S

CH2M HILL ENGINEERING CHANGE NOTICE

☒ DM ☐ FM ☐ TM

1a. **ECN** 722818 **R** 0

1b. **Proj. ECN** N/A - - R

2. **Simple Modification** ☒ Yes ☐ No	3. **Design Inputs** – For full ECNs, record information on the ECN-1 Form (not required for Simple Modifications)		4. **Date** 1/19/05
5. **Originator's Name, Organization, MSIN, & Phone No.** Owen Nelson, 7G330, R3-25, 3-1610		6. **USQ Number** No. - - - R - ☒ N/A	7. **Related ECNs** N/A
8. **Title** Specification for a Primary Exhaust System For Waste Tank Ventilation	9. **Bldg. / Facility No.** 241-C	10. **Equipment / Component ID** POR-126/127	11. **Approval Designator** ESQR
12. **Engineering Documents/Drawings to be Changed** (Incl. Sheet & Rev. Nos.) RPP-21568 Rev. 0		13. **Safety Designation** ☐ SC ☐ SS ☐ GS ☒ N/A	14. **Expedited/Off-Shift ECN?** ☐ Yes ☒ No
15a. **Work Package Number** N/A	15b. **Modification Work Completed** N/A (Responsible Engineer / Date)	15c. **Restored to Original Status (TM)** N/A (Responsible Engineer / Date)	16. **Fabrication Support ECN?** ☐ Yes ☒ No

17. **Description of the Change** (Use ECN Continuation pages as needed)

Details of changes:

Section 3.2.9 (Electrical Grounding).

Was: all ducts joints using non-conductive gasket material shall have grounding jumpers provided across the connection.

Is: Verbiage deleted.

Design Change Summary:

This requirement is not necessary since an existing path for conductivity already exists in the design. The bolts are ASTM A193 Gr B8 (stainless). Nuts are ASTM A194 Gr 8F (Stainless). The washers are 18-8 stainless. The flanges are ASTM A182 Gr F 304L (stainless). Conductivity continuity will be maintained through joints by like materials.

18. **Justification of the Change** (Use ECN Continuation pages as needed)

The Justification for each change is explained in the specific item Design Change Summary, sheets 3 through 9.

Note: These documents do not implement any permanent or temporary changes to the facility or procdures. The USQ process, therefore, is not applicable.

19. **ECN Category**

☒ **Direct Revision**
☐ **Supplemental**
☐ **Void/Cancel**

ECN Type

☐ **Supercedure**
☐ **Revision**

20. **Distribution**

Name	MSIN	Name	MSIN
B. Zuroff	S7-67	W. T. Thompson	S7-66
O.D. Nelson	R3-25	A CH2M EQRG	
J.G. Propson	S7-70		
T.L. Bennington	R3-25		
R. L. Brown	S7-75		
S.D. Doss	S7-03		
T.R. Farris	S7-24		

Release Stamp

MAR 0 8 2005
DATE: HANFORD RELEASE
STA: 4 ID: 8

CH2M HILL ENGINEERING CHANGE NOTICE	1a. **ECN** 722818 **R** 0
Page 2 of 9 ☒ **DM** ☐ **FM** ☐ **TM**	1b. **Proj. ECN** N/A - - R

21. Revisions Planned (Include a brief description of the contents of each revision)

None

Note: All revisions shall have the approvals of the affected organizations as identified in block 11 "Approval Designator," on page 1 of this ECN.

22. Design Basis Documents

☒ **Yes** ☐ **No**

23. Commercial Grade Item Dedication Numbers (associated with this design change)

N/A

24. Engineering Data Transmittal Numbers (associated with this design change, e.g., new drawings, new documents)

EDT-820920

25. Other Non Engineering (not in HDCS) documents that need to be modified due to this change

Type of Document	Document Number	Update Completed On	Responsible Engineer (print/sign and date)
Alarm Response Procedure	N/A	N/A	N/A
Operations Procedure	N/A	N/A	N/A
Maintenance Procedure	N/A	N/A	N/A
Type of Document	Document Number	Type of Document	Document Number
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

26. Field Change Notice(s) Used?

☐ **Yes** ☒ **No**

If Yes, Record Information on the ECN-2 Form, attach form(s), include a description of the interim resolution on ECN Page 1, block 17, and identify permanent changes.

NOTE: ECNs are required to record and approve all FCNs issued. If the FCNs have not changed the original design media then they are just incorporated into the design media via an ECN. If the FCN did change the original design media then the ECN will include the necessary engineering changes to the original design media.

27. Design Verification Required?

☐ **Yes** ☒ **No**

If Yes, as a minimum attach the one page checklist from TFC-ENG-DESIGN-P-17.

28. Approvals

Facility/Project Signatures		Date	A/E Signatures		Date
Design Authority	~~B. Zuroff~~ E W GIRGIS	3-4-05	Originator/Design Agent	O.D. Nelson	3/8/05 3/4/05
Resp. Engineer	J.G. Propson	3-4-05	Professional Engineer	N/A	
Resp. Manager	W. T. Thompson	3/4/05	Project Engineer	N/A	
Quality Assurance	T.L. Bennington	3-4-5	Quality Assurance	N/A	
IS&H Engineer	R.E. Butler	3-4-05	Safety	N/A	
NS&L Engineer	N/A		Designer	N/A	
Environ. Engineer	S.D. Doss	3-4-05	Environ. Engineer	N/A	
Engineering Checker			Other	N/A	
Other	System Engineer: T.R. Farris	3-3-05	Other	N/A	
Other	Rad Con: R. L. Brown	3-4-05	DEPARTMENT OF ENERGY / OFFICE OF RIVER PROTECTION		
Other			Signature or a Control Number that tracks the Approval Signature		
Other			N/A		
Other			ADDITIONAL SIGNATURES		
Other			N/A		
Other			N/A		

Document/Drawing No. RPP-21568 Sheet N/A Revision 0

17. Description of the Change Cont.

Section 3.3.2.9 (Isolation Valves).

Was: Stem packing shall be Teflon and the resilient seat shall be Buna-N.

Is: Stem packing shall be Teflon and the resilient seat shall be EPDM.

Design Change Summary:

Per Section 3.2.5.1 of RPP-21568 Rev. 0, the minimum ambient air temperature is -32 degrees F. Per the valve manufactures data sheets, Buna-N gasket is only rated to 0 degrees F. However, EPDM is rated to -40 degrees F. In order to meet this requirement, EPDM is required

Section 3.3.2.9 (Isolation Valves).

Was: Isolation valves shall meet the design requirements of ASME B31.3.

Is: Isolation valves shall meet the design requirements of ASME B31.1.

Design Change Summary:

Per the requirements of RPP-19233 Rev. 0 (General WAC 246-247 Technology Standards Exemptions for Waste Tank Ventilation Systems) Section 4.4.3 (Section DA, Dampers and Louvers), the applicable code is ASME B31.1.

Section 3.3.2.13 (Condensate Drain and Seal Pot System) a) .

Was: The system shall be designed to drain and capture any condensate located in the heater housing, the filter train assembly, or the fan housing to the buyer's waste tank(s) or collection tank/system (as determined by the buyer) located at the Hanford site. The condensate shall be returned to the tank/collection point by use of either a gravity drain or condensate pump. The drain system will need to operate effectively at the maximum negative pressure capacity of the fan. Individual lines from each drainage point in the system shall be sloped a minimum of 1/8" per foot to the seal pot.

Is: The system shall be designed to drain and capture any condensate located in the heater housing, the filter train assembly, or the fan housing to the buyer's waste tank(s) or collection tank/system (as determined by the buyer) located at the Hanford site. The condensate shall be returned to the tank/collection point by use of either a gravity drain or condensate pump. Electrical power for the condensate pump will be provided by an off skid source. The drain system will need to operate effectively at the maximum negative pressure capacity of the fan. Individual lines from each drainage point in the system shall be sloped a minimum of 1/8" per foot to the seal pot.

Design Change Summary:

The condensate pump is being powered by an off-skid source through a hardwired relay. This off skid branch circuit is connected directly to the condensate pump. The condensate pump will be controlled by the exhauster PLC. The existing 120VAC power system does not have the capacity to supply power to the condensate pump.
The system engineer concurred with this approach.

Document/Drawing No. RPP-21568 Sheet N/A Revision 0

17. Description of the Change cont.

Section 3.3.2.13 (Condensate Drain and Seal Pot System) e).

Was: The seal pot piping materials and construction shall conform to the requirements of ASME B31.3, Chapter III. The piping shall be ASTM A 312, Grade TP 304L and fittings shall be ASTM A 403, Class WP 304L. All piping shall be pressure tested in accordance with ASME B31.3 as an assembly with the filter housing.

Is: The seal pot piping materials and construction shall conform to the requirements of ASME B31.3, Chapter III. The piping shall be ASTM A 312, Grade TP 304L and fittings shall be ASTM A 403, Class WP 304L. All piping shall be pressure tested in accordance with methods of ASME B31.3 as an assembly with the filter housing at an pneumatic test pressure of 2 psig.

Design Change Summary:

ASME B31.3 requires a test pressure of 15 psig. This is a pressure the condensate drain and seal pot system will never achieve. Maximum pressure this system could possibly encounter would be the maximum fan static pressure of @ 30" of water. A test pressure of 2 psig was selected as a reasonable test pressure per engineering judgment.

Section 3.3.3.1 (Service Power).

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

Is: Deleted verbiage

Design Change Summary:

In order to meet the requirements of UL-508 as required in Section 3.3.3.6 (Wiring Practices and Electrical Safety Requirements), "Dedicated non-grounding fault interrupted circuits being deleted" are not allowed.

Section 3.3.3.1 (Service Power).

Was: Seller shall provide calculations for and appropriately label electrical components (disconnects, etc.) with arc flash hazard potentials.

Is: Deleted verbiage

Design Change Summary:

CHG will be providing the calculations and determining labeling requirements for the flash hazard. CHG had been waiting for the electrical design for the power system which will provide electricity to the exhausters to be completed. This is required to determine the electrical potential that will be available. An A/E is providing the design for the electrical power to the exhausters.

Section 3.3.3.2 (Mini-Power Zone).

Was: Capacity shall be included in mini-power zone to power additional customer-installed exhauster-to-tank(s) heat trace lines, approximately 300 feet worth (assume same power rating as other exhauster heat trace).

Is: Deleted verbiage

Design Change Summary:

The existing exhauster 120VAC power system does not have the capacity to supply power to trace external to the exhauster. Power to supply the farm trace heat will be provided by a new farm electrical system, not the exhauster power distribution system.

