

ENGINEERING CHANGE NOTICE

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 (5/16/7/25/98)

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13a. Description of Change
 See attached sheets. Requirements for 1000 CFM Exhausters.

13b. Design Baseline Document? Yes No

14a. Justification (mark one)

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14b. Justification Details
 Functional requirements for 500 CFM exhasuters were modified to the present criteria. Requirements for 1000 CFM exhausters were added to provide documentation of those requirements.

Informal Review per HNF-PRO-445.

15. Distribution (include name, MSIN, and no. of copies)

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FUNCTIONAL REQUIREMENTS FOR PORTABLE EXHAUSTER SYSTEM TO BE USED DURING SALTWELL PUMPING

OD Nelson
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U.S. Department of Energy Contract DE-AC06-96RL13200

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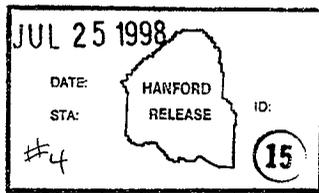
Abstract: Defines functional requirements for portable exhausters used to ventilate primary tanks during saltwell pumping, and provide back-up to primary and annulus ventilation systems at C-106 and AY-102.

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Janis Braden
Release Approval

7/25/98
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FUNCTIONAL REQUIREMENTS

FOR

**PORTABLE EXHAUSTER SYSTEM TO BE
USED DURING SALTWELL PUMPING**

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1.0 INTRODUCTION

1.1 Background

A number of single shell waste storage tanks at the Hanford Site have been identified as having the potential for producing flammable gases. These gases are produced within the contents of the tank and are released into the tank dome space by steady state releases from the waste and potentially by episodic releases when pockets of gas are disturbed during waste intrusive activities. The release of flammable gas is postulated to occur in a relatively short period of time (minutes to hours), creating the potential for flammable/explosive concentrations within the tank.

1.2 Scope

This document defines the functional requirements of a portable exhauster that will be installed to reduce the concentration of flammable gases within a tank. This will provide a safer operating environment for future saltwell pumping operations.

1.3 Site Location

The first exhauster will be installed on tank 241-A-101 but will be capable of being installed at other outdoor locations and will be suitable for year-round operation. It is expected that the systems will be adaptable to various tanks without significant re-engineering or rework.

2.0 SAFETY CLASSIFICATION

The safety classification for the exhauster assembly is Safety Class per HNF-SD-WM-SEL-040, Rev 0C, "TWRS Facility Safety Equipment List," and HNF-2050, Rev. 0, Project W-320 Safety Class and Safety Significant Engineering Evaluation" unless stated otherwise herein.

3.0 DESIGN REFERENCE DOCUMENTS

The latest edition of the following procedures, codes and standards are referenced in this document and are to be used in the design, fabrication, testing, and installation of the portable exhauster.

Engineering and Safety Analysis Procedures

ICF KH A/E Standard GC-LOAD-01
ICF KH A/E Standard GH-CLIM-01
WHC-CM-4-46, Safety Analysis Manual
WHC-CM-6-1, Standard Engineering Practices

Codes and Standards

AISC Manual of Steel Construction

AMCA Standards Handbook, Publication 99-86

ANSI/ASHRAE 52.1, Gravimetric and Duct-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

ASME B31.3, Chemical Plant and Petroleum Refinery Piping

ASME N509, Nuclear Power Plant Air Cleaning Units and Components

ASME N510, Testing of Nuclear Air Treatment Systems

ASME AG-1, Code on Nuclear Air and Gas Treatment

AWS D1.1, Structural Welding Code

AWS D9.1, Specification for the Welding of Sheetmetal

DOE Order 6430.1A, General Design Criteria

DOE-RL-92-36, Hanford Site Hoisting and Rigging Manual

ERDA 76-21, Nuclear Air Cleaning Handbook

IES-RP-CC-001-86, Institute of Environmental Sciences

MICA, Midwest Insulation Contractors Association

NFPA 70, National Electrical Code

NFPA 77, Recommended Practice on Static Electricity

NFPA 780, Lightning Protection Code

SMACNA - HVAC Duct Construction Standards Metal and Flexible

SSPC-SP-3, Power Tool Cleaning

SSPC-SP-10, Near White, Blast Cleaning

Washington Administration Code (WAC) Chapters 246-247

4.0 GENERAL DESIGN CRITERIA

4.1 Process Flow Criteria

The exhauster will draw warm moist air from the tank, heat and filter the air, and then release the air to the environment. The system shall have a design capacity of 230 to 500 cubic feet per minute (CFM) as noted in Appendix A or 470 to 1000 CFM as noted in Appendix B.

The design conditions of the air entering the exhauster will be 150°F at 100% relative humidity (RH) with no entrained moisture. The air stream will contain varying amounts of hydrogen, nitrous oxide, methane, and ammonia vapors. The air will be heated to reduce the relative humidity to less than 70% prior to passing through the prefilter. The air will then pass through the prefilter, two (2) high efficiency particulate air (HEPA) filters in series, a fan, and will discharge through a stack. The stack will contain a section that allows for the installation of air flow measuring and temporary or continuous sampling devices.

Moisture separators are not required for this application. Any moisture that does accumulate inside the exhauster will be collected in a drain system, routed to a seal pot and returned to the tank of origin.

4.2 General Component Criteria

The design life of this system shall be 10 years.

The exhauster system design shall take into consideration that all components will be decontaminated and decommissioned.

All components and materials shall be designed and selected to be compatible with the air stream as defined in this document (see section 4.1) or as may be determined with updated information.

The exhauster system shall be designed for the structural loads associated with lifting and transportation via truck.

The exhauster system shall be designated Safety Significant. For W-320 these exhausters will be classified as Safety Class and designed to withstand the natural phenomenon hazards defined in Hanford A/E Standard GC-LOAD-01. The system is not required to function during or following an earthquake, but shall be designed to maintain the integrity of the pressure boundary of the exhauster from the riser connection up to and including the second HEPA filter.

The inside of the exhauster and ductwork shall meet the Ignition Source Control Set #2 criteria per Administrative Control 5.10 of HNF-SD-WM-TSR-006, "Tank Waste Remediation System Technical Safety Requirements" (IC-2). The outside

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of the exhauster and ductwork shall be considered a physical barrier between the classified and unclassified locations.

The exhauster system shall be designed to meet the outdoor weather conditions as defined in the Mechanical A/E Standard GH-CLIM-01 except that the minimum winter temperature shall be -32°F.

Bonding or other appropriate means shall be provided to ensure electrical continuity of all components of the exhauster system.

The exhauster shall be grounded and all components bonded to assure grounding during any lightning activity per NFPA 780.

The exhauster system shall be designed to ensure that the requirements of NFPA 77 are met to prevent the build-up of static electricity.

APPENDIX A: 500 CFM PORTABLE EXHAUSTER

1.0 SYSTEM DESCRIPTION AND COMPONENT REQUIREMENTS FOR 500 CFM EXHAUSTERS

The exhauster shall be designed and fabricated to meet the following criteria and conditions.

