates. 3

C. Selector Switches 4

- 1. Stainless steel enclosure, NEMA ICS 6, type 4. 5
- 2. Two-position, maintained contact (start/stop). 6
- 3. Three-position, maintained contact (hand/off/auto). 7

D. Enclosures for Electrical Equipment 8

- 1. All enclosures for electrical equipment shall be type 3R or type 4, conforming to NEMA ICS 6 or NEMA 250, as appropriate. 9

E. Molded Case Circuit Breakers 10

- 1. NEMA AB 1 with integral thermal and instantaneous magnetic trip in each pole. Provide common trip handle for all poles with capability of physical lockout. Terminals, minimum 75 degrees C rated. 11
- 2. Breaker enclosures shall be type 3R, conforming to NEMA 250. 12

F. Variable Speed Drives 13

- 1. Manufacturers: 14
 - a. Cutler Hammer. 15
 - b. Allen Bradley. 16
 - c. Westinghouse. 17
 - d. Substitutions: Submit to the FERMCO Construction Manager for engineering approval. The listing of equipment suppliers in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal. It is the offerer's responsibility to propose equipment that is best suited for this 18

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- project in combined terms of quality and price.
- 2. Provide enclosed variable frequency drive suitable for load intended, conforming to the requirements of NEMA ICS 3.1.
- 3. Ratings
 - a. Rated Input Voltage: 480 volts, three phase, 60 Hertz.
 - b. Motor Nameplate Voltage: 460 volts, three phase, 60 Hertz.
 - c. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
 - d. Operating Ambient: -10 degrees C to 40 degrees C.
 - e. Humidity: 20-90 percent noncondensing.
- 4. Design
 - a. Employ microprocessor-based inverter logic isolated from power circuits.
 - b. Employ pulse width modulated inverter system.
 - c. Employ switching power supply operating off DC link.
 - d. Design for ability to operate drive with motor disconnected from output.
 - e. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.
- 5. Product Options and Features
 - a. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.
 - b. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
 - c. Volts per Hertz Adjustment: Manufacturer's standard.
 - d. Current Limit: 150 percent of rated for 1 minute.
 - e. Acceleration Rate Adjustment: 0.5-30 seconds.
 - f. Deceleration Rate Adjustment: 1-30 seconds.
 - g. Provide hand-off-automatic selector switch and manual speed control.

- h. Input Signal: 4-20 mA DC, 250 ohms loop impedance (maximum). 1
- i. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic mode. 2
- j. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode. 3
- k. Manual Bypass: Provide contactor, motor running overload protection, and short circuit protection for full voltage, nonreversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation. 4
- l. Disconnecting Means: Include integral circuit breaker on the line side of each drive. 5

2.2 MATERIALS

A. Conduit

- 1. Rigid steel, heavy wall, galvanized conduit conforming to ANSI C80.1. Conduit shall be 3/4 inch minimum in diameter. Attachment straps, hangers, and struts shall be galvanized. 21
- 2. Liquid-tight flexible metal conduit conforming to UL 360. Conduit shall be 3/4 inch minimum in diameter. 22

B. Wire and Cable

- 1. Single conductor, 600-volt insulated copper conductor. Conductors for power and lighting branch circuits shall not be smaller than No. 12 AWG. Conductors No. 12 AWG and larger shall be stranded. Conductors for control shall not be smaller than No. 14 AWG stranded. Conductors for Class 1 remote-control and signal circuits shall be enclosed in cable and shall comply with NFPA 70. Conductors for solenoid valves and/or limit switches shall be multiconductor No. 16 AWG, as required. Power and lighting conductor insulation shall be Type THW, XHHW, or THWN. Conductors 23

required to be rated 90 degrees C in accordance with NFPA 70 shall be type XHHW-2 or THW-2.

2. Any special conductors shall be as required and UL listed for the purpose intended.

C. Instrument Cable

1. Instrumentation cable shall be No. 16 AWG stranded tinned copper conductors. Conductors shall be polyethylene insulated and rated 600 volts, 60 degrees C. Conductors shall be twisted with aluminum-polymer shield; No. 18 AWG stranded, tinned copper drain wire. Cable shall have overall-chrome gray FR-PVC jacket.