Document/Drawing No. RPP-21568 Sheet N/A Revision 0

17. Description of the Change Cont.

Section 3.3.3.5 (Cabinet Temperature Control)

Was: Heating and cooling components shall be powered with DC voltage. Thermostats shall be rated for outdoor use and mounted externally for temperature changes made without opening cabinets. In addition, external cabinet temperatures shall be displayed.

Is: The sample cabinet shall include the following: 1) Cooling fan shall be powered with DC voltage; 2) Thermostats shall be rated for outdoor use and mounted externally for temperature changes made without opening cabinets; and 3) internal cabinet temperature shall be displayed on the outside of the cabinet.

Design Change Summary:

Clarification of information

Section 3.3.4.1 (Pressure Monitoring)

Was: The system shall also have interlocks to shutdown the exhaust fan on certain abnormal tank pressure situations.

Is: Deleted verbiage

Design Change Summary:

This requirement was removed since vacuum relief devices will be installed at each tank. The vacuum relief devices will be the first line of defense for tank pressure / vacuum abnormalities.

Section 3.3.4.3 (Stack Monitoring)

WAS: The exhaust stack monitoring system in compliance with 40 CFR 61.93 (b)(1)(i), 40 CFR 61.93 (b)(1)(ii), 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities" and 40 CFR 52 Appendix E, "Protection of Environment".

Is: The exhaust stack monitoring system in compliance with 40 CFR 61.93 (b)(1)(i), 40 CFR 61.93 (b)(1)(ii), 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities" and 40 CFR 52 Appendix E, "Protection of Environment". Compliance with these requirements may be shown with data from the W-314 exhausters.

Design Change Summary:

Stack sampling system identical to W-314 design. W-314 design was designed and tested to 40 CFR 52 Appendix E. Requalification of stack is not required.

Note: An AutoCAD page may be used in place of this form (the header section items must be included on the AutoCAD page).

Document/Drawing No. RPP-21568 Sheet N/A Revision 0

17. Description of the Change Cont.

Section 3.3.4.3 (Stack Monitoring) a) Sample Collection System

Was: The sample collection system shall be designed to operate in a pH range of 10-14, RH of 85% (or optionally use a sample line air dryer if other system components cannot meet humidity requirement), and a temperature range of 27 to 75 °C (80 to 167 °F).

Is: The sample collection system shall be designed to operate in a pH range of 10-14, RH of 85% (or optionally use a sample line air dryer if other system components cannot meet humidity requirement), and a temperature range of 27 to 48 °C (80 to 120 °F).

Design Change Summary:

The original design for the 241-C and W-314 exhausters required the use of a new design from Eberline for a high temperature (167 degrees F). The 167 degrees F requirement is only valid in Double shell tanks with multiple mixer pumps running for an extended (months) period of time. CAM detector head. Unfortunately, while W-314 was trying to qualify these heads at PNNL, they failed to pass qualification testing. The 241-C exhauster procurement specification also had CAM temperature requirements for the high temperature CAMs. Since these CAMs are not available, the decision was made to use the standard AMS-4 CAM system for testing and initial operations. These CAMs have a operational upper limit of 122 degrees F.

Section 3.3.4.3 (Stack Monitoring) f) Data Collection/Storage Capability.

Was: The PLC will interface with the LAN system to store the rates and totals for historical reference.

Is: Deleted verbiage

Basis: This design feature is not required by SST engineering.

Section 3.3.4.3 (Stack Monitoring) g) Vacuum System

Was: The vacuum pumps and associated equipment shall be mounted in an environmentally controlled cabinet. The cabinet shall be insulated (see Section 3.3.2.14) and its vents shall be easily closeable (e.g., sliding doors/louvers) in winter months.

Is: Deleted verbiage

Design Change Summary:

This requirement is not required since the vacuum pumps and associated equipment are rated for outdoor use.

Section 3.3.4.4 (Liquid Monitoring)

Was: The transmitters shall be a discrete signal switch type with 2 adjustable positions for the glycol heater transmitter (high and low level) and 5 adjustable positions for the seal pot transmitter (high, high-high, pump control, low, low-low level).

Is: Deleted verbiage

Design Change Summary:

This was a design feature that was desired for the new 241-C exhausters based upon experience with existing portable exhausters. Unfortunately, an instrument does not exist that will perform these functions in the specified environment.

Document/Drawing No. RPP-21568 Sheet N/A Revision 0

17. Description of the Change Cont.

Section 3.3.4.5 (Programmable Logic Controller).

Was: Separate power supplies shall be provided for the sample system and the loop power required by the pressure transmitters.

Is: Deleted verbiage

Design Change Summary:

Initially, this was a desired design feature imposed upon the new 241-C exhausters. Subsequently, a decision was made not to modify the existing exhauster electrical design. The system engineer concurred with this approach.

Section 3.3.5.4 (Welding Procedures and Qualifications)

Was: The seller shall submit copies of all welding procedures, procedure qualification records, and welder qualification records to be employed in the performance of this purchase order.

Is: The seller shall submit copies of all welding procedures, procedure qualification records required for the performance of this purchase order.

Design Change Summary:

Welding and NDE procedures were submitted and approved by CHG QA and a CHG welding engineer. Premier requested that welder qualification records not be submitted to CHG due to the number of welders that might work on the exhausters. CHG QA concurred, but instituted a QAIP (Quality Assurance Inspect Plan) that had AVS verify welder qualifications at various times during fabrication. Fabrication is complete and all welder qualifications were found acceptable and documented per the CHG QAIP.

Section 4.1.2 (Rotating Equipment Balancing and Vibration Criteria).

Was: When vibration readings are taken, the exhauster shall be bolted to a level/flat concrete pad free of major cracks in order to simulate installation conditions at the Hanford site.

Is: When vibration readings are taken, the exhauster shall be placed on a concrete pad free of major cracks.

Design Change Summary:

This will produce the most extreme vibration condition and will bound the vibration testing.

Section 4.1.3 (Filter Housing Testing) e).

Was: HEPA filter element holding frames at each filter position shall be pressure decay leak tested in accordance with the requirements of ASME AG-1, Table SA-B-1310. The leak rate shall not exceed 0.6% (Basis: RPP-16920) of the rated flow adjusted for section area (per ASME AG-1, Table SA-B-1310, Note 1).

Is: e) HEPA filter element holding frames at each filter position shall be pressure decay leak tested. The leak rate shall not exceed 0.1% of the housing volume per hour at the system leak test pressure as defined in ASME N509, Section 4.6.4.

Design Change Summary:

The leak rate of 0.6% was not correct. This leak rate was calculated per the housing volume as shown in RPP-16920. The housing volume in RPP-16920 is smaller than the 241-C exhausters. Per TFC-ENG-STD-07, REV C, section 3.3.5.4 (Inspection and Testing), "The leak rate shall not exceed 0.1% of the housing volume per hour at the system leak test pressure as defined in ASME N509, Section 4.6.4.".

Note: An AutoCAD page may be used in place of this form (the header section items must be included on the AutoCAD page).

Document/Drawing No. RPP-21568 Sheet N/A Revision 0

17. Description of the Change Cont.

Section 4.1.3 (Filter Housing Testing) f).

Was: The filter train, drain piping, and seal pot shall be pressure decay leak tested before pre-filter and HEPA filters are installed. Test shall be conducted to meet the requirements of ASME AG-1, Table SA-B-1310. The leak rate shall not exceed 0.6% (Basis: RPP-16920) of the rated flow adjusted for section area (per ASME AG-1, Table SA-B-1310, Note 1)

Is: The filter train, drain piping, and seal pot shall be pressure decay leak tested before pre-filter and HEPA filters are installed. The leak rate shall not exceed 0.1% of the housing volume per hour at the system leak test pressure as defined in ASME N509, Section 4.6.4.

Design Change Summary:

The leak rate of 0.6% was not correct. This leak rate was calculated per the housing volume as shown in RPP-16920. The housing volume in RPP-16920 is smaller than the 241-C exhausters. Per TFC-ENG-STD-07, REV C, section 3.3.5.4 (Inspection and Testing), "The leak rate shall not exceed 0.1% of the housing volume per hour at the system leak test pressure as defined in ASME N509, Section 4.6.4.".

Table 5-1 Definitive Design Report Documentation, Drawings.

Was: Requirement for P&ID drawings.

Is: Deleted verbiage

Design Change Summary:

During the early stages of the ventilation design and fabrication effort, two copies of the P&ID were being maintained. A decision was made to update the CH2M Hill P&ID drawing set relinquishing the fabrication vendor from having to supply them. TFC-ENG-STD-10, REV.A-3 " Drawing Standard" addresses uniform drawing symbology. This standard will be in effect for the life cycle of this drawing set.

Section 5.6.6.3 (Piping and Instrumentation Diagrams).

Was: All instruments and devices shall be shown symbolically and identified by letters that are found in ISA 5.1, section 3. Show all instrumentation on the P&ID. The P&ID shall define and show in schematic form the piping, equipment and instrumentation adequately for subsequent engineering design modifications and operation. The object of the P&ID is to provide sufficient information on all process and service lines, equipment, instruments, and controls. P&ID drawings shall be in accordance with buyer-supplied procedures, as well as the following guidelines:

P&ID Drafting Guidelines

- Crossing lines must not touch. If possible, break lines in the vertical direction only.
- Break instrument lines crossing process and service lines.
- Keep parallel lines at least ¼ inch apart.
- Instrument supply or signal lines entering or leaving the P&ID are noted by hollow arrows.
- Draw instrument identification balloons 9/16-inch diameter. For P&ID line type symbols see ISA 5.1.

Is: Deleted verbiage

Design Change Summary:

During the early stages of the ventilation design and fabrication effort, two copies of the P&ID were being maintained. A decision was made to update the CH2M Hill P&ID drawing set relinquishing the fabrication vendor from having to supply them. TFC-ENG-STD-10, REV.A-3 " Drawing Standard" addresses uniform drawing symbology. This standard will be in effect for the life cycle of this drawing set.

Document/Drawing No. RPP-21568 Sheet N/A Revision 0

17. Description of the Change Cont.

Table 5-2 Deliverables and Schedule, Item 16.

Was: "and welder/welding operator qualification test records".

Is: Removed verbiage

Design Change Summary:

Welding and NDE procedures were submitted and approved by CHG QA and a CHG welding engineer. Premier requested that welder qualification records not be submitted to CHG due to the number of welders that might work on the exhausters. CHG QA concurred, but instituted a QAIP (Quality Assurance Inspect Plan) that had AVS verify welder qualifications at various times during fabrication. Fabrication is complete and all welder qualifications were found acceptable and documented per the CHG QAIP.

Table 5-2 Deliverables and Schedule, Items 21, 22, 24, 25, 26, 27, 28, 29, 30 and 31

Was: 2 weeks prior to shipment

Is: Prior to final acceptance

Design Change Summary:

Due to similarity between W-314 exhausters and these exhausters.