1.1 Major System Components

The major system components are:

- Ductwork
- Isolation Valves
- Glycol Heater and Associated Components
- 1 Prefilter and Housing
- 2 HEPA Filter Test Sections
- 2 HEPA Filters and Filter Housing
- 1 Exhaust Fan
- Stack
- Condensate Drain and Seal Pot System
- Insulation
- Instrumentation and Controls
- Electrical System
- Support Skid

1.2 General Requirements

Materials: All materials used shall be new and as specified on design drawings. The use of lead or asbestos is not permitted. Insulation material shall be free of halogenated hydrocarbons.

Special requirements: All components and materials which are in direct contact with the air stream shall meet the Ignition Source Control Set #2 criteria per Administrative Control 5.10 of HNF-SD-WM-TSR-006, "Tank Waste Remediation System Technical Safety Requirements." In addition, all components in the air stream shall be chemically compatible with the environment as identified in Section 4.

Maintenance: All material and equipment shall be fabricated and installed to facilitate routine removal, cleaning or decontamination, and calibration. Adequate space and accessibility shall be provided for removal and replacement of individual instruments or equipment without removal of adjacent equipment. Valves, test points/ports, and calibration adjustments shall be accessible.

Space envelope: The entire assembly shall be no wider than 8'-0". The stack shall be removable for transportation to minimize total overall height.

Painting: All internal and external surfaces of non-corrosion resistant material shall be coated with a paint meeting the requirements for outside storage and operation. Where carbon steel metal is welded to stainless steel, the painted surface shall extend a

minimum 1/4" beyond the weld zone onto the stainless steel surface. All flange faces and threaded surfaces shall not be painted. The minimum requirements for painting all non-corrosion resistant material surfaces are as follows: a) surface preparation shall be in accordance with SSPC-SP-3 or SSPC-SP-10; b) primer coat shall be applied using Amercoat 86 or equal, minimum dry film thickness of 0.002 inch (2 mils); and c) the finish coat shall be painted with Amercoat 33, or equal material. Dry film thickness shall be 0.003 inch (3 mils) minimum.

Tank protection: The exhauster system shall be designed to protect the tank and maintain the tank pressure above its minimum operating pressure of -7" WG. The exhauster system shall also be designed to protect the tank inlet filter seal loop at a operating pressure of -4.0" WG.

1.3 Skid

The exhaust system will be mounted on a skid that supports the system components as well as any instrumentation necessary to monitor and control system components. The skid will be designed to be portable allowing the system to be moved, by crane and truck, to other tanks for similar applications with little or no modification of the system.

The support skid shall be sized to accommodate the exhaust train and any support equipment. The skid shall have leveling devices. The structural frame shall allow convenient access to the filter train components for maintenance and operations.

The skid shall be fabricated from carbon steel unless otherwise indicated.

Lift points shall be provided for rigging, transportation, and site installation. The lift points shall be designed to lift the gross weight of the unit by crane and comply with the requirements of the Hanford Site Hoisting and Rigging Manual (DOE-RL-92-36). The lifting points and the gross weight of the unit shall be identified on the drawing and on the skid.

1.4 Ductwork

1.4.1 Non-Flexible

Duct material, fabrication, welding, and nondestructive examination inspection requirements shall conform to the requirements of ASME N509, paragraphs 5.10 and 7.3.

Testing shall be performed as described in ASME N510, to the requirements of ASME N509, paragraph 4.12.

Ductwork shall be constructed of type 304-L stainless steel.

All ductwork shall be welded with flanged end connections. All sheet metal seams shall be welded.

Fabricated ductwork shall be designed to operate at the maximum negative pressure capacity of the exhaust fan and the conditions defined in Section 4.

1.4.2 Flexible

Flexible ductwork shall be used at the exhaust inlet, fan inlet, and at the fan outlet.

The flexible ductwork at the exhaust inlet shall allow for adjustments in the location of the exhaust to accommodate a match-up with the tank access riser.

All flexible duct connections shall be selected taking into account abrasion, leakage, tear strength, tensile strength, air stream temperature, and outdoor exposure conditions as stated in Section 4.

All flexible ductwork shall be designed to operate at the maximum negative pressure capacity of the exhaust fan, and the conditions defined in Section 4.

All flexible ductwork shall be bonded to ensure electrical continuity.

1.5 Isolation Valves

Butterfly valves shall be used for isolation of the exhaust filter train from the tank and fan for operation and maintenance. Valves shall be located at the inlet to the filter train and at the inlet to the fan.

Valve materials shall meet the design conditions as stated in Section 4. Bubble-tight shut off is required. The valve shall be connected to the adjacent flanges so that the duct is electrically continuous.

The valves must be equipped with gear operators that can be locked. Reach handles shall be provided if easy access to the valves is not attainable.

1.6 Heater

A glycol heating system shall be used. The heating system shall be capable of heating a 500 cfm air stream to meet the relative humidity requirements given in Section 4. The heating system shall be vented to atmosphere.

The heater shall operate in IC-2 Conditions. The design shall be such that no risk of fire or explosion can occur due to heating system failure.

The heater to flange penetration at the duct shall be sealed and meet the pressure/decay requirements of ASME N510.

1.7 Prefilter and Prefilter Housing

The prefilter increases the life of the HEPA filters. The prefilter traps the larger airborne particles allowing for a more economical operating system. It also applies ALARA concepts by allowing less frequent change out of the HEPA filters, thereby reducing exposure of personnel to radiation sources.

The prefilter housing serves as a containment barrier and holding device for the prefilter. The housing must provide easy access to the prefilter for maintenance and operation. The housing must provide for the attachment of pressure differential measurement components and condensate drain piping.

The prefilter shall be 24" x 24" x 2" glass fiber media filter of the throwaway cartridge type. The prefilter shall have a maximum clean-filter pressure drop of 0.5" WG at nominal rated capacity and shall be capable of operating at 200°F and 100 percent relative humidity with a minimum 30 percent efficiency in accordance with ASHRAE 52-76. The filter shall have an efficiency rating of 30% or more based on ASHRAE Standard 52.1-1992 Test Standards or ASME AG-1, Section FB. The frame shall be corrosion resistant when operating in the environment defined in Section 4.

The prefilter housing shall be sized to handle a single prefilter with a capacity of 500 cfm. This housing shall be stainless steel and mate up dimensionally with the test sections identified in Section 5.9. The housing must provide easy access to the filters for maintenance and operation. Provisions must be included in the design to maintain containment during filter changeout. The prefilter housing shall have a one inch socket weld half coupling at the low point on the bottom for the attachment of condensate drain piping.

Each filter housing assembly shall meet the applicable sections of ASME N509 and the test requirements of ASME N510.

The filter housings shall be leak tested using the pressure decay method in accordance with ASME N510. Leakage shall not exceed the requirements of ASME N509-1989, Appendix B, Section B3.