D. Nameplates

1. Nameplates shall be engraved, three-layer laminated plastic, 5/16-inch bold style, black letters on white background.

E. Wire Markers and Cable Tags

1. Wire markers shall be single-conductor, slip-on, heat-shrinkable sleeve with typed or printed black letters on a white background. Wire markers shall be similar to W. H. Brady Co. computer-printable "Bradysleeve" or approved equal.
2. Cable tags shall be rectangular, flat, non-heat-shrinkable tags with 1/8-inch-high letters. Cable markers shall be similar to Raychem-type TMS or approved equal.

F. Splicing and Termination Components

1. Wire connectors, UL 486A, as applicable.
2. Insulation tape, UL 510.
3. Provide solderless terminal lugs on stranded conductors.
4. Twist-on splicing connectors (wire nuts) are not acceptable for 480-volt splices.

2.3 FABRICATION

A. Conduit

- 1. Route conduit parallel or at right angles to equipment lines. Provide conduit supports at approximately 8-foot intervals.
- 2. Cut conduit square using saw or pipecutter. All cut ends of conduit shall be reamed.
- 3. Install no more than the equivalent of three 90-degree bends between boxes. Use hydraulic one-shot conduit bender or factory elbows for conduit diameter larger than 1-1/2 inch.
- 4. Use form 8 conduit bodies to make sharp changes in direction. Avoid moisture traps; provide junction box with weep hole.
- 5. Provide cast metal boxes such as FS or FD.
- 6. Provide 1/8-inch nylon pull cord in empty conduits.
- 7. Final conduit connections to motors or other vibrating equipment shall be made with approximately 3-foot liquid-tight flexible metal conduit.

B. Wire and Cable

- 1. All wire and cable shall be completely enclosed in conduit or in junction boxes, metal raceway, or panels.
- 2. Swab conduit before installing cable. Remove burrs, dirt, or other debris.
- 3. When pulling cable into conduit, use wire pulling compound.
- 4. Splices shall be made only in outlet or junction boxes.
- 5. Provide equipment grounding conductor along with phase conductors in all conduits.
- 6. Multiconductor cables shall contain an integral ground conductor.
- 7. Grounding conductors shall be connected to equipment with compression lugs. Grounding connections shall be made to clean, dry surfaces. Scale, rust, grease, and dirt shall be removed from surfaces to which grounding connections are to be made.

8. Conductors shall be color coded. Conductors No. 6 AWG and larger shall be identified using colored tape at terminals and splice points. Conductors No. 8 AWG and smaller shall be identified using colored insulation or jacket. Color coding shall be as follows:

480Y/277V	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
	Neutral (grounded)	Gray
	Ground	Green or bare

208Y/120V	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral (grounded)	White
	Ground	Green or bare

240/120V	Phase	Black
	Phase	Red
	Neutral (grounded)	White
	Ground	Green

C. Nameplates

1. Degrease and clean surfaces to receive nameplates.
2. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using self-tapping screws.

D. Wire and Cable Markers

1. Provide wire markers on each conductor in pull boxes and junction boxes, and at each load connection. Provide cable tags in pull boxes for multiconductor cables.
2. Wire and cable tags shall identify panel and circuit number or control wire number, as required.

E. Motor Starters

1. Install motor controllers with selector switches approximately 54 inches above finished floor.

- 2. Install overload heater elements in motor controllers to match motor characteristics. 1
- 3. Provide engraved nameplate identifying motor served. 2

- F. Selector Switches 3
- 1. Mount selector switches at a mounting height of 54 inches above the floor, adjacent to the equipment controlled. Provide unistrut mounting supports. 4

- G. Variable Speed Drives 5
- 1. Fabrication 6
- a. Wiring Terminations: Match conductor materials and sizes indicated. 7
- b. Enclosure: NEMA 250, Type 4. 8
- c. Finish: Manufacturer's standard enamel. 9
- 2. Do not install drive until building environment can be maintained within the service conditions required by the manufacturer. 10
- 3. Select and install overload heater elements in motor drives to match installed motor characteristics. 11
- 4. Provide engraved plastic nameplates. 12
- 5. Provide neatly typed label inside each motor drive door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. 13

- H. Grounding 14
- 1. Provide ground conductor termination lugs (minimum two) adequate for 4/0 wire on each shipping section. 15
- 2. Bond all electrical enclosures to any conducting structures on which they are mounted and to the ground termination lugs in accordance with NFPA 70. 16

2.4 SOURCE QUALITY CONTROL 17

- A. Testing 18
- 1. Power and Control Wire: All wires shall be tested for continuity. Wire insulation shall be megger tested between each conductor and ground. 19

A 1000-volt megger shall be used for insulation rated 600 volts. Minimum resistance shall be 50 megohms.