Table 5-2 Deliverables and Schedule, Item 23.

Was: Piping and Instrument Diagram

Is: Deleted

Design Change Summary:

During the early stages of the ventilation design and fabrication effort, two copies of the P&ID were being maintained. A decision was made to update the CH2M Hill P&ID drawing set relinquishing the fabrication vendor from having to supply them. TFC-ENG-STD-10, REV.A-3 " Drawing Standard" addresses uniform drawing symbology. This standard will be in effect for the life cycle of this drawing set.

4.1.4 EXHAUST FAN AND EXHAUST TRAIN FLOW TESTING, SECTIONS A) CLEAN SYSTEM AIR FLOW, B) MAXIMUM HOUSING COMPONENT PRESSURE DROP AIRFLOW AND C) ZERO AIRFLOW TEST

WAS: Record vibration data on the fan shaft bearings in all three planes (horizontal, vertical and axial) – acceptance criteria, less than 0.1 IPS peak velocity filtered to the fans fundamental frequency (x1 rpm) and less than 0.25 IPS peak velocity unfiltered (overall).

IS: Record vibration data on the fan shaft bearings in all three planes (horizontal, vertical and axial) – acceptance criteria, have less than 0.25 IPS peak velocity unfiltered (overall).

Design Change Summary:
The acceptance criteria of the fan vibration is based on AMCA 204-96 for in-situ testing of BV-3 rigidity mounted fans. The acceptance criteria is 0.25 IPS (filter out). This in accordance with RPP-19233, *General WAC 246-247 Technology Standards Exemption Justifications for Waste Tank Ventilation Systems,* Table C-2.

5.6.6 SUBMITTALS REQUIRED FOR CONTRACT COMPLETION

WAS: The seller shall notify the buyer three weeks before the intended shipping date, and shall allow the buyer one week after receiving the package, and before shipment, to review the data package.

IS: Deleted.

Design Change Summary: Due to similarity between W-314 exhausters and these exhausters. The justification relates to Table 5-2

Note: An AutoCAD page may be used in place of this form (the header section items must be included on the AutoCAD page).

Specification for a Primary Exhaust System for Waste Tank Ventilation

Owen D. Nelson
CH2M Hill
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-99RL14047

EDT/ECN: ECN 722818 -RO UC:
Cost Center: Charge Code:
B&R Code: Total Pages: 104

Key Words: Exhauster Procurement Specification
241-C Farm Portable Exhaust Skid Procurement Specification

Abstract: Exhaust Skid for C-Farm
Procurment specification for POREX 126 & 127 Exhausters

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[redacted] MAR 0 8 2005
DATE:
HANFORD RELEASE
STA: 4
ID: 8

Release Approval — Date 3-8-05 — Release Stamp

Approved For Public Release

Tank Farm Contractor (TFC) **RECORD OF REVISION**	(1) Document Number RPP-21568	Page 1

(2) Title
Specification for a Primary Exhaust System for Waste Tank Ventilation

Change Control Record

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release	
		(5) Resp. Engr. (print/sign/date)	(6) Resp. Mgr. (print/sign/date)
RS 1	Direct Revision Per ECN 722818	Owen D. Nelson See ECN signature sheet.	Warren T. Thompson WT Th 3/9/05

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SPECIFICATION FOR A PRIMARY EXHAUSTER SYSTEM FOR WASTE TANK VENTILATION

1.0 INTRODUCTION

1.1 SCOPE

This specification covers the technical requirements for the design, fabrication, testing, delivery and supporting documentation of a skid mounted exhauster system planned for use in the 241-C tank farm to ventilate all or selected 100-Series tanks. This document also contains the project management and deliverable data requirements for this exhauster system.

Note that the ventilation system for 241-C tank farm may also include, if determined necessary, moisture deentrainers, tank vacuum controllers, and tank air flow controllers. Such items, if required, will be external to the exhauster skid system and are therefore not included within the scope of this specification. Separate requirements will be developed for those items as needed.

1.2 BACKGROUND

Since 1943, large underground steel-lined concrete storage tanks have been used on the Hanford Site in Richland, Washington, to store byproducts of plutonium production. The tank ventilation systems play a key role in being able to store this waste safely. These exhauster systems will be used to ventilate waste tanks in order to contain and control radioactive emissions to the environment, maintain flammable gas levels within applicable limits, and support retrieval activities during waste feed delivery and treatment.

The exhauster will be connected to each tank utilizing new tank farm ductwork. Before the tank vapor space air can be discharged to the atmosphere, it must be filtered through two stages of high efficiency particulate air (HEPA) filters. These HEPA filters and their housings, together with a suitable exhaust fan and stack, form the major components of the exhauster. The HEPA filters must be protected from entrained moisture, high humidity and from loading by dust. Therefore, the air entering the system must be heated (and monitored) to lower the relative humidity, and then pre-filtered before entering the first stage of HEPA filtration. Both stages of HEPA filters must be capable of being tested-in-place per ASME AG-1/N509/N510, to ensure that the desired efficiency is maintained. The pressure drop across major components in the air stream must also be monitored. The flow of air leaving the exhauster must be monitored and the system must be designed to be capable of maintaining nearly constant flow as the HEPA filters load

with particulate and/or as the pressure in the tank vapor space fluctuates. Instrumentation will be installed for monitoring and sampling the exhaust gas for radionuclides.

1.3 SPECIFICATION APPROACH

This specification deals with the construction of an exhauster skid system. The buyer has identified specific electrical and control interface items to assure commonality in operator training and maintenance with existing exhausters currently in use at Hanford. The seller is to perform analysis to assure that the components, parts, and assembly requirements specified in this specification meet all design and code requirements.

Those pieces of equipment identified by manufacturer, model number, etc., within the specification shall be furnished as specified, if available. If not available, the buyer shall be notified and a reasonable substitute will be mutually agreed upon. The seller is free to select the component suppliers and specific characteristics of those items not directly specified.

The buyer will supply to the seller the computer program used to control the exhauster. Once fabrication is complete, the seller shall perform testing as outlined in this specification using the supplied computer program. The buyer or buyer's representative shall be present to witness the performance of the testing required by this specification.

Drawings provided in the appendices of this specification are intended to provide supplemental direction to assist the seller in understanding the overall scope and design attributes of the equipment assemblies required by this specification. These drawings are not intended to depict the final configuration. As-built drawings of a previously constructed exhauster system (for Project W-314) nearly identical to the exhauster system specified herein, are available upon request and should also be used by the seller to fully understand the scope of the equipment assemblies required by this specification. It should be noted that these drawings depict a "dual train" exhauster system consisting of two mirror image exhauster units, whereas the system required by this specification is a single train unit. There are other minor changes to equipment and instrumentation as well, provided in the text sections of this specification. In any case, the drawings included in the appendices of this specification will NOT be updated during the design and fabrication of the exhauster units built to this specification. Instead, any and all changes will be formally communicated between the seller and buyer, and the seller will maintain configuration control of the appropriate drawing sets (i.e., drawings created from the appendices of this specification or from the prior as-built drawings) during design and fabrication as required by Section 5.7. Post-fabrication as-built drawings will be provided by the seller as required by this specification.

2.0 APPLICABLE DOCUMENTS

The following codes and standards, including documents referenced therein, form a part of the Basis of Design as specified in the applicable sections of this document. The most current revisions shall be used. In the event of conflict between documents referenced herein and the requirements of this specification, the requirements of this specification shall take precedence. Exceptions to any of these codes/standards or any portion(s) thereof shall be allowed only as provided and approved by the buyer.

2.1 NATIONAL CODES AND STANDARDS

ASCE 7-02	Minimum Design Load for Building and Other Structures
AISC 316/317	Manual of Steel Construction
AISI SG503	Design and Fabrication of Cold-Formed Steel Structures
AMCA 99	Standards Handbook, Publication 99
ANSI B16.5a-1998	Pipe Flanges and Flanged Fittings
ANSI N13.1-1999	Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities
ANSI Y14.1-1995	American National Standard Drawing Sheet Size and Format
ANSI Y14.5M-1994	Dimensioning and Tolerancing
ANST-SNT-TC-1A	American Society for Non-Destructive Testing
ASME B31.3-2002	Process Piping
ASME, SEC II, Part C-2003	Weld Filler Material
ASME, BPVC, SEC IX-2003	Welding and Brazing Qualifications
ASME N509-2002	Nuclear Power Plant Air Cleaning Units and Components
ASME N510-1991	Testing of Nuclear Air Treatment Systems

ASME AG-1-2003	Code on Nuclear Air and Gas Treatment
ASME NQA-1-2000	Quality Assurance Program Requirements for Nuclear Facilities
ASTM A182-2004	Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A240-2004	Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A312-2004	Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A36-2004	Standard Specification for Carbon Structural Steel
ASTM A403-2004	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ANSI/ABMA 11-1999	Load Ratings and Fatigue Life for Roller Bearings
AWS D1.1-2004	Structural Welding Code
AWS D1.2-2003	Structural Welding Code - Aluminum
AWS D1.3-1998	Structural Welding Code - Sheet Steel
AWS D9.1-2000	Specification for the Welding of Sheet metal
AWS QC-1-1996	Standard and Guide for Qualification & Certification of Welding Inspectors
DOE-RL-92-36	Hanford Site Hoisting and Rigging Manual
DOE-STD-1020	Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities
ERDA 76-21	Nuclear Air Cleaning Handbook
IEEE 112-1996	Test Procedure for Polyphase Induction Motors and Generators
ISA 5.4-1991	Instrument Loop diagrams

ISA 5.1-1992	Instrumentation Symbols and Identifications
ISO-1940-1-2004	Mechanical Vibration - Balance Quality Requirements of Rigid Rotors
MICA	Midwest Insulation Contractors Association
MIL-STD-889B	Dissimilar Metals
MIL-STD-1472F	Human Engineering
NCIG-01	Visual Weld Acceptance Criteria for Structural Welding at Nuclear Power Plants
NEMA MG-1-2003	Motors and Generators
NFPA 70-2003	National Electrical Code
NFPA 77-2002	Recommended Practice on Static Electricity
NFPA 79-2002	Electrical Standard for Industrial Machinery
NUREG 0700	The Human-System Interface Design Review Guideline
SMACNA 1481-1997	HVAC Duct Construction Standards Metal and Flexible
SNT-TC-1A-2001	ASNT's Guideline to Personnel Qualification and Certification in NDT
SSPC SP 3-2000	Power Tool Cleaning
UL 508-2003	UL Standard for Safety Industrial Control Equipment Seventeenth Edition
40CFR52	Protection of Environment
40CFR60 Method 1, 1A, 2, 2C	Sampler Location and Placement Design Criteria
40CFR61	National Emission Standards for Hazardous Air Pollutants

3.0 REQUIREMENTS

3.1 ITEM DEFINITION

3.1.1 MAJOR SYSTEM COMPONENTS

The major components of the exhauster are:

- Support Skid
- Ductwork
- Isolation Valves
- Heater System
- Filter Train Assembly
- Exhaust Fan and Motor
- Stack
- Condensate Drain and Seal Pot System
- Power Distribution System
- Instrumentation and Controls

3.1.2 INTERFACE DEFINITION

The seller's design shall incorporate the capabilities to accommodate all interface requirements as defined below:

3.1.2.1 Airstream Design Conditions

The design conditions of the airstream entering the exhauster will be from 20°F to 150°F at 100% relative humidity with no entrained moisture. The relative humidity of the air entering the HEPA filter assembly shall not exceed 70% and the relative humidity of the air leaving the exhaust stack shall not exceed 85%. The airstream may contain varying amounts of hydrogen, nitrous oxide, methane, and ammonia vapors. The airstream entering the exhauster is drawn from tanks containing a high pH (10-14 nominal) waste.