The housing manufacturer shall provide filter housing test data for the housing specified or the subassembly shall be tested at the manufacture's plant at rated air flow to determine conformance to ASME N509, paragraph 5.6.1, for uniform air flow.

Filters and housings shall meet the design conditions identified in Section 4.

1.8 HEPA Filters and HEPA Filter Housing

HEPA filters shall meet the requirements of ASME AG-1, Section FC and the test requirements of ASME N510.

The HEPA filters shall be 24" x 24" x 5 7/8" Nuclear Grade throw-away extend-Media Dry-Type in a rigid frame having minimum particle-collection efficiency of 99.97% for 0.3 micrometer thermally-generated dioctylphthalate (DOP) particles or other specified challenge aerosols. Pressure drop of a clean filter shall be a maximum of 1" WG at rated flow. The frame shall be corrosion resistant for air stream design conditions as defined in Section 4. Each filter shall have a gelatin seal gasket material and shall be on the air entering end. Face guards shall be on both ends.

The HEPA filter housing provides a sealed barrier for the confinement of airborne radionuclides. The HEPA filter housing serves to encapsulate and hold the HEPA filter.

The filter housing shall provide for the attachment of pressure differential measurement components.

The HEPA filter housing shall be sized to handle two 24" x 24" x 5 7/8" filters in series. The second HEPA filter must have the capability of being aerosol tested independently of the first HEPA filter. Since stack sampling is only performed periodically it is essential to make provision to verify the integrity of the second filter. The filter housing shall have a filter seating surface that will accommodate a gelatin seal. The housing and all internal components and mechanisms shall be stainless steel. The housing must mate up to and be compatible with the test sections identified in Section 5.9. The housing must provide easy access to the filters for maintenance and operation. Provisions must be included in the design to maintain containment during filter changeout. The housing shall have a one inch socket weld half coupling at the low point on the bottom for the attachment of condensate drain piping.

The housing will accommodate a gelatin seal filter installed such that the filter resides in the clean access area of the housing.

Each filter housing shall meet the applicable sections of ASME N509 and the test requirements of ASME N510.

The filter housings shall be leak tested using the pressure decay method in accordance with ASME N510. Leakage shall not exceed the requirements of ASME N509-1989, Appendix B, Section B3.

Filters and housings shall meet the design conditions identified in Section 4.

1.9 Test Sections

The test sections shall provide the means for in place testing of the HEPA filters. Testing confirms that any airborne radionuclide particles will be captured to the level of efficiency of the installed HEPA filter. The test sections also form part of the confinement barrier for the exhaust airstream.

Each test section shall be a 500 cfm fixed diffuser type. Material shall be 304L stainless steel and compatible with the prefilter and HEPA filter sections in the filter train assembly. One (1) test section will be placed downstream of the prefilter section and upstream of the first (1st) HEPA filter section and the second (2nd) test section will be placed between the first (1st) stage HEPA filter housing and the second (2nd) stage HEPA filter housing. The test section housings shall have a one inch socket weld half coupling at the low point on the bottom for the attachment of condensate drain piping.

These test sections shall meet the design conditions identified in Section 4.

1.10 Exhaust Fan

The exhaust fan shall be constructed of spark arresting materials. It shall meet AMCA Standard 99-0401-86 and be Type A construction.

The fan shall be a centrifugal type with a steep characteristic operating curve. The fan shall be a CCW upblast, AMCA arrangement eight. The exhaust fan shall be statically and dynamically balanced as an assembly.

All components utilized on the fan that come in contact with the air stream shall be so designed to prevent any form of sparking. The fan shall be designed to be operated in IC-2 conditions. The material must also be compatible with the chemical constituents in the air stream per Section 4.

The fan shall have shaft seals that reduce inleakage to a minimum.

Bearings shall be self-aligning type with average L-50 life of 100,000 hours. Bearings and all grease fittings shall be located outside of the air stream.

No electrical devices shall be in the airstream.

The fan shall be sized to move 500 cfm of air at the design conditions stated in Section 4.

The fan shall be selected to operate on the stable portion of its performance curve at a nominal air flow range of 230 to 520 cfm. The rating and characteristics of the fan must account for the pressure drops encountered from existing in-place components, loading of HEPA filters, etc. The fan shall be designed for variable speed operation that allows for a constant air volume at changing static and velocity pressure requirements. The primary HEPA filter will be loaded up to 5.4" WG differential pressure at rated flow and the overall HEPA bank will be operated up to a maximum of 5.4" WG differential pressure measured across both filters.

The fan shall be equipped with a factory installed shaft drive. All drive components shall be covered with guards.

The fan shall have a one inch plugged drain connection at the low point on the fan housing to allow for attachment of condensate drain piping.

1.11 Fan Motor

The fan motor shall be suitable for service at 460 VAC, 3-phase, 60 hertz.

Motor insulation shall be non-hygroscopic and suitable for the service conditions specified for the driven equipment. Motor insulation shall be class F. The temperature rise shall be 40°C (class B). Service factor shall be 1.15. The motor shall be continuous duty UL/Canadian Standard Association approved.

1.12 Exhaust Stack

The stack provides the means to exhaust the filtered air, houses the air velocity probe for measurement of the stack velocity, and houses the air sampling probe.

The exhaust stack shall be constructed of stainless steel. The exhaust stack shall be attached to the fan outlet but shall be supported independently of the exhaust fan. The

stack shall be designed to maintain a minimum exhausted air velocity of 2500 fpm with 500 CFM airflow. There shall be a flexible connection (see Section 5.4.2) between the fan and the stack.

The stack will be approximately ten feet high from the fan outlet and shall be flange connected for easy removal during transportation.

1.13 Condensate Drain and Seal Pot System

The condensate drain and seal pot system provides a drain path and collection point for condensate generated in the system. The condensate shall gravity flow to the tank of origin.

This system shall be designed to drain and capture any condensate located in the filter train system including the HEPA housing, fan housing and stack. The drain system will need to operate effectively at the maximum negative pressure capacity of the fan. The system shall be designed to assure that freezing cannot occur under the design conditions of Section 4.

Seal pot instrumentation requirements shall be as identified in Section 5.16.

The seal pot shall have a drain connection and be designed for total drainage. The filter train cannot be moved with any moisture in the seal pot.

Drainage piping shall be fabricated from stainless steel material, all welded and flange construction, unless otherwise indicated. Piping materials and construction shall conform to the requirements of ASME B31.3. Individual lines from each drainage point in the system shall be sloped (minimum 1/8"/ft) to the seal pot. The seal pot must be equipped with a fill port, an overflow, and high and low level alarms (see instrumentation, Section 1.16.4).

All piping shall be pressure tested as an assembly with the filter housing.

The drain lines and seal pot shall be heat traced and lagged with insulation having an "R" greater than 3.5.

1.14 Insulation

The exhaust system, including the fan housing and stack, will be insulated to maintain the necessary air temperatures and relative humidity to minimize condensation in the system under the design conditions stated in Section 4.