2. Utilization Equipment:

- a. Make electrical connections to utilization equipment in accordance with manufacturer's instructions.
- b. Installation shall conform to the requirements of NFPA 70.
- c. Motor windings shall be checked for continuity.
- d. Motor windings rated 460 volts nominal shall be megger tested with a 1000-volt megger prior to connection of power leads. Minimum acceptable resistance shall be 50 megohms.
- e. Motor and phase rotation shall be checked with a phase rotation tester similar to G. Biddle Company (Catalog No. 56060) or equal on equipment which could be damaged by reverse rotation.
 - 1) Motor and phase rotation shall be verified before energizing motors.
 - 2) All motors shall be "bumped" to check for proper direction of rotation prior to performing operational tests on the equipment.

B. Verification of Performance: Record for submittal, the results of testing, Article 2.4, Paragraph A above.

PART 3 EXECUTION

Not used.

END OF SECTION

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SECTION 16170
GROUNDING AND BONDING FOR OFF-GAS TREATMENT SYSTEM

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding conductors.
- B. Equipment grounding conductors.
- C. Bonding.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements.
- B. Section 01011 - Submittals.
- C. Section 15173 - Motors for Off-Gas Treatment System.
- D. Section 16053 - Basic Electrical Materials and Methods for Off-Gas Treatment System.
- E. Section 16856 - Heating Cables and Panel for Off-Gas Treatment System.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

- A. InterNational Electrical Testing Association (NETA):
 - 1. NETA ATS-95 Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code, 1996 Edition.

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- C. Underwriters Laboratories, Inc. (UL): 1
1. UL 467-93 UL Standard for Safety 2
Grounding and Bonding 3
Equipment. 4

1.5 SYSTEM DESCRIPTION 5

- A. Subcontractor shall provide grounding and bonding of 6
all electrical equipment and conductive metallic items 7
to skid(s) on which it is located. Each skid shall 8
have two ground lugs attached at opposite ends for 9
connection to the area ground grid at the installation 10
site. Grounding resistance of all equipment shall be 5 11
ohms maximum. 12
13

1.6 SUBMITTALS 14

- A. Provide Submittals as required by Section 01012. 15
16
B. Certification of ground testing instrumentation. 17
18
19

1.7 QUALITY ASSURANCE 20

- A. Conform to requirements of NFPA 70. 21
22
23
B. Furnish products listed and classified by Underwriters 24
Laboratories, Inc., as suitable for the purpose 25
specified and shown. 26
27
28
C. Provide certification of ground testing instrumentation 29
according to NETA ATS. 30
31

PART 2 PRODUCTS 32

2.1 MANUFACTURERS 33

- A. Acceptable Manufacturers: 34
35
1. Mechanical Connectors 36
37
a. Burndy. 38
b. Ideal. 39
c. Ilsco. 40
2. Exothermic Connections 41
a. Cadweld. 42
b. Thermoweld. 43

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SECTION 16856
HEATING CABLES AND PANEL FOR OFF-GAS TREATMENT SYSTEM

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Heat trace power distribution panel.
- B. Heating cable.

1.2 RELATED SECTIONS

- A. Section 01010 - General Requirements
- B. Section 01011 - Submittals
- C. Section 15060 - Piping, Fittings, Valves, and Accessories
- D. Section 15250 - Insulation.
- E. Section 16053 - Basic Electrical Materials and Methods for Off-Gas Treatment System.

1.3 REFERENCE DRAWINGS

- A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code, 1996 Edition.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA AB 1-93 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA PB 1-90 Panelboards.
 - 3. NEMA ICS 2-93 Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.

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- 4. NEMA ICS 6-93 Industrial Control and Systems Enclosures
- 5. NEMA 250-91 Enclosures for Electrical Equipment (1000 Volts Maximum).

1.5 SYSTEM DESCRIPTION

A. Heat tracing for tanks, pumps, pipe, and any other outdoor equipment requiring freeze protection with outside temperature at -10 degrees F. Supplier shall design and provide all materials, equipment and installation to provide the required freeze protection as specified herein and indicated on drawings. Freeze protection system may be installed and tested in factory or at site.