Vapor compounds of the chemical waste concentrations listed in Table 3-1 may be present in the airstream. Minimum and maximum concentrations for wastes in single-shell tanks (SSTs) and double-shell tanks (DSTs) are

presented. These concentrations are from the Best-Basis Inventory Calculation Detail Report and Calculation Detail Report – Supplemental Analytes, queried on June 20, 2004. The Calculation Detail Report lists adjusted concentrations for each waste phase and waste type in the 149 SSTs and 28 DSTs. The highest and lowest reported adjusted concentrations are listed in the table below. Because a tank usually contains more than one waste phase and waste type, the actual range of average tank concentrations would be expected to be smaller than the range of concentrations listed. For the purposes of this specification, however, the worst case data from either the single shell tank or double shell tank list shall be considered (since it is possible that the exhauster could be used to ventilate either type of tank in the future).

Table 3-1 Chemical Composition Range

Double-Shell Tank Chemical Composition Range			Single-Shell Tank Chemical Composition Range		
Analyte	**Minimum Concentration (μg/g)** [1]	**Maximum Concentration (μg/g)** [1]	**Analyte**	**Minimum Concentration (μg/g)** [1]	**Maximum Concentration (μg/g)** [1]
Al	1.29E+02	1.40E+05	Al	0E+00	2.87E+05
Bi	0.00E+00	8.91E+03	Bi	0E+00	9.28E+04
Ca	<1.55E+00	1.07E+05	Ca	0E+00	4.60E+05
Cl	5.75E+01	8.07E+03	Cl	0E+00	1.05E+04
Cr	6.43E+01	2.96E+04	Cr	0E+00	2.45E+04
F	<2.37E+01	7.43E+04	F	0E+00	4.52E+04
Fe	<2.70E-01	1.04E+05	Fe	0E+00	2.71E+05
Hg	0.00E+00	1.96E+02	Hg	0E+00	1.49E+03
K	2.76E+02	3.12E+04	K	0E+00	7.49E+03
La	0.00E+00	1.90E+03	La	0E+00	1.81E+04
Mn	0.00E+00	3.48E+04	Mn	0E+00	6.54E+04
Na	2.08E+04	2.25E+05	Na	0E+00	3.26E+05
Ni	0.00E+00	3.08E+03	Ni	0E+00	5.09E+04
NO_2	4.94E+02	1.04E+05	NO_2	0E+00	1.15E+05
NO_3	6.95E+01	2.22E+05	NO_3	0E+00	6.00E+05
OH	7.84E-01	6.77E+04	OH	0E+00	2.46E+04
Pb	0.00E+00	4.92E+03	Pb	0E+00	1.89E+04
PO_4	2.99E+02	1.72E+05	PO_4	0E+00	2.50E−05

Double-Shell Tank Chemical Composition Range			Single-Shell Tank Chemical Composition Range		
Analyte	**Minimum Concentration (µg/g)[1]**	**Maximum Concentration (µg/g)[1]**	**Analyte**	**Minimum Concentration (µg/g)[1]**	**Maximum Concentration (µg/g)[1]**
Si	6.99E+00	1.73E+04	Si	0E+00	6.52E+05
SO_4	1.57E+02	2.47E+04	SO_4	0E+00	1.62E+05
Sr	0.00E+00	3.56E+02	Sr	0E+00	1.89E+04
TIC as CO_3	3.30E+03	1.89E+05	TIC as CO_3	0E+00	1.81E+05
TOC	0.00E+00	5.06E+04	TOC	0E+00	4.25E+04
U_{TOTAL}	1.01E+00	3.50E+04	U_{TOTAL}	0E+00	1.61E+05
Zr	0.00E+00	1.14E+05	Zr	0E+00	3.92E+04
Radionuclides	4.90E-01	4.36E+04	Radionuclides	0E+00	9.05E+04

[1]Radionuclide concentration in µCi/g.

3.1.2.2 Electrical Connection

The exhauster power connection design shall be capable of operating the exhauster from either a 480V, AC terminal buss connection (3-phase, 4-wire) or a standard weld receptacle (480V, 3-phase, 4-wire). A grounding lug shall be incorporated onto the skid (for equipment ground - not the power system ground). The buyer shall provide location of this lug on the skid. A 2" power conduit routed from the transfer switch enclosure to the duct inlet end of exhaust skid shall be included. This conduit will be used by the buyer to install power at the Hanford site.

3.1.2.3 Seal Pot Condensate Drain

The condensate shall be returned to the buyer's designated waste tank(s) or collection tank/system (drain point determined and piping supplied by the buyer) by use of the exhauster's gravity drain or condensate pump connection. A 1" flanged connection shall be provided on the gravity drain line (used for normal seal pot overflow) and condensate pump line. A 1/2" flanged connection shall also be provided on the seal pot drain line (used for complete draining of the seal pot).

3.1.2.4 Exhauster Inlet Flange Connection

The inlet to the exhauster shall be a 12-inch, Class 150, flanged connection. This flange constitutes the primary interface with the farm ductwork.

3.1.2.5 Exhaust Skid Structural Installation

The design of the exhaust skid shall include mounting holes through base framework to accommodate fastening the skid to a concrete pad during installation at the Hanford site. The buyer shall provide location and size of mounting holes.

3.2 CHARACTERISTICS

3.2.1 PERFORMANCE

The exhauster shall be capable of producing up to 2000 SCFM or equivalent total mass flow of saturated air (150 lbs/minute) over its entire range of operating conditions. The maximum expected upstream static pressure, as seen at the exhauster inlet flange, should be no greater than 12 inches water gage (in WG) vacuum. This value shall be used to determine system design pressures as described in ASME AG-1 (or ASME N509, section 4.6).

3.2.2 DESIGN LIFE

The system shall be designed for continuous operation over 35 years, with the exception of consumable materials.

3.2.3 SPACE ENVELOPE

The entire assembly footprint shall be no wider than 8'-0". The stack shall be removable for transportation to meet overall transportation height limits of 13'-6" or less, depending on local and state restrictions.

3.2.4 MAINTAINABILITY

3.2.4.1 Accessibility

Critical equipment instrumentation or high maintenance items shall be accessible for ease of inspection and removal/replacement. Equipment dimensions shall accommodate the fifth to ninety-fifth percentile of the

user population when possible (per NUREG 0700, section 6.1 and MIL-STD-1472F, section 5.6). 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. Large equipment items shall have integral lifting attachments as practical. The structural skid frame shall allow convenient access to the filter train components for maintenance and operations.

3.2.4.2 Decontamination

The design shall take into consideration that all components must be capable of being decontaminated and ultimately decommissioned, dismantled, and disposed of as radioactive waste. All material and equipment shall be fabricated and installed to facilitate routine removal, cleaning or decontamination. Attention shall be paid to eliminating crevices and obtaining smooth weldments through the entire exhauster flow stream. Longitudinal seams shall be placed in the top quadrant of ductwork.

3.2.4.3 Special Tools

The exhauster system shall be designed to facilitate maintenance with commercially available tools wherever possible. The seller shall furnish all special tools unique to the seller's equipment that are necessary for installation, start-up, operation, maintenance, and adjustment of the equipment and accessories furnished by the seller. The special tools become the property of the buyer. If supplied, the seller shall also provide a list of all special tools furnished, identifying the function of each tool and the specific item(s) for which it is used. Seller shall also indicate whether the tool is required for assembly, disassembly, installation, start-up, operation, maintenance, or adjustment. The seller shall provide detailed drawings or procurement information for the special tools.

3.2.5 ENVIRONMENTAL REQUIREMENTS

3.2.5.1 Climate

This section defines the natural conditions (e.g., weather) in which the exhauster will be subjected to. Equipment shall be designed to operate in the environmental conditions listed in this section.

- **Ambient Air Temperature**

The ambient air temperature range is 120^0F to -32^0F, and with a maximum 24-hour differential of 52^0F.

- **Relative Humidity**

  The relative humidity range is 0 to 100% (Rate of change is negligible)

- **Surface Precipitation**

  The surface precipitation is 1.56 inches in a 24-hour period.

- **Hail Events**

  The hail diameter is less than or equal to 0.75 in.

- **Sand and Dust**

  The sand/dust concentration is 1.10×10^{-5} lbm/ft^2 with a typical size of 350 μm.

- **Solar Radiation**

  The maximum expected solar radiation is 900 Langleys per day.

- **Glaze**

  The maximum expected glaze is 1 in.

3.2.5.2 Electromagnetic Noise/Radiation

The control systems shall be designed and constructed such that stray electromagnetic radiation/noise (i.e. RF, cellular phones, power) does not interfere with the control circuit function.

3.2.6 INDUCED LOADS

This section defines the induced loads in which the Exhauster will be subjected to.

3.2.6.1 Seismic

a) The exhaust train assembly consisting of components defined in Section 3.1.1 shall be designed to retain structural integrity during and after a design basis earthquake (DBE). A mathematic analysis for DBE shall be performed unless the manufacturer provides justification

for the conservatism of an alternate method.

b) Seismic qualification of the filter housings as a separate component, shall be based on a seismic shake table test of the housing with HEPA filter elements installed in accordance with the requirements of ASME AG-1, Article AA-4350.

c) Table 3-2 shows the response spectra for design motion for the equipment. These design spectra are applied for two horizontal and one vertical direction in a free field. The critical damping used for the design and analysis shall be 5 percent.

d) If similar equipment has previously been qualified by means of testing and/or analysis equivalent to those described above, the results of these test/analysis may be used to demonstrate seismic qualification if it can be shown that previous seismic inputs can envelope the response spectra corresponding to the unit components.