The insulation shall not interfere with the testing, maintenance, and service of any components or systems.

The insulation shall be protected from the weather and shall meet the design requirements as stated in Section 4.

Insulation shall meet the requirements of the Midwest Insulation Contractors Association (MICA) for materials, design and application.

The insulation material shall have an "R" value of not less than 7 for the ductwork, test sections, and filter housings.

1.15 Electrical Equipment

1.15.1 Service Power

Electrical components shall meet the requirements of NEC (NFPA 70), UL, and NEMA MG-1.

One main service 3-phase, 3-wire, 480 VAC, with a factory installed equipment ground bar, shall be provided in a weatherproof enclosure suitable for outdoor installation. The main ampere rating shall be as required for the total electrical load. The symmetrical short circuit current rating shall be as required to withstand the available fault current at the point of connection.

Dedicated non-ground fault interrupted (non-GFI) circuits shall be provided for the stack monitoring and sampling and control circuits.

The distribution panel board shall be provided with feeder branch circuit breakers with ampere rating sized for the following connected electrical equipment loads.

- a) Exhaust fan
- b) Glycol heater
- c) Glycol recirculation pump
- d) Alarm panel
- e) Mini-power zone supply
- f) One spare circuit breaker
- g) Flammable gas monitor (future)
- h) Generic air sampling system (future)

1.15.2 Alarm Panel

The alarm panel shall provide a LCD readout and local visual (a clear strobe light) annunciation for the following alarm conditions.

- a) High differential pressure alarm across the first HEPA filter
- b) Low differential pressure alarm across the first HEPA filter
- c) High differential pressure alarm across the second HEPA filter
- d) Low differential pressure alarm across the second HEPA filter
- e) High differential pressure across prefilter
- f) High differential pressure across HEPA 1 & 2
- g) Low differential pressure across HEPA 1 & 2
- h) High negative pressure at the exhaust inlet
- i) High or low liquid level at the seal pot
- j) Exhaust fan "not running" annunciation when abnormal condition shut down

- k) Low glycol heater level
- l) Low stack flow
- m) High stack flow
- n) Low plenum temperature
- o) High plenum temperature
- p) Alarms for all interlocks and system problems (SEE TABLE 1)
- q) Rate of change for HEPA filter 1
- r) Rate of change for HEPA filter 2
- s) Rate of change for HEPA filter 1 & 2

The clear strobe light shall be visible in daylight for a minimum distance of 100 yards.

1.15.3 Indicator Location

Fan "on/off" status lights shall be located near the fan start and stop switches.

1.16 Exhauster Instrumentation and Control

The instrumentation and control system's performance shall not be adversely affected by the site and process ambient conditions of Section 4.

The components exposed to a vapor space shall meet IC-2 Criteria. All other instrument components will comply with the 1996 NEC. All Safety Class or Safety Significant instrumentation shall be capable of 1% accuracy or better. All electrical enclosures shall be purchased as NEMA 3R or better for outdoor use.

1.16.1 Pressure Monitoring

The exhaust system shall be equipped with a differential pressure (DP) system that measures filter performance. The DP transmitters shall be rated as intrinsically safe. Each transmitter shall have dedicated barriers rated for a 24 volt DC loop with a 4 to 20 mA signal. The DP transmitters shall measure the DP across the prefilter, first HEPA filter, second HEPA filter, and first and second HEPA filters. The DP shall be indicated on the control panel with LCD's. The system shall also have interlocks to shutdown the exhaust fan on certain alarm situations. Alarms shall be indicated on a data message display and illuminate a clear strobe light.

1.16.2 Temperature Monitoring

Exhaust temperature monitoring system shall consist of three thermocouples (J Type), one before the heater, one before the first HEPA filter, and one before the exhaust fan inlet. The thermocouples shall be installed in thermowells and connected to the SLC. The thermocouple before the 1st HEPA Filter shall have an interlock (see Interlock Section). On detection of a High Temperature of 200° F and a Low Temperature of 40° F alarms shall be indicated on a data message display and illuminate a clear strobe light.

1.16.3 Stack Monitoring

The exhaust stack shall be equipped with a multi-port flow tube and flow transmitter. The transmitter must have a logic function and transmit a 4 to 20 mA signal to the SLC. On detection of a High flow of 530 cfm or a Low flow of 230 cfm alarms shall be indicated on a data message display and illuminate a clear strobe light.

The stack flow transmitter system shall have a limit alarm relay to convert a 4 to 20 mA signal into dry contact for the Safety Class 1 cabinet (provided by others).

1.16.4 Liquid Monitoring

A liquid level control system using an on-off conductance actuated liquid level control shall be required at the seal pot.

The seal pot shall have a level transmitter. This transmitter shall feed a 4 to 20 mA signal to the SLC. The seal pot system will be equipped with a Low liquid level 30% and High liquid level 65% of the seal pot liquid volume alarms. The liquid level shall be indicated on the control panel LCD and have latching visual alarms.

1.16.5 Programmable Logic Controller

The exhauster control system shall be a small logic controller (SLC), which will provide a 24-volt DC power supply, expandable I/O slots and contain a serial communications port. The SLC shall be compatible with the Salt Well Pump Skid, as required by the Interim Stabilization Program. This system will require a memory of 12K. The function of this control system will be to operate the exhaust fan and alert personnel of alarm situations. All alarms shall read out on a data message display. The control system shall have interlocks to shutdown the exhaust fan on certain alarm situations. See interlocks.

The SLC/programming shall include an interface with the LAN system for data logging the fan start and stop times, total flow to date, CFM, log all alarms received, date and time alarms are received and reset, HEPA filter DP's, plenum temperatures, seal pot level, glycol level, plenum pressure, and be capable of a remote emergency stop of the exhauster.

Variable speed control shall be compatible with the SLC and maintain flows from 230 cfm to 530 cfm.

1.16.6 Interlocks - Set points

The DP interlocks will consist of a Low DP, and High High DP on the 1st and 2nd HEPA filters and across both HEPA Filters. The Low DP shall be set at 0.1 in. WG. The High High DP on the 1st HEPA filter shall be set at 5.4 in. WG, on the 2nd HEPA filter the High High DP shall be set at 3.7 in. WG, and on the High High DP across both HEPA filters set at 5.4 in. WG. The exhauster shall shutdown when receiving a Low DP or High High DP. The only exclusion to the DP is during the initial start up of the system.

On start up of the system there will be a 10 second time delay allowing the system to clear the Low DP condition.

The temperature interlock will consist of a High Temperature set at 200°F. On detection of a high temperature the heater will shutdown. Alarms shall be indicated on a data message display and illuminate a clear strobe light.

See TABLE 1 for a listing of setpoints.

1.16.7 Other

The glycol heater control system shall be within the control cabinet. The heater power shall be interlocked to prevent over heating of the HEPA filters (see interlocks).