B. Power distribution panel with heat trace freeze protection control package.

1.6 SUBMITTALS

A. Provide submittals as required by Section 01011.

1.7 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum 3 years experience.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate installation of heating cable with installation of piping and piping insulation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Raychem.

B. Chromalox.

C. Thermon.

2.2 EQUIPMENT

- A. Heat Trace Power Distribution Panel: As required for equipment requiring freeze protection, and consisting of the following:
 - 1. Distribution panelboard with 30 mA GFCI circuit breakers. Panel shall conform to NEMA PB 1 with circuit breakers conforming to NEMA AB 1. Panel shall be rated 100 amp minimum, 120/240 V, 1 phase (or as required by heating cables) with breakers sized for heating cables served and panel amperes adequate for heating cable load served.
 - 2. Selector Switch: Hand-Off-Auto.
 - 3. Contactor: NEMA ICS 2.
 - 4. Contactor coil status light.
 - 5. Enclosure: Type 4X according to NEMA 250.

2.3 MATERIALS

- A. Heating Cable
 - 1. Self-limiting, parallel resistance electric tracing cable. Maximum output temperature 150 degrees F.
 - 2. Rating: 120 V or as required.

2.4 ACCESSORIES

- A. Thermostat: Type 4X according to NEMA ICS 6, adjustable setpoint, suitable for -30 degrees F to 140 degrees F.
- B. Pilot light.
- C. Power termination kits, splice kits, tee kits, and end seals shall be utilized.
- D. Provide stainless steel identification tags for all devices. Include assembly and circuit numbers.

2.5 FABRICATION

- A. Provide heat trace power distribution panel separately. Install heating equipment on tanks,

filters, pumps, and piping systems as required.
Install to allow for heat trace cable to be
moved aside for maintenance of piping system.

- B. Install in accordance with manufacturer's instructions and NFPA 70.
- C. Avoid pinching and making sharp bends in cable.
- D. Prevent damage by sharp objects during installation.
- E. Do not install electric tracing cables across expansion joints.
- F. All electric heat trace cables shall be installed in the 7 and 8 o'clock positions or in the 4 and 5 o'clock positions on horizontal runs of pipes.
- G. Accurately record actual locations of heating cable, thermostats, and branch circuit connections.

2.6 SOURCE QUALITY ASSURANCE

- A. Test continuity of heating cable.
- B. Measure insulation resistance to manufacturer's recommended values. Use test instruments in accordance with manufacturer's instructions.
- C. Perform continuity and insulation resistance test on completed cable installation prior to installation of thermal insulation.
- D. Measure voltage and current at each unit.

PART 3 EXECUTION

Not used.

END OF SECTION

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Waste Loadout
System

WASTE LOADOUT SYSTEM

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1.0 GENERAL

The remediation of OU1 pit wastes requires that the waste be dried and shipped to an off-site disposal facility by railcars. The pit wastes are processed through a dryer and mixed with wet waste to achieve optimum moisture content for off-site shipment.

The drying/mixing facility operates 24 hours per day, 7 days per week, whereas the waste loadout and shipping operations are planned for 8 hours per day, 5 days per week. An interim storage is, therefore, provided in the waste loadout area for storage of waste that is produced in second and third shifts as well as over the weekend. The following is a brief description of the waste loadout system.

2.0 SYSTEM DESCRIPTION

- A. Four empty railcars are transferred from north to south into the Loadout Facility by the on-site yard locomotive and decoupled from the engine. At the opposite end of the rail spur, the cars are coupled to an in-plant railcar mover. The car mover moves the railcars into the various areas of the facility.
- B. The Loadout Facility consists of three discrete areas. Area 1 is the rail car lid removal and liner placement area; Area 2 is the railcar loading area; and Area 3 is the decontamination area. The facility equipment is located under roof to prevent exposure to precipitation. Further modeling is to be performed to determine the requirements for containment. The facility will have a curbed concrete floor, sloped to a sump to provide containment for any liquids, such as windblown precipitation.
- C. The first railcar is moved to the first area of the facility, where the lid is removed. Here, operators on adjacent structural steel platforms disconnect the lid latches from both sides of the car. Then, the operator remotely maneuvers the lifting beam with the overhead bridge crane to secure the beam to the two lifting lugs on the lid. The crane is then actuated to lift the lid from the car and store it at grade level. An area is provided for lid repair, when required, in the lid removal area.
- D. Next, the operators insert a plastic liner into the railcar. The top of the liner is draped over the side of the railcar to prevent contamination during loading.