3.2.6.2 Wind Loads

a) The exhaust train assembly consisting of components defined in Section 3.1.1 shall be designed to retain structural and operational integrity during and after an extreme wind condition. A mathematic analysis for this condition shall be performed unless the manufacturer provides justification for the conservatism of an alternate method.

b) Wind loading design shall be in accordance with the definitions and requirement of ASCE 7-02 utilizing the following criteria:

    1) Wind speed - 80 mph

    2) 3 second wind gust - 100 mph

    3) Importance factor - 1.0

    4) Exposure category - C

    5) Horizontal wind missile - yes, 2 x 4 timber plank, 15 lbs, traveling at 50 mph (73.5 ft/s), maximum trajectory height = 30 ft.

c) If similar equipment has previously been qualified by means of testing and/or analysis equivalent to those described above, the results of these test/analysis may be used to demonstrate wind-loading qualification.

3.2.6.3 Snow Loads

a) The exhaust train assembly consisting of components defined in Section 3.1.1 shall be designed to retain structural and operational integrity during and after a snow load condition. A mathematic analysis for this condition shall be performed unless the manufacturer provides justification for the conservatism of an alternate method.

b) The ground snow loads are: 15 lb/ft^2

3.2.6.4 Ashfall Events

a) The exhaust train assembly consisting of components defined in Section 3.1.1 shall be designed to retain structural and operational integrity during and after an ashfall load condition. A mathematic analysis for this condition shall be performed unless the manufacturer provides justification for the conservatism of an alternate method.

b) A combination snowfall and ash fall LOAD of 20 lb/ft^2 shall be used.

3.2.6.5 Dead loads

a) The exhaust train assembly consisting of components defined in Section 3.1.1 shall be designed to retain structural and operational integrity with dead loads applied. A mathematic analysis for this condition shall be performed unless the manufacturer provides justification for the conservatism of an alternate method.

b) Dead loads include the weights of all permanent materials and equipment, including the structure's own weight. Design dead loads shall include the weight of all permanent service equipment. Load calculations shall include an allowance for any loading anticipated to be added at a later date. Initially assumed loads shall be revised so that the final design reflects the configuration shown on the drawings.

c) The unit weights of materials and construction assemblies for buildings and other structures shall be those given in ASCE 7-02. Where unit weights are neither established in that standard nor determined by test or analysis, the weights shall be determined from data in manufacturer drawings or catalogs.

Table 3-2 - Response Spectra

Horizontal Response Spectra						
Frequency (Hertz)	**Damping**					
	0.50%	2%	5%	7%	10%	12%
100	0.26	0.26	0.26	0.26	0.26	0.26
33.3	0.26	0.26	0.26	0.26	0.26	0.26
13.3	0.57	0.48	0.41	0.38	0.36	0.35
10	0.77	0.59	0.47	0.43	0.38	0.36
5	1.04	0.76	0.58	0.52	0.45	0.42
3.3	0.98	0.72	0.54	0.48	0.42	0.39
2	0.74	0.55	0.41	0.37	0.33	0.30
1	0.45	0.34	0.26	0.23	0.21	0.19
0.5	0.22	0.17	0.13	0.12	0.11	0.10
0.25	0.08	0.06	0.05	0.05	0.04	0.04
Vertical Response Spectra						
Frequency (Hertz)	**Damping**					
	0.50%	2%	5%	7%	10%	12%
100	0.18	0.18	0.18	0.18	0.18	0.18
33.3	0.18	0.18	0.18	0.18	0.18	0.18
13.3	0.60	0.46	0.37	0.33	0.30	0.28
10	0.66	0.49	0.37	0.33	0.29	0.27
5	0.60	0.44	0.33	0.30	0.26	0.24
3.3	0.48	0.36	0.27	0.24	0.21	0.19
2	0.32	0.24	0.18	0.16	0.14	0.13
1	0.19	0.14	0.11	0.10	0.09	0.08
0.5	0.14	0.11	0.08	0.07	0.07	0.06
0.25	0.06	0.05	0.04	0.03	0.03	0.03

3.2.6.6 Thermal Forces

a) The exhaust train assembly consisting of components defined in Section 3.1.1 shall be designed to retain structural and operational integrity caused by Thermal forces. A mathematic analysis for this condition shall be performed unless the manufacturer provides justification for the conservatism of an alternate method.

b) The design of structures shall include the effects of stresses and movements resulting from variations in temperature. Structures shall be designed for movements resulting from the maximum seasonal temperature change. The design shall provide for the lags between air temperatures and the interior temperatures of massive concrete members or structures. Consideration shall be given to passive soil loading resulting from thermal growth of subgrade structures.

3.2.6.7 Load Combinations and Allowable Stresses

Load combinations, allowable stresses, and strength requirements for load conditions that include live load; dead load; snow load; normal operating loads; and NPH loads of extreme wind, earthquake, flood, and ashfall for all structures, systems, and components shall comply with DOE-STD-1020.

<u>Load factors and load combination for structures, systems, and components</u>

Combine response from various loading to determine structural demand as follows.

Where:

DL	=	DEAD LOAD
LL	=	LIVE LOAD
RL	=	ROOF LIVE LOAD
S	=	SNOW LOAD
W	=	WIND LOAD
E	=	EARTHQUAKE
A	=	ASHFALL
T	=	THERMAL
C	=	CREEP/SHRINKAGE

Allowable Stress (AS) Design:

AS = DL + LL + RL(or S)

AS = 0.62 [DL + LL + RL(or S) + W + T(or C)]

For shear stress

AS = 0.71 [DL + LL + RL(or S) + E(or A) + T(or C)]

For all stress other than shear stress

AS = 0.59 [DL + LL + RL(or S) + E(or A) + T(or C)]

Ultimate Strength (U) Design:

U = 1.4DL + 1.7LL + 1.7RL(or 1.7S)

U = 1.4 [DL + T(or C)]

U = DL + LL + RL(or S) + W(or E or A) + T(or C)

Strength (S) Design: Steel (Load & Resistance Factor Design)

S = 1.4DL

S = 1.2DL + 1.6LL + 0.5(RL or S)

S = 1.2DL + 0.5LL + 1.6(RL or S)

S = DL + LL + RL(or S) + W(or E or A)

3.2.7 STORAGE

The exhauster shall be capable of being stored outside for up to 1 year without permanent damage that would impair the exhauster system from operation. Sheet metal isolation covers shall be provided on the inlet and exit of the filter train and stack during transport and storage. The seller shall identify any special storage requirements deemed necessary to protect the mechanical or electronic equipment from this storage requirement.

3.2.8 TRANSPORTATION ACCELERATIONS

The packaged exhauster shall be contained within a shipping container or suitable protective device. The exhauster shipping container, or protective device, shall be designed to support the exhauster so it can withstand a .75g (forward) hard braking stop and a rearward acceleration of .25g's, as well as shock and vibration loads associated with transportation.

3.2.9 ELECTRICAL GROUNDING

The exhauster will be properly grounded when installed and connected to a tank. All non-energized metallic objects shall be grounded and bonded per NFPA 70 (article 250) to assure grounding of the entire system during any lightning activity.

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

3.3 DESIGN AND CONSTRUCTION

3.3.1 MATERIALS, PROCESSES, AND PARTS

3.3.1.1 Quality

Materials shall be free from any defects or imperfections that may affect performance. The seller shall not incorporate any rebuilt or refurbished components into this assembly.

When requested by the buyer, the Supplier shall provide a Certificate of Compliance that must certify conformance and traceability of supplied materials to the subject Purchase Order/Contract Order. The document must be legible and reproducible.

The Supplier shall warrant that "all items furnished under this Purchase Order/Contract Order are genuine (i.e., not counterfeit) and match the quality, test reports, markings and/or fitness for use required by the Purchase Order/Contract Order". The statement shall be on supplier letterhead and signed by an authorized agent of the supplier. Any materials furnished as part of this Purchase Order/Contract Order, which have been previously found to be suspect/counterfeit by the Department of Energy, shall not be accepted.

3.3.1.2 High-strength and Heat Treatments

The seller shall identify to the buyer for review of all high-strength materials to be incorporated and applicable post-weld heat treatments.

3.3.1.3 Structural

Materials for all structural members shall be selected in accordance with industry-accepted procedures.

3.3.1.4 Metallic

Metallic parts shall be of corrosion-resistant metal, or shall be suitably finished to resist corrosion. Dissimilar metals, such as those defined by MIL-STD-889, that have active electrolytic corrosion properties shall not be used in direct contact.

3.3.1.5 Deterioration and Protection

Material subject to deterioration when exposed to climatic and other environmental conditions specified herein shall be protected against such deterioration. The use of any protective coating that will crack, scale, or erode due to extremes of climatic or other environmental conditions during the required exhauster life shall not be used. All protective coatings shall require the concurrence of the buyer.

3.3.1.6 Fasteners

All fasteners provided must meet the following requirements:

Fasteners shall exhibit grade marks and manufacturer's identification symbols (head marks) as required in the specifications referenced in the Purchase Order/Contract Order.

Any fasteners supplied with head marks matching those displayed in Appendix A, Suspect/Counterfeit Fastener Head mark list, or facsimiles thereof, shall be deemed to be unacceptable under the terms of this Purchase Order/Contract Order.

When requested by the buyer, the supplier shall provide a legible and reproducible copy of the manufacturer's Certified Material Test Reports (CMTR). These CMTRs shall report the values of the actual chemical and physical tests performed on the represented fastener lot/material heat. Fastener packaging/labeling shall be traceable by lot number or other positive means to the CMTRs.

Fasteners shall be inspected to verify compliance with the Purchase Order/Contract Order requirements. Additionally, fasteners may also be subjected to destructive testing.

3.3.1.7 Edges

All sharp and flame-cut edges shall be deburred.

3.3.2 EXHAUSTER MECHANICAL COMPONENTS

Appendix B contains detailed design sketches of the exhaust skid mechanical components. These sketches are intended to supplement the specific design requirements provided in this section of the specification. Any deviations from the Parts Lists contained in the appendices shall be approved by the buyer. The sketches will not be updated with changes made during design of exhauster. Note discussion concerning these and other drawings in Section 1.3.

All equipment and components shall be have a Equipment Identification Number (EIN) as shown on EXHSTR-P&ID-2, -3, -4, and –5 in Appendix C. The airstream handling components are listed below and shall be configured on the support skid in the order shown:

1. A short 12-inch diameter spool piece with Class 150 flanges
2. A 12-inch diameter isolation valve
3. A transition to the heater housing
4. Heater housing
5. A prefilter housing
6. A test section
7. A HEPA filter housing
8. A test section
9. A HEPA filter housing
10. A transition to the fan inlet flange
11. Connection port
12. A (fan inlet) isolation valve
13. A flexible metal connector
14. Fan Assembly
15. A transition from fan outlet to flexible connector
16. Flexible metal connector
17. Fixed section of stack
18. Removable section of stack

The general arrangement of the exhauster is shown in EXHSTR-MECH-1.