Heat Trace shall be individual for each of the condensate lines and have a light indicating heat trace is operational.

The Control Panel shall have multiple indicators (DP's, CFM, Temperatures, etc.) a start stop station equipped with indication lights and a message view indicator. The interior of the control cabinet shall be controlled to maintain an internal temperature between 40°F and 140°F.

The Intrinsic Cabinet shall be controlled to maintain an internal temperature between 40°F and 140°F.

TABLE 1: Set Points

| Sensor & Location | Set Point | Action |
|--------------------------------------|-----------|--|
| High DP at exhauster inlet | 3.5" WG | Alarm |
| Low DP across heater | N/A | Indication only |
| High DP across prefilter | 1.0 | Alarm & take action |
| Low DP across 1st HEPA | 0.1" WG | Alarm & shutdown system |
| High DP across 1st HEPA | 4.5" WG | Alarm & take action |
| High High DP across 1st HEPA | 5.4" WG | Alarm & shutdown system |
| Low DP across 2nd HEPA | 0.1" WG | Alarm & shutdown system |
| High DP across 2nd HEPA | 3.2" WG | Alarm & take action |
| High High DP across 2nd HEPA | 3.7" WG | Alarm & shutdown system |
| High DP across both HEPAs | 4.5" WG | Indication only |
| High High DP across both HEPAs | 5.4" WG | Alarm & shutdown system |
| Low DP across both HEPAs | 0.1" WG | Alarm & shutdown system |
| High temperature at 1st HEPA | 200°F | Alarm & shutdown heater |
| Low temperature at 1st HEPA | 40°F | Alarm only |
| Low flow in stack | 230 cfm | Alarm & shut down salt well pump |
| High flow in stack | 530 cfm | Alarm & shut down exhauster system |
| Low level in seal pot | 30% | Alarm & shut down exhauster system |
| High level in seal pot | 65% | Alarm & shut down exhauster system |
| Low level in heater glycol reservoir | 50% | Alarm & shut down heater and heater recirculation pump |
| Rate of change at 1st HEPA | 0.5" | Alarm & shut down exhauster system |
| Rate of change at 2nd HEPA | 0.5" | Alarm & shut down exhauster system |
| Rate of change at 1st & 2nd HEPA | 0.5" | Alarm & shut down exhauster system |

APPENDIX B: 1000 CFM PORTABLE EXHAUSTER

1.0 SYSTEM DESCRIPTION AND COMPONENT REQUIREMENTS FOR 1000 CFM EXHAUSTERS

The exhauster shall be designed and fabricated to meet the following criteria and conditions.

1.1 Major System Components

The major system components are:

- Ductwork
- Isolation Valves
- Demister
- Glycol Heater and Associated Components
- 1 Prefilter and Housing
- 2 HEPA Filter Test Sections
- 2 HEPA Filters and Filter Housing
- 1 Exhaust Fan
- Stack
- Condensate Drain and Seal Pot System
- Insulation
- Instrumentation and Controls
- Electrical System
- Support Skid

1.2 General Requirements

Operating Modes: The exhausters shall have 3 SLC controlled modes of operation.

Flow Control - Exhauster fan speed is controlled to meet a pre-determined constant flow rate between 500 and 1000 SCFM by the SLC.

Pressure Control - Exhauster fan speed is controlled by the SLC to maintain a constant vacuum at the fan inlet of 12 INWC.

High Vacuum - Intended for use in dry applications only (eg. 102-AY annulus). PLC is set to maximize fan speed. Seal pot drain lines from the plenum and the fan housing drain may be plugged in this mode of operation to prevent by-passing of HEPA filters.

Materials: All materials used shall be new and as specified on design drawings. The use of lead or asbestos is not permitted. Insulation material shall be free of halogenated hydrocarbons.

Special requirements: All components and materials which are in direct contact with the air stream shall meet the Ignition Source Control Set #2 criteria per Administrative Control 5.10 of HNF-SD-WM-TSR-006, "Tank Waste Remediation System Technical

Safety Requirements" (IC-2). In addition, all components in the air stream shall be chemically compatible with the environment as identified in Section 4.

Maintenance: All material and equipment shall be fabricated and installed to facilitate routine removal, cleaning or decontamination, and calibration. Adequate space and accessibility shall be provided for removal and replacement of individual instruments or equipment without removal of adjacent equipment. Valves, test points/ports, and calibration adjustments shall be accessible.

Space envelope: The entire assembly shall be no wider than 8'-0". The stack shall be removable for transportation to minimize total overall height.

Painting: All internal and external surfaces of non-corrosion resistant material shall be coated with a paint meeting the requirements for outside storage and operation. Where carbon steel metal is welded to stainless steel, the painted surface shall extend a minimum 1/4" beyond the weld zone onto the stainless steel surface. All flange faces and threaded surfaces shall not be painted. The minimum requirements for painting all non-corrosion resistant material surfaces are as follows: a) surface preparation shall be in accordance with SSPC-SP-3 or SSPC-SP-10; b) primer coat shall be applied using Amercoat 86 or equal, minimum dry film thickness of 0.002 inch (2 mils); and c) the finish coat shall be painted with Amercoat 33, or equal material. Dry film thickness shall be 0.003 inch (3 mils) minimum.

Tank protection: The exhauster system shall be designed to protect the tank and maintain the tank pressure above its minimum operating pressure of -7" WG. The exhauster system shall also be designed to protect a primary tank inlet filter seal loop at a operating pressure of -4.0" WG.

1.3 Skid

The exhaust system will be mounted on a skid that supports the system components as well as any instrumentation necessary to monitor and control system components. The skid will be designed to be portable allowing the system to be moved, by crane and truck, to other tanks for similar applications with little or no modification of the system.

The support skid shall be sized to accommodate the exhaust train and any support equipment. The skid shall have leveling devices. The structural frame shall allow convenient access to the filter train components for maintenance and operations.

The skid shall be fabricated from carbon steel unless otherwise indicated.

Lift points shall be provided for rigging, transportation, and site installation. The lift points shall be designed to lift the gross weight of the unit by crane and comply with the requirements of the Hanford Site Hoisting and Rigging Manual (DOE-RL-92-36). The lifting points and the gross weight of the unit shall be identified on the drawing and on the skid.

1.4 Ductwork

1.4.1 Non-Flexible

Duct material, fabrication, welding, and nondestructive examination inspection requirements shall conform to the requirements of ASME N509, paragraphs 5.10 and 7.3.

Testing shall be performed as described in ASME N510, to the requirements of ASME N509, paragraph 4.12.

Ductwork shall be constructed of type 304-L stainless steel.

All ductwork shall be welded with flanged end connections. All sheet metal seams shall be welded.

Fabricated ductwork shall be designed to operate at the maximum negative pressure capacity of the exhaust fan and the conditions defined in Section 4.

1.4.2 Flexible

Flexible ductwork shall be used at the exhaust inlet, fan inlet, and at the fan outlet.