- E. The railcar is then moved by the car mover to the second area, where it is loaded with waste via a front-end loader. The blended waste is transferred from the storage area to the railcar with a front-end loader. The car mover may be required to provide limited car movement to obtain the full capacity of the railcar.
- F. The second area will incorporate an integral track scale to provide local indication of the net weight of the railcar. The net weight will be recorded on the shipping manifest along with the serial number of the car.
- G. Waste is sampled at the dryer feed pile to ensure that only waste meeting waste acceptance criteria is processed through the dryer. Dried waste is mixed automatically in a mixer with wet waste to produce a product that is at optimum moisture content.
- H. Waste loadout area provides for storage of dry waste materials and shredded debris. If required, these materials may be blended with waste at optimum moisture content by a front-end loader for off-site shipment.
- I. Samples are taken from the storage pile to ensure that the waste loaded into railcars meets the total rad concentration criteria.
- J. During loading of the railcars, grab samples are taken. Each sample is referenced to the railcar serial number. These samples are retained at site to be used as verification samples, in case questions arise at a later date whether or not the shipment meets the waste acceptance criteria.
- K. Once the car is filled, the car mover moves the filled car back to the first area. Here, the top of the liner is placed over the waste and sealed. The lid is then replaced by the overhead bridge crane system and secured by latches.
- L. The car mover then moves the car to the third stage of the facility. Here, the car is uncoupled from the train and surveyed to comply with DOT requirements. Any gross surface contamination is removed, and smears taken and counted to determine the removable contamination level. In addition, the car surface dose rate measurements are taken and recorded. During decontamination of the first car, the second car is staged by the car mover in the first area for lid removal and liner placement. The sequence continues until the second car is ready for decontamination. At that time, the car mover advances the string of cars until the second car is positioned in the decontamination area.

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M. The sequence continues for all remaining cars until the train of four cars is completed. Then, the yard locomotive transfers the four car train to an on-site holding area until a shipping manifest can be prepared.

N. The waste is sampled at the dryer feed pile to ensure that waste being loaded into the railcars meets the waste acceptance criteria. However, if the waste sampling system is not functioning properly, and a particular car does not meet all of the shipping and disposal requirements, then the car is removed from the train and returned by the yard locomotive to the loadout facility. Once the lid is removed, a backhoe or other suitable equipment is used to remove the waste from the car and transfer it back to the blending area via a dump truck. Here, it is reblended with other waste to meet the shipping and disposal requirements. Reject waste may be blended with other waste either in the waste loadout or waste preparation areas. Details of this unloading facility and equipment will be developed in final design.

O. The Waste Loadout Facility is operated one shift (8 hours) per day, 5 days per week, 52 weeks per year, and is designed for a loadout rate of 680 tph.

3.0 EQUIPMENT

A railcar lid bridge crane, a front-end loader, and a railcar track weigh scale are the primary pieces of equipment required in the waste loadout area. The following is a brief description of each of these items.

A. The railcar weigh scale consists of a pit mounted, electronic track scale to indicate and record the net weight of the railcar. Scale range shall be 100 tons minimum and 200 tons maximum, with an accuracy of 50 pounds over the entire range. The track is supported by a structural steel frame and mounted on electronic load cells in a concrete pit. The output of the scale is a local readout of the railcar net weight, as well as a hard copy printout of the final net weight for record keeping for the shipping manifest.

B. The front-end loader is a diesel engine driven, rubber tired vehicle, with a 4½ cubic yard bucket. It handles materials in full bucket with material densities of up to 150 pounds per cubic foot. The loader is operated manually with an operator located in an enclosed cab with HEPA air filtration. The loader has an articulated frame design with center hinge point and a general purpose steel bucket. The minimum clear lifting height is 10 feet, measured with the bucket rolled to dump position.

C. The lid bridge crane system consists of one 2-ton overhead bridge crane with two 1-ton hoists for handling the railcar lid. Each electric hoist is mounted to an electric trolley that runs on the bridge, and the hook of each hoist is connected to opposite ends of a

lifting beam (spreader bar). The lifting beam is maneuvered remotely by the operator to engage the lifting hooks on the lid for handling. The hoists are to be wire rope type with electric dynamic braking and mechanical safety brakes. The bridge crane incorporates a festoon system for electric power supply and control from a local control station of the facility.

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