Ventilation system components shall be fabricated, assembled, and tested to meet the latest requirements of ASME AG-1 and ASME N509/ASME N510. Where conflicts occur or if one requirement is less stringent, ASME AG-1 takes precedence.

Items 5 through 9 shall be considered a combined assembly and the product of a single manufacturer.

3.3.2.1 HEPA Filter Housings

a) The exhaust train assembly will require two (2) HEPA filter housings. These filter housings shall be a Flanders BF Series, 1 x 2, type 1, right hand access (when facing direction of air flow) and shall be fabricated from 11 and 14 gage, ASTM A240, Type 300 series stainless steel with a 2-B mill finish. All welded components shall be fabricated from Type 300 series stainless steel, Grade L.

b) Housing hardware material shall meet the requirements for Type 300 series stainless steel, excluding the access door knobs which shall be cast aluminum.

c) The filter housings shall not exceed a nominal depth of 25" in the direction of airflow.

d) The filter housings shall be adequately reinforced to withstand the system structural capability pressure as defined in ASME AG-1 (or ASME N509, section 4.6.6.1).

e) All "pressure retaining" weld joints and seams shall be 100% continuously welded. Weld joints and seams shall be wire brushed or buffed after final NDE/inspection as required to remove heat discoloration, oxidation, all burrs and sharp edges.

f) The housings shall be insulated to a nominal thickness of 2" using 8-lb/cubic foot mineral wool insulation. The insulation shall cover the sides, top, bottom and access doors for the housings and shall fill, to the maximum extent practical, the external housing voids. The insulation shall be permanently sealed into the housing by the welded installation of 11 or 12 gage ASTM A240, Type 300 series stainless steel false panels. All welded components shall be fabricated from Type 300 series stainless steel, Grade L.

g) The housings shall accommodate two (2) Flanders GG-F (24" x 24" x

11 1/2") Fluid Seal, Type B (Nuclear Grade) HEPA elements. Filter-to-housing seal shall be effected by means of a "knife-edge" frame in the housing that engages with a continuous perimeter channel on the face of a filter element that has been filled with a viscous, non-drying fluid. The filter elements shall not require any special attachments or devices to function correctly within the housings.

h) The housings shall be equipped with two (2) static pressure ports. The ports shall be located upstream and downstream of the filter elements on the top of the housing. The port fittings shall be 1/4", Schedule 40, seamless, stainless steel pipe meeting the requirements of ASTM A312, Type 300 series stainless steel. All welded components shall be fabricated from Type 300 series stainless steel Grade L. The ports shall extend a minimum of 1" above the insulation false panel and threaded to accept a 1/4" FNPT fitting.

i) The first filter housing shall be equipped with one (1) temperature port. The port will be located on the top of the housing directly in front of the HEPA filter. The port fitting shall be 1", Schedule 40, seamless, stainless steel pipe meeting the requirements of ASTM A312, Type 300 series stainless steel. All welded components shall be fabricated from Type 300 stainless steel Grade L. The port shall extend a minimum of 1" above the insulation false panel and threaded to accept a 1" FNPT fitting.

j) The housings shall be equipped with a floor drain centered at the bottom of the housing. The drain shall be 1" Schedule 40, seamless, pipe meeting the requirements of ASTM A312, Type 300 series stainless steel. All welded components shall be fabricated from Type 300 series stainless steel Grade L.

k) A toggle or over-center ("Davis-Lok") type filter element clamping assembly or locking tray shall be used to secure the filter elements in the housing. The clamping assembly shall apply a sealing force that is even and uniform across the top and bottom of the filter element. The clamping assembly or locking tray shall be replaceable.

l) The housings shall be equipped with an access port for the filter element.

m) The filter element clamping assembly or locking tray shall be accessible from the access port and shall be operable through any containment change-out bags.

n) The housings shall be equipped with filter removal rods to draw the filters to the change-out position. The removal rods shall be operated from inside the change-out bag, and the filters shall be removed by pulling against the bottom of the filter frame. There shall be no penetration through the housing for operation of the removal rod. All change out operations shall be within the bag so there is a barrier between the worker and the filter at all times.

o) The access port shall be equipped with a containment change-out bag adapter. The adapter shall be welded to the housing. The welded joints/seams used to fabricate and secure the change-out adapter to the housing shall be considered "pressure retaining" joints and meet the requirements of 3.3.2.1.e. The adapter shall be hemmed or rolled on its outer edge and include two (2) continuous ribs. The ribs are required to hold the containment bag elastic cord and/or safety strap during filter element bag in/bag out procedures.

p) A containment change-out bag shall be provided for each access port that meets the airstream design conditions of Section 3.1.2.1. The bags shall be nominal 5 mils thick, translucent and have elastic O-ring (compatible with the maximum bag temperature) hemmed into the open end of the bag.

q) A nylon safety strap shall be provided with the bag to prevent the bag from slipping off of the access port bag adapter during filter element bag in/bag out procedures.

r) A nylon-cinching strap shall also be provided with the bag to "tie-off" the bags slack when the housing door is installed and the unit is operational.

s) The access port shall include a removable door assembly that encloses the access port, the bag adapter and the bag with its accessories.

t) The door shall include a minimum of four (4) tie down latches. The latches shall be designed in such a manner as <u>not</u> to impede the bag in/bag out process.

u) The door shall include a continuous rubber lip on its perimeter that affects a positive "compression" seal between the door and the housing.

v) The door shall interface with the housing in such a manner that the

door cannot be closed or installed until the filter element is correctly installed in the housing and the clamping assembly or locking tray is fully engaged.

3.3.2.2 Prefilter Section

a) The exhaust train assembly will require one (1) prefilter housing. This prefilter housing shall be a Flanders BF Series, 1 x 2, type 1, right hand access (when facing direction of air flow) and shall be fabricated from 11 and 14 gage, ASTM A240, Type 300 series stainless steel with a 2-B mill finish. All welded components shall be fabricated from Type 300 series stainless steel, Grade L.

b) Housing hardware material shall meet the requirements for Type 300 series stainless steel.

c) The prefilter housing shall not exceed a nominal depth of 14" in the direction of airflow.

d) The prefilter housing shall be adequately reinforced to withstand the structural capability pressure of the system as defined in ASME AG-1 (or ASME N509, section 4.6.6.1).

e) All "pressure retaining" weld joints and seams shall be 100% continuously welded. Weld joints and seams shall be wire brushed or buffed after final NDE/inspection as required to remove heat discoloration, oxidation, all burrs and sharp edges.

f) The housings shall be insulated to a nominal thickness of 2" using 8-lb/cubic foot mineral wool insulation. The insulation shall cover the sides, top and bottom of the housings and shall fill, to the maximum extent practical, the external housing voids. The insulation shall be permanently sealed into the housing by the welded installation of 11 or 12 gage ASTM A240, Type 300 series stainless steel false panels. All welded components shall be fabricated from Type 300 series stainless steel, Grade L.

g) The housing shall accommodate two (2) 24" x 24" x 2" UL Class I pre-filters, with a minimum efficiency of 45% (in accordance with ASHRAE standard 52) and metal frames. The filter element shall <u>not</u> require any special attachments or devices to function correctly within the housings.

h) The housing shall be equipped with two (2) static pressure ports. The ports shall be located upstream and downstream of the filter element on the top of the housing. The port fittings shall be 1/4", Schedule 40, seamless, stainless steel pipe meeting the requirements of ASTM A312, Type 300 series stainless steel. All welded components shall be fabricated from Type 300 series stainless steel Grade L. The ports shall extend a minimum of 1" above the insulation false panel and threaded to accept a 1/4" FNPT fitting.

i) The housing shall be equipped with a floor drain centered at the bottom of the housing. The drain shall be 1" Schedule 40, seamless, pipe meeting the requirements of ASTM A312, Type 300 series stainless steel. All welded components shall be fabricated from Type 300 series stainless steel Grade L.

j) The housings shall be equipped with an access port for the filter element.

k) The housings shall be equipped with filter removal rods to draw the filters to the change-out position. The removal rods shall be operated from inside the change-out bag, and the filters shall be removed by pulling against the bottom of the filter frame. There shall be no penetration through the housing for operation of the removal rod. All change out operations shall be within the bag so there is a barrier between the worker and the filter at all times.

l) The access port shall be equipped with a containment change-out bag adapter. The adapter shall be welded to the housing. The welded joints/seams used to fabricate and secure the change-out adapter to the housing shall be considered "pressure retaining" joints and meet the requirements of 3.3.2.2.e. The adapter shall be hemmed or rolled on its outer edge and include two (2) continuous ribs. The ribs are required to hold the containment bag elastic cord and/or safety strap during filter element bag in/bag out procedures.

m) A containment change-out bag shall be provided for each access port that meets the airstream design conditions of Section 3.1.2.1. The bags shall be nominal 5 mils thick, translucent and have elastic O-ring (compatible with the maximum bag temperature) hemmed into the open end of the bag.

n) A nylon safety strap shall be provided with the bag to prevent the bag from slipping off of the access port bag adapter during filter element

bag in/bag out procedures.

o) A nylon-cinching strap shall also be provided with the bag to "tie-off" the bags slack when the housing door is installed and the unit is operational.

p) The access port shall include a removable door assembly that encloses the access port, the bag adapter and the bag with its accessories.

q) The door shall include a minimum of four (4) tie down latches. The latches shall be designed in such a manner as not to impede the bag in/bag out process.

r) The door shall include a continuous rubber lip on its perimeter that affects a positive "compression" seal between the door and the housing.