The flexible ductwork at the exhaust inlet shall allow for adjustments in the location of the exhauster to accommodate a match-up with the tank access riser.

All flexible duct connections shall be selected taking into account abrasion, leakage, tear strength, tensile strength, air stream temperature, and outdoor exposure conditions as stated in Section 4.

All flexible ductwork shall be designed to operate at the maximum negative pressure capacity of the exhaust fan, and the conditions defined in Section 4.

All flexible ductwork shall be bonded to ensure electrical continuity.

1.5 Isolation Valves

Butterfly valves shall be used for isolation of the exhaust filter train from the tank and fan for operation and maintenance. Valves shall be located at the inlet to the filter train and at the inlet to the fan.

Valve materials shall meet the design conditions as stated in Section 4. Bubble-tight shut off is required. The valve shall be connected to the adjacent flanges so that the duct is electrically continuous.

The valves must be equipped with gear operators that can be locked. Reach handles shall be provided if easy access to the valves is not attainable.

1.6 Heater

A glycol heating system shall be used. The heating system shall be capable of heating a 1000 cfm air stream to meet the relative humidity requirements given in Section 4. The heating system shall be vented to atmosphere.

The heater shall operate in IC-2. The design shall be such that no risk of fire or explosion can occur due to heating system failure.

The heater to flange penetration at the duct shall be sealed and meet the pressure/decay requirements of ASME N510.

1.7 Prefilter and Prefilter Housing

The prefilter increases the life of the HEPA filters. The prefilter traps the larger airborne particles allowing for a more economical operating system. It also applies ALARA concepts by allowing less frequent change out of the HEPA filters, thereby reducing exposure of personnel to radiation sources.

The prefilter housing serves as a containment barrier and holding device for the prefilter. The housing must provide easy access to the prefilter for maintenance and operation. The housing must provide for the attachment of pressure differential measurement components and condensate drain piping.

The prefilter shall be 24" x 24" x 2" glass fiber media filter of the throwaway cartridge type. The prefilter shall have a maximum clean-filter pressure drop of 0.5" WG at nominal rated capacity and shall be capable of operating at 200°F and 100 percent relative humidity with a minimum 30 percent efficiency in accordance with ASHRAE 52-76. The filter shall have an efficiency rating of 30% or more based on ASHRAE Standard 52.1-1992 Test Standards or ASME AG-1, Section FB. The frame shall be corrosion resistant when operating in the environment defined in Section 4.

The prefilter housing shall be sized to handle a single prefilter with a capacity of 1000 cfm. This housing shall be stainless steel and mate up dimensionally with the test sections identified in Section 5.9. The housing must provide easy access to the filters for maintenance and operation. Provisions must be included in the design to maintain containment during filter changeout. The prefilter housing shall have a one inch socket weld half coupling at the low point on the bottom for the attachment of condensate drain piping.

Each filter housing assembly shall meet the applicable sections of ASME N509 and the test requirements of ASME N510.

The filter housings shall be leak tested using the pressure decay method in accordance with ASME N510. Leakage shall not exceed the requirements of ASME N509-1989, Appendix B, Section B3.

The housing manufacturer shall provide filter housing test data for the housing specified or the subassembly shall be tested at the manufacture's plant at rated air flow to determine conformance to ASME N509, paragraph 5.6.1, for uniform air flow.

Filters and housings shall meet the design conditions identified in Section 4.

1.8 HEPA Filters and HEPA Filter Housing

HEPA filters shall meet the requirements of ASME AG-1, Section FC and the test requirements of ASME N510.

The HEPA filters shall be 24" x 24" x 11 1/2" Nuclear Grade throw-away extend-Media Dry-Type in a rigid frame having minimum particle-collection efficiency of 99.97% for 0.3 micrometer thermally-generated dioctylphthalate (DOP) particles or other specified challenge aerosols. Pressure drop of a clean filter shall be a maximum of 1" WG at rated flow. The frame shall be corrosion resistant for air stream design conditions as defined in Section 4. Each filter shall have a gelatin seal gasket material and shall be on the air entering end. Face guards shall be on both ends.

The HEPA filter housing provides a sealed barrier for the confinement of airborne radionuclides. The HEPA filter housing serves to encapsulate and hold the HEPA filter. The filter housing shall provide for the attachment of pressure differential measurement components.

The HEPA filter housing shall be sized to handle two 24" x 24" x 11 1/2" filters in series. The second HEPA filter must have the capability of being aerosol tested independently of the first HEPA filter. Since stack sampling is only performed periodically it is essential to make provision to verify the integrity of the second filter. The filter housing shall have a filter seating surface that will accommodate a gelatin seal. The housing and all internal components and mechanisms shall be stainless steel. The housing must mate up to and be compatible with the test sections identified in Section 5.9. The housing must provide easy access to the filters for maintenance and operation. Provisions must be included in the design to maintain containment during filter changeout. The housing shall have a one inch socket weld half coupling at the low point on the bottom for the attachment of condensate drain piping.

The housing will accommodate a gelatin seal filter installed such that the filter resides in the clean access area of the housing.

Each filter housing shall meet the applicable sections of ASME N509 and the test requirements of ASME N510.

The filter housings shall be leak tested using the pressure decay method in accordance with ASME N510. Leakage shall not exceed the requirements of ASME N509-1989, Appendix B, Section B3.

Filters and housings shall meet the design conditions identified in Section 4.

1.9 Test Sections

The test sections shall provide the means for in place testing of the HEPA filters. Testing confirms that any airborne radionuclide particles will be captured to the level of efficiency of the installed HEPA filter. The test sections also form part of the confinement barrier for the exhaust airstream.

Each test section shall be a 1000 cfm fixed diffuser type. Material shall be 304L stainless steel and compatible with the prefilter and HEPA filter sections in the filter train assembly. One (1) test section will be placed downstream of the prefilter section and upstream of the first (1st) HEPA filter section and the second (2nd) test section will be placed between the first (1st) stage HEPA filter housing and the second (2nd) stage HEPA filter housing. The test section housings shall have a one inch socket weld half coupling at the low point on the bottom for the attachment of condensate drain piping.

These test sections shall meet the design conditions identified in Section 4.

1.10 Exhaust Fan

The exhaust fan shall be constructed of spark arresting materials. It shall meet AMCA Standard 99-0401-86 and be Type A construction.

The fan shall be a centrifugal type with a steep characteristic operating curve. The fan shall be a CCW upblast, AMCA arrangement eight. The exhaust fan shall be statically and dynamically balanced as an assembly.

All components utilized on the fan that come in contact with the air stream shall be so designed to prevent any form of sparking. The fan shall be designed to be operated in an air stream containing hydrogen gas concentrations of up to 8 percent. The material must also be compatible with the chemical constituents in the air stream per Section 4.

The fan shall have shaft seals that reduce inleakage to a minimum.

Bearings shall be self-aligning type with average L-50 life of 100,000 hours. Bearings and all grease fittings shall be located outside of the air stream.

No electrical devices shall be in the airstream.

The fan shall be sized to move 1000 cfm of air at the design conditions stated in Section 4.

The fan shall be selected to operate on the stable portion of its performance curve at a nominal air flow range of 470 to 1030 cfm. The rating and characteristics of the fan must account for the pressure drops encountered from existing in-place components, loading of HEPA filters, etc. The fan shall be designed for variable speed operation that allows for a constant air volume at changing static and velocity pressure requirements. The primary HEPA filter will be loaded up to 5.4" WG differential pressure at rated flow and the overall HEPA bank will be operated up to a maximum of 5.4" WG differential pressure measured across both filters.

The fan shall be equipped with a factory installed shaft drive. All drive components shall be covered with guards.

The fan shall have a one inch plugged drain connection at the low point on the fan housing to allow the for attachment of condensate drain piping.

1.11 Fan Motor

The fan motor shall be suitable for service at 460 VAC, 3-phase, 60 hertz.

Motor insulation shall be non-hygroscopic and suitable for the service conditions specified for the driven equipment. Motor insulation shall be class F. The temperature rise shall be 40°C (class B). Service factor shall be 1.15. The motor shall be continuous duty UL/Canadian Standard Association approved.

1.12 Exhaust Stack

The stack provides the means to exhaust the filtered air, houses the air velocity probe for measurement of the stack velocity, and houses the air sampling probe.

The exhaust stack shall be constructed of stainless steel. The exhaust stack shall be attached to the fan outlet but shall be supported independently of the exhaust fan. The stack shall be designed to maintain a minimum exhausted air velocity of 2500 fpm with 1000 CFM airflow. There shall be a flexible connection (see Section 5.4.2) between the fan and the stack.

The stack will be approximately ten feet high from the fan outlet and shall be flange connected for easy removal during transportation.

1.13 Condensate Drain and Seal Pot System

The condensate drain and seal pot system provides a drain path and collection point for condensate generated in the system. The condensate shall gravity flow to the tank of origin.

This system shall be designed to drain and capture any condensate located in the filter train system including the HEPA housing, fan housing and stack. The drain system will need to operate effectively at the maximum negative pressure capacity of the fan. The system shall be designed to assure that freezing cannot occur under the design conditions of Section 4.

Seal pot instrumentation requirements shall be as identified in Section 5.16.

The seal pot shall have a drain connection and be designed for total drainage. The filter train cannot be moved with any moisture in the seal pot.

Seal pot drain penetrations into the plenum shall not preclude the installation of test plugs used to isolate the seal pot from the plenum in the high vacuum operating mode.

Drainage piping shall be fabricated from stainless steel material, all welded and flange construction, unless otherwise indicated. Piping materials and construction shall conform to the requirements of ASME B31.3. Individual lines from each drainage point in the system shall be sloped (minimum 1/8"/ft) to the seal pot. The seal pot must be equipped with a fill port, an overflow, and high and low level alarms (see instrumentation, Section 1.16.4).

All piping shall be pressure tested as an assembly with the filter housing.

The drain lines and seal pot shall be heat traced and lagged with insulation having an "R" greater than 3.5.

1.14 Insulation

The exhaust system, including the fan housing and stack, will be insulated to maintain the necessary air temperatures and relative humidity to minimize condensation in the system under the design conditions stated in Section 4.

The insulation shall not interfere with the testing, maintenance, and service of any components or systems.

The insulation shall be protected from the weather and shall meet the design requirements as stated in Section 4.

Insulation shall meet the requirements of the Midwest Insulation Contractors Association (MICA) for materials, design and application.

The insulation material shall have an "R" value of not less than 7 for the ductwork, test sections, and filter housings.

1.15 Electrical Equipment

1.15.1 Service Power

Electrical components shall meet the requirements of NEC (NFPA 70), UL, and NEMA MG-1.

One main service 3-phase, 3-wire, 480 VAC, with a factory installed equipment ground bar, shall be provided in a weatherproof enclosure suitable for outdoor installation. The main ampere rating shall be as required for the total electrical load. The symmetrical short circuit current rating shall be as required to withstand the available fault current at the point of connection.

Dedicated non-ground fault interrupted (non-GFI) circuits shall be provided for the stack monitoring and sampling and control circuits.

The distribution panel board shall be provided with feeder branch circuit breakers with ampere rating sized for the following connected electrical equipment loads.

- a) Exhaust fan
- b) Glycol heater
- c) Glycol recirculation pump
- d) Alarm panel
- e) Mini-power zone supply
- f) One spare circuit breaker
- g) Flammable gas monitor (future)
- h) Generic air sampling system (future)

1.15.2 Alarm Panel

The alarm panel shall provide a LCD readout and local visual (a clear strobe light) annunciation for the following alarm conditions.

- a) High differential pressure alarm across the first HEPA filter
- b) Low differential pressure alarm across the first HEPA filter
- c) High differential pressure alarm across the second HEPA filter
- d) Low differential pressure alarm across the second HEPA filter
- e) High differential pressure across prefilter
- f) High differential pressure across HEPA 1 & 2
- g) Low differential pressure across HEPA 1 & 2
- h) High negative pressure at the exhauster inlet
- i) High or low liquid level at the seal pot
- j) Exhaust fan "not running" annunciation when abnormal condition shut down
- k) Low glycol heater level
- l) Low stack flow
- m) High stack flow
- n) Low plenum temperature
- o) High plenum temperature
- p) Alarms for all interlocks and system problems (SEE TABLE 1)
- q) Rate of change for HEPA filter 1
- r) Rate of change for HEPA filter 2
- s) Rate of change for HEPA filter 1 & 2

The clear strobe light shall be visible in daylight for a minimum distance of 100 yards.

1.15.3 Indicator Location

Fan "on/off" status lights shall be located near the fan start and stop switches.

1.16 Exhauster Instrumentation and Control

The instrumentation and control system's performance shall not be adversely affected by the site and process ambient conditions of Section 4.

The components exposed to a vapor space shall meet IC-2 criteria. All other instrument components will comply with the 1996 NEC. All Safety Class or Safety Significant

(Safety Class 1, 2, or 3) instrumentation shall be capable of 1% accuracy or better. All electrical enclosures shall be purchased as NEMA 3R or better for outdoor use.

1.16.1 Pressure Monitoring

The exhaust system shall be equipped with a differential pressure (DP) system that measures filter performance. The DP transmitters shall be rated as intrinsically safe. Each transmitter shall have dedicated barriers rated for a 24 volt DC loop with a 4 to 20 mA signal. The DP transmitters shall measure the DP across the prefilter, first HEPA filter, second HEPA filter, and first and second HEPA filters. The DP shall be indicated on the control panel with LCD's. The system shall also have interlocks to shutdown the exhaust fan on certain alarm situations. Alarms shall be indicated on a data message display and illuminate a clear strobe light.