3.3.2.3 Test Sections

a) The exhaust train assembly will require one (1) filter housing inlet test section and one (1) filter housing combination test section.

b) The inlet test section shall be a Flanders test "inlet" section, type 1 arrangement for a BF Series, 1 x 2, type 1, right hand access (when facing direction of air flow) filter housing. The inlet test section shall be located upstream of the first bank of HEPA filter elements.

c) The combination test section shall be a Flanders test "combination" section, type 1 arrangement for a BF Series, 1 x 2, type 1, right hand access (when facing direction of air flow) filter housing. The combination test section shall be located between the two banks of HEPA filter elements.

d) The test sections shall be fabricated from 11 and 14 gage, ASTM A240, Type 300 series stainless steel with a 2-B mill finish. All welded components shall be fabricated from Type 300 series stainless steel, Grade L.

e) The test sections shall not exceed a nominal depth of 28" in the direction of airflow.

f) Test section hardware material shall meet the requirements for Type

300 series stainless steel.

g) The test sections shall be adequately reinforced to withstand the system structural capability pressure as defined in ASME AG-1 (or ASME N509, section 4.6.6.1).

h) The differential pressure drop across each of the test sections shall not exceed 0.75 in WG at the rated capacity of the HEPA filter assembly.

i) All "pressure retaining" weld joints and seams shall be 100% continuously welded. Weld joints and seams shall be wire brushed or buffed after final NDE/inspection as required to remove heat discoloration, oxidation, all burrs and sharp edges.

j) The test sections shall be insulated to a nominal thickness of 2" using 8-lb/cubic foot mineral wool insulation. The insulation shall cover the sides, top and bottom of the test sections and shall fill, to the maximum extent practical, the external housing voids. The insulation shall be permanently sealed into the housings by the welded installation of 11 or 12 gage ASTM A240, Type 300 series stainless steel false panels. All welded components shall be fabricated from Type 300 series stainless steel Grade L.

k) The test sections shall be constructed in such a manner to allow HEPA filter "in place" testing in accordance with the requirements of ASME AG-1, Article FC-5120 (or ASME N510, section 10) outside the system using apparatus and devices which are supplied as an integral part of the test section. Apparatus and devices shall include as a minimum:

   1. Inlet test section - challenge aerosol inlets, mixing apparatus (diffusers) and upstream sample outlets.

   2. Combination test section - downstream mixing apparatus (diffusers) and sample outlets for the upstream filter elements, plus challenge aerosol inlets, mixing apparatus (diffusers) and upstream sample outlets for the downstream filter elements.

l) Apparatus and devices that make up the test sections shall meet the intent of the <u>non-mandatory</u> design guidelines of ASME AG-1, Appendix HA-C (or N509, Appendix C).

m) Apparatus and devices that make up the test sections shall be designed

to allow qualification testing of the apparatus and devices in accordance with ASME AG-1, Appendix HA-D (or ASME N510, section 9) as required.

n) The inlet and combination test sections shall be equipped with a floor drain centered at the bottom of the housing. The drain shall be 1" Schedule 40, seamless, pipe meeting the requirements of ASTM A312, Type 300 series stainless steel. All welded components shall be fabricated from Type 300 series stainless steel Grade L.

3.3.2.4 Heater Section

a) The exhaust train assembly will require one (1) heater housing duct section.

b) The heater housing section details are shown on EXHSTR-MECH-10.

c) The heater section shall be fabricated from 10, 11 or 12 Gage (as required), ASTM A240, Type 300 series stainless steel with a 2-B mill finish. All welded components shall be fabricated from Type 300 series stainless steel, Grade L.

d) The heater section shall be adequately reinforced to withstand the system structural capability pressure as defined in ASME AG-1 (or ASME N509, section 4.6.6.1).

e) The heater section shall be all welded construction and fabricated in accordance with the housing/test section manufacturers standard fabrication processes.

f) All "pressure retaining" weld joints and seams shall be 100% continuously welded. Weld joints and seams shall be wire brushed or buffed after final NDE/inspection as required to remove heat discoloration, oxidation, all burrs and sharp edges.

g) The heater section shall be insulated to a nominal thickness of 2" using 8-lb/cubic foot mineral wool insulation. The insulation shall cover the sides, top and bottom of the heater section. The insulation shall be permanently sealed into the heater housing by the welded installation of 11 or 12 Gage ASTM A240 Type 300 stainless steel false panels. All welded components shall be fabricated from Type 300 series stainless steel Grade L.

h) The heater section shall be equipped with a heat exchanger mounting flange. The flange shall be considered a "pressure retaining" component and fabricated from 1/4" ASTM A240 Type 300 stainless steel plate. All welded components shall be fabricated from Type 300 series stainless steel Grade L. The flange shall accept the installation of a liquid to stainless steel air heating coil.

i) The heater housing shall be equipped with two (2) static pressure ports. The ports shall be located upstream and downstream of the heat exchanger on the top of the housing. The port fittings shall be 1/4", Schedule 40, seamless, stainless steel pipe meeting the requirements of ASTM A312, Type 300 series stainless steel. All welded components shall be fabricated from Type 300 series stainless steel Grade L. The ports shall extend a minimum of 1" above the insulation false panel and threaded to accept a 1/4" FNPT fitting.

j) The heater housing shall be equipped with one (1) temperature port. The port will be located on the top of the housing before the heat exchanger. The port fitting shall be 1", Schedule 40, seamless, stainless steel pipe meeting the requirements of ASTM A312, Type 300 series stainless steel. All welded components shall be fabricated from Type 300 series stainless steel Grade L. The ports shall extend a minimum of 1" above the insulation false panel and threaded to accept a 1" FNPT fitting.

k) The heater section shall be equipped with a floor drain centered at the bottom of the housing. The drain shall be 1" Schedule 40, seamless, pipe meeting the requirements of ASTM A312, Type 300 series stainless steel. All welded components shall be fabricated from Type 300 series stainless steel Grade L.

3.3.2.5 Transition Ducting Sections

a) The exhaust train assembly will require one (1) filter housing inlet transition duct section and one (1) filter housing outlet transition duct section.

b) The transition section details are shown on EXHSTR-MECH-8.

c) The transition sections shall be fabricated from 10, 11 or 12 Gage (as required), ASTM A240, Type 300 series stainless steel with a 2-B mill finish. All welded components shall be fabricated from Type 300 series stainless steel, Grade L. The flanges shall be, at a minimum, 150# flanges and meet the requirements of ASTM A182.

d) The transition sections shall be adequately reinforced to withstand the system structural capability pressure, as defined in ASME AG-1 (or ASME N509, section 4.6.6.1), and to support 150% of their own finished weight when mounted to the housing/test section.

e) The transition sections shall be all welded construction and fabricated in accordance with the housing/test section manufacturers standard fabrication processes.

f) All "pressure retaining" weld joints and seams shall be 100% continuously welded. Weld joints and seams shall be wire brushed or buffed after final NDE/inspection as required to remove heat discoloration, oxidation, all burrs and sharp edges.

g) The transition sections shall be insulated to a nominal thickness of 2" using 8-lb/cubic foot mineral wool insulation. The insulation shall cover the sides, top and bottom of the transition sections. The insulation shall be permanently sealed into the transition by the welded installation of 11 or 12 Gage ASTM A240 Type 300 stainless steel false panels. All welded components shall be fabricated from Type 300 series stainless steel Grade L.

h) The outlet transition section shall be equipped with two (2) instrumentation ports. The ports shall be located on the top of the transition section. The port fittings shall be 1", schedule 40, seamless pipe meeting the requirements of ASTM A312, Type 300 series stainless steel. All welded components shall be fabricated from Type 300 series stainless steel, Grade L. The ports shall be long enough to extend past the insulation false panel and be threaded to accept a 1" FNPT fitting. One (1) of the ports shall be sealed using a 1" NPT Class 3000 pipe cap. The buyer will install instrumentation in this port, if required, at a later date.

3.3.2.6 Vent Train Base

a) The exhaust train assembly will require one (1) vent train base that supports the system components as well as any required electrical, instrumentation and control components.

b) The vent train base details are shown on EXHSTR-FRM-1.

c) The skid shall be fabricated from ASTM A-36 carbon steel or a buyer

approved substitution.

d) The vent train base shall be all welded construction. Joints and seams shall be wire brushed or buffed after final NDE/inspection as required to remove heat discoloration, oxidation, all burrs and sharp edges.

e) The vent train base shall be designed to allow the exhauster skid to be portable, allowing it to be lifted without any damage to components thereof (e.g., pressure boundary seams/seals). The skid shall be capable of being moved, by crane and truck, with no modifications of the system (except stack removal for transport). Lift points shall be provided for Lifting and Handling rigging, and attachment of load binders (transportation). Any spreader bar or special lifting device shall be provided and load tested in accordance with DOE-RL-92-36. The lift points shall be designed to lift the gross weight of the unit by crane with a minimum design load factor of 5.0 on ultimate strength of material. The transportation attachment shall be designed to withstand 1.5 g's in any axis applied non-simultaneously. The lifting points and the gross weight of the unit shall be identified on the drawing and on the skid. The skid shall identify the approximate center of gravity of the assembly for lifting and handling.

3.3.2.7 Inlet Spool Section

a) The exhaust train assembly will require one (1) inlet spool section.

b) The inlet spool section details are shown on EXHSTR-MECH-11.

c) The inlet spool section shall be fabricated from 12" Schedule 40, straight seam welded stainless steel pipe meeting the requirements of ASTM A312, Type 300 stainless steel. All welded components shall be fabricated from Type 300 series stainless steel Grade L. The flanges shall be, at a minimum, 150# flanges and meet the requirements of ASTM A182.

d) The inlet spool section shall be adequately reinforced to withstand the system structural capability pressure, as defined in ASME AG-1 (or ASME N509, section 4.6.6.1), and to support 150% of its own weight when mounted to the filter train.

e) All "pressure retaining" weld joints and seams shall be 100% continuously welded. Weld joints and seams shall be wire brushed or buffed after final NDE/inspection as required to remove heat

discoloration, oxidation, all burrs and sharp edges.

f) The inlet spool shall be equipped with one (1) static pressure port. The port shall be located on the top of the spool section. The port fitting shall be ¼", schedule 40, seamless, stainless steel pipe meeting the requirements of ASTM A312, Type 300 series stainless steel. All welded components shall be fabricated from Type 300 series stainless steel Grade L. The port length shall be long enough to allow for insulation to be added to the inlet spool section at time of exhauster installation and be threaded to accept a ¼" FNPT fitting.

3.3.2.8 Flexible Ductwork

a) To minimize fan induced vibration a flexible duct joint shall be installed on both sides of the fan. The flex joint shall be flanged at both ends and be constructed of Type 300 series stainless steel Grade L. Flanges shall be flat faced and conform to 150# class. One flange shall be welded in place and the other flange to be floating lap type (Vanstone flange). [Hyspan]

b) The flex joints shall be leak tight and be able to withstand the system structural capability pressure as defined in ASME AG-1 (or ASME N509, section 4.6.6.1). Both fan inlet and outlet flex joints shall be able to accommodate a minimum lateral flange offset and extension of ½" in each direction, a compression of 1 ½", and a temperature range of -32°F to 170°F. A Type 300 series stainless steel Grade L flow liner shall be provided for each flex joint to accommodate the 2000 SCFM airflow rate.

3.3.2.9 Isolation Valves

a) Butterfly valves shall be used to isolate the filter train assembly from the storage tanks and the exhaust fan. Isolation valves shall meet the design requirements of ASME B31.1. Isolation valves shall be Keystone KLOK BFV 360-173, or approved equivalent, with 316 stainless steel body, disc, and stem. Stem packing shall be Teflon and the resilient seat shall be EPDM. The stem bushing shall be RFTF/Fiberglass Epoxy. The valves shall be furnished with electric actuators and position switches. The electric actuators shall include a standard manual override. Valves shall meet the requirements of ASME AG-1 (or ASME N509 par 5.9.1.4) for leakage Class I and shall be individually tested in accordance with ASME AG-1 (or ASME N509 section 5.9.7).

b) A 12-inch valve shall be located at the inlet to the heater housing transition section and a TBD-inch valve (sized by the seller) shall be located at the outlet of the filter train assembly transition section. Reach handles shall be provided if easy access to the valves is not attainable.

c) All instrumentation shall have the capability to isolate the pressure transmitters from the plenum atmosphere to allow for calibration testing of the transmitters.

3.3.2.10 Heater System

a) The heater system shall be capable of heating a 2000-SCFM airstream having a dry bulb temperature of 150°F and a relative humidity of 100% to a dry bulb temperature of approximately 170°F. The air temperature downstream of the heater shall be verified by the seller based on the relative humidity requirements stated in Section 3.1.2.1. The seller shall evaluate ASTM A182 for the need of high temperature service items.

b) The heater system details are shown on EXHSTR-MECH-17.

c) The heater system shall consist of the following components: an electric heating element, circulating pump, expansion tank (with sight glass), and a liquid to stainless steel air heating coil in a stainless steel housing sized to connect directly to the filter train assembly.

d) The heater shall use a 480 VAC, 3-phase, electric in-line heating unit to heat the liquid medium. The heater operation shall be controlled by the Programmable Logic Controller (PLC).

e) A 120 VAC electric, sealless circulating pump and an expansion tank will serve as a liquid reservoir. The liquid side of the system is to be filled with a mixture of demineralized water and propylene glycol. Water and glycol mixture to be rated for –32° F. The liquid side of the system shall be vented to atmosphere or otherwise protected from overpressure.

f) The expansion tank shall be equipped with a fill port and be fabricated from Type 304L stainless steel. The expansion tank shall be adequately sized to preclude adding/removing glycol over its entire expected operating temperature range. The expansion tank shall include a sight glass which indicates minimum and maximum fill levels.

g) The heating system shall be equipped with a drain pan adequately sized to accommodate a full glycol dump (not shown on EXHSTR-MECH-17).

h) Piping materials and construction shall conform to the requirements of ASME B31.3 chapter III for normal service fluids. The piping for the expansion tank system shall be ASTM A 312, Grade TP 304L, and fittings shall be ASTM A 403, Class WP 304L.

i) All piping shall be pressure tested as an assembly. Hydrostatic or pneumatic leak test heater reservoir and heater system piping per ASME/ANSI B31.3.

3.3.2.11 Exhaust Fan and Motor

a) The fan and fan drive shall be designed and tested to ASME AG-1 (or ASME N509). The fan shall be tested and rated per AMCA 210 and AMCA 211A.

b) The fan shall meet AMCA Standard 99-0401-86, Type A construction with a CCW or CW up blast (as required for right hand filter train configuration), AMCA arrangement eight, and be constructed of buyer approved spark-arresting materials. The fan shall be equipped with a factory installed shaft drive and all drive components shall be covered with guards. The fan shall have a 1" IPS drain connection at the low point on the fan housing to allow for attachment of condensate drain piping. The minimum housing thickness shall be no less than ¼". The fan shall be equipped with inlet and outlet flanges with standard bolt patterns. Flange thickness shall be no less than 3/8" and flange faces shall be flat to within a tolerance of ± 1/32". All seams and flanges shall be seal welded. The fan shall be equipped with a bolted access door with 40 – 45 durometer neoprene gasketing (or buyer approved replacement) that is flush with the housing surface. The access door shall be sized to accommodate balancing the fan wheel in place. The bolted inlet collar for access to the fan wheel shall have neoprene gasket 40 – 45 durometer (or buyer approved replacement) between the inlet collar and the fan housing to assure water tightness.

c) The fan shall be selected to operate on the stable portion of its performance curve at a nominal flow range of 500 to 2000 SCFM. The fan shall be sized to move 2000 SCFM of air at the system maximum operating pressure, as defined in ASME AG-1 (or ASME N509 section 4.6.3). Pressure losses through the exhaust train shall account for all components and ductwork and include, as a minimum, 5.9 in WG for dirty HEPA filters and 1 in WG across the pre-filter and heater section. Fan sizing shall also include pressure losses through

the stack. The fan shall operate at the airstream conditions described in Section 3.1.2.1.

d) The fan shall be statically and dynamically balanced per ASME AG-1 (or ASME N509) as an assembly. Amplitudes over the motor rpm range of operation shall not exceed those presented in Table BA-4162-1 of ASME AG-1 (or section 5.7.3 of ASME N509).

e) The natural frequency of the fan rotating assembly (includes shaft, wheel, and coupling hub) shall be determined to ensure that when operating at maximum speed, the assembly is at a minimum of 25% below its first resonance modal. The natural frequency of the fan wheel in the axial direction shall be verified to be at least 10% below or above the fan over its entire operating speed range. Additionally, the natural frequency of the entire exhauster skid shall be verified to show that any structural resonance frequency is at least 10% above or below the fan over its entire operating speed range.

f) Fan bearings shall be grease lubricated, anti-friction bearings in accordance with ANSI/ABMA 11 (or buyer approved equal) with a minimum of L-10 life of 100,000 hours. Bearings shall be furnished with pressure lubrication fittings that are accessible without disassembly of the fan shaft/bearing guard. Bearings and all grease fittings shall be located outside of the airstream. A bearing to shaft locking device shall maintain shaft concentric with the bearing housing. The fan wheel shall be tested for an over speed condition of 15% above its maximum operating speed for 10 minutes without increased vibration. A visual inspection shall serve to further verify that no deformation or cracks have occurred.

g) The motor shall be a totally enclosed inverter duty motor designed for variable speed operation to allow for a constant air volume at changing pressure conditions. The motor shall be tested and rated in accordance with IEEE-112 and NEMA MG-1 as determined by the manufacturer.

h) The fan motor shall be a continuous duty UL/Canadian Standard Association approved 480 VAC, 3-phase, 60 hertz Motor, inverter duty with non-hygroscopic minimum class F insulation, class B (105° F temperature rise), with a service factor of 1.15. The motor shall be totally enclosed and suitable for the service conditions identified in the environmental section for the driven equipment. Motor coupling to fan shall allow for dial indications for in-field runout checkout.

i) The exhaust fan shall be equipped with a method of limiting shaft leakage. The mechanism to limit shaft leakage shall be manufactured from the same material that satisfies the requirements of Section

3.3.2.11.b. The seal arrangement shall be non-contact labyrinth or approved by the buyer prior to ordering the fan or any associated fabrication that deals with the fan assembly.

j) Fan shafting shall be ground and polished to a dimensional tolerance based on the requirements of the selected bearing manufacturer. The vendor shall provide the bearing manufacturer data prior to ordering shafting for buyer approval of the diametrical tolerance. The shafting shall not exceed 0.001" run out over the entire length of the shaft.

k) The fan housing shall be thermally insulated (see Section 3.3.2.14).

l) The fan bearing/shaft guard shall be "finger safe" but also allow for maintenance (i.e., greasing the bearings, performing vibration monitoring) without removal of the guard.

3.3.2.12 Exhaust Stack

a) 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 probes.

b) The stack shall be sized to maintain a minimum exhaust air velocity of 2500 fpm at 2000-SCFM airflow. The maximum stack exit velocity shall not exceed the accuracy ranges of all stack instrumentation and shall meet the noise requirement of Section 3.3.9.

c) The exhaust stack shall be constructed of ASTM A312, Type 304L stainless steel and supported independently of the exhaust fan and ground attachments. The use of guide wires is not permitted. The flanges for each section shall be, at a minimum, 150# flanges and meet the requirements of ASTM A182.

d) The stack shall consist of two sections. The sections are identified as the lower and upper sections respectively.

e) The lower section shall be constructed of 304L stainless steel, schedule 40 pipe. The lower section will have two sample ports, 90 degrees apart, constructed of 304L stainless steel, 1 inch schedule 40 pipe. The lower section details are shown on EXHSTR-MECH-6.

f) The air sample probes shall be located and qualified by the seller. The sampler location shall be placed as required per 40 CFR 61.93. (40CFR60 Appendix A Method 1 and 1A.)

To locate the sample probes within the stack, in terms of distance from last disturbance, ANSI/HPS N13.1 requires that testing be completed to find a location where the contaminant concentration and the fluid momentum can both be demonstrated to meet numerical criteria for acceptable mixing. The stack details presented in this specification locate the probes within the stack per Environmental Protection Agency (EPA) Method 1, which contains the "8- and 2-diameter" rule. This rule states that sampling shall be conducted at locations that are at least 8 stack diameters downstream and 2 diameters upstream from any flow disturbance.

g) The upper section contains an air velocity probe for measurement of system flow and two shrouded probes for taking air samples. Access port(s) shall be provided to allow installation, inspection and testing of the sample probes, as required by ANSI N13.1. The inspection and testing port(s) shall be 4 inch. The upper section also includes seven 1 inch ports. The upper section details are shown on EXHSTR-MECH-6.

h) The upper stack section (removable) shall be equipped with lift points provided for lifting and handling, and shall be analyzed by calculation for adequacy. The lifting points and the gross weight of the stack section shall be identified on the drawing and on the stack.

i) The exhauster stack shall be thermally insulated (See Section 3.3.2.14).

3.3.2.13 Condensate Drain and Seal Pot System

a) The system shall be designed to drain and capture any condensate located in the heater housing, the filter train assembly, or the fan housing to the buyer's waste tank(s) or collection tank/system point by use of either a gravity drain or condensate pump. Electrical power for the condensate pump will be provided by an off skid source. The drain system will need to operate effectively at the maximum negative pressure capacity of the fan. Individual lines from each drainage point in the system shall be sloped a minimum of 1/8" per foot to the seal pot.

b) The seal pot system details are shown on EXHSTR-MECH-15.

c) The seal pot shall have penetrations for a 1" IPS valved fill port, 1" IPS valved drain to the tank, 1" IPS valved drain to the condensate pump, and ½" IPS drain to atmosphere (total drainage). The seal pot design shall include a vent to release air pressure from the headspace to accommodate filling and level measurement of the seal pot. The vent

shall be routed from the top of the seal pot back to the airstream