1.16.2 Temperature Monitoring

Exhaust temperature monitoring system shall consist of three thermocouples (J Type), one before the heater, one before the first HEPA filter, and one before the exhaust fan inlet. The thermocouples shall be installed in thermowells and connected to the SLC. The thermocouple before the 1st HEPA Filter shall have an interlock (see Interlock Section). On detection of a High Temperature of 200° F and a Low Temperature of 40° F alarms shall be indicated on a data message display and illuminate a clear strobe light.

1.16.3 Stack Monitoring

The exhaust stack shall be equipped with a multi-point flow tube and flow transmitter. The transmitter must have a logic function and transmit a 4 to 20 mA signal to the SLC. On detection of a High flow of 1030 cfm or a Low flow of 470 cfm alarms shall be indicated on a data message display and illuminate a clear strobe light.

The stack flow transmitter system shall have a limit alarm relay to convert a 4 to 20 mA signal into dry contact for the Safety Class 1 cabinet (provided by others).

1.16.4 Liquid Monitoring

A liquid level control system using an on-off conductance actuated liquid level control shall be required at the seal pot.

The seal pot shall have a level transmitter. This transmitter shall feed a 4 to 20 mA signal to the SLC. The seal pot system will be equipped with a Low liquid level 30% and High liquid level 65% of the seal pot liquid volume alarms. The liquid level shall be indicated on the control panel LCD and have latching visual alarms.

1.16.5 Programmable Logic Controller

The exhauster control system shall be a small logic controller (SLC), which will provide a 24-volt DC power supply, expandable I/O slots and contain a serial communications port. The SLC shall be compatible with the Salt Well Pump Skid, as required by the Interim Stabilization Program. This system will require a memory of 12K. The function of this control system will be to operate the exhaust fan and alert personnel of alarm situations. All alarms shall read out on a data message display. The control system shall have interlocks to shutdown the exhaust fan on certain alarm situations. See interlocks.

The SLC/programming shall include an interface with the LAN system for data logging the fan start and stop times, total flow to date, CFM, log all alarms received, date and time alarms are received and reset, HEPA filter DP's, plenum temperatures, seal pot level, glycol level, plenum pressure, and be capable of a remote emergency stop of the exhauster.

Variable speed control shall be compatible with the SLC.

1.16.6 Common Interlocks - Set points

The HEPA Filter DP interlocks will consist of a Low DP, and High High DP on the 1st and 2nd HEPA filters and across both HEPA Filters. They will be shared by all three operating modes regardless of flow rate or plenum vacuum with respect to atmosphere. The Low DP shall be set at 0.1 in. WG. The High High DP on the 1st HEPA filter shall be set at 5.4 in. WG, on the 2nd HEPA filter the High High DP shall be set at 3.7 in. WG, and on the High High DP across both HEPA filters set at 5.4 in. WG. The exhauster shall shutdown when receiving a Low DP or High High DP. The only exclusion to the DP is during the initial start up of the system.

On start up of the system there will be a 10 second time delay allowing the system to clear the Low DP condition.

The temperature interlock will consist of a High Temperature set at 190°F. On detection of a high temperature the heater will shutdown. Alarms shall be indicated on a data message display and illuminate a clear strobe light.

The seal pot interlock will consist of low and high seal pot liquid levels set at 30% and 80% of the seal pot volume respectively. On detection of liquid levels outside the operating parameters, the exhauster fan will be shutdown. When in the high vacuum operating mode, seal pot levels are not applicable.

See TABLE 1 for a listing of setpoints for each of the operating modes.

1.16.7 Other

The glycol heater control system shall be within the control cabinet. The heater power shall be interlocked to prevent over heating of the HEPA filters (see interlocks).

Heat Trace shall be individual for each of the condensate lines and have a light indicating heat trace is operational.

The Control Panel shall have multiple indicators (DP's, CFM, Temperatures, etc.) a start stop station equipped with indication lights and a message view indicator. The interior of the control cabinet shall be controlled to maintain an internal temperature between 40°F and 140°F.

The Intrinsic Cabinet shall be controlled to maintain an internal temperature between 40°F and 140°F.

TABLE 1
SET POINTS

| FC = FLOW CONTROL | | | |
|-----------------------------------|------------------|---------------------------|------------|
| PC = PRESSURE CONTROL | | | |
| HV = HIGH VACUUM | | | |
| CONTROL TYPE | ALARM/ INTERLOCK | MESSAGE VIEW | SET POINT |
| HV | ALARM | INLET VACUUM LO | 6 INWC |
| HV | INTERLOCK | INLET VACUUM HI | 19.5 INWC |
| HV | ALARM | STACK FLOW HI | 1000 SCFM |
| HV | ALARM | STACK FLOW LO | 675 SCFM |
| | | | |
| PC | ALARM | INLET VACUUM LO | 6 INWC |
| PC | INTERLOCK | INLET VACUUM HI | 12.75 INWC |
| PC | INTERLOCK | STACK FLOW HI | 1000 SCFM |
| PC | ALARM | STACK FLOW LO | 675 SCFM |
| | | | |
| FC | INTERLOCK | PLENUM VACUUM 1 HI | 3.5 INWC |
| FC | INTERLOCK | PLENUM 1 PRESSURE HI | 5.0 INWC |
| FC | INTERLOCK | STACK FLOW HI | 1100 SCFM |
| FC | INTERLOCK | STACK FLOW LO | 470 SCFM |
| | | | |
| ALL | INTERLOCK | FILTER 1 DP HIHI | 5.4 INWC |
| ALL | ALARM | FILTER 1 DP HI | 4.5 INWC |
| ALL | INTERLOCK | FILTER 1 DP LO | 0.1 INWC |
| ALL | INTERLOCK | FILTER 1 DP ROC | 0.5 LOGIC |
| | | | |
| ALL | INTERLOCK | FILTER 2 DP HIHI | 3.7 INWC |
| ALL | ALARM | FILTER 2 DP HI | 3.2 INWC |
| ALL | INTERLOCK | FILTER 2 DP LO | 0.1 INWC |
| ALL | INTERLOCK | FILTER 2 DP ROC | 0.5 LOGIC |
| | | | |
| ALL | INTERLOCK | FILTER 1 & 2 DP HIHI | 5.4 INWC |
| ALL | INTERLOCK | FILTER 1 & 2 DP LO | 4.5 INWC |
| | | | |
| FC, PC * | INTERLOCK | SEAL POT LEVEL LO | 30% |
| FC, PC | INTERLOCK | SEAL POT LEVEL HI | 80% |
| | | | |
| ALL | **ALARM | GLYCOL LEVEL LO | 50% |
| | | | |
| ALL | ***ALARM | HEATER AIR TEMPERATURE HI | 190 F |
| ALL | ALARM | HEATER TEMPERATURE LO | 40 F |
| | | | |
| * NOT APPLICABLE FOR HIGH VACUUM | | | |
| ** GLYCOL PUMP & HEATER SHUT DOWN | | | |
| *** SHUTS DOWN HEATER | | | |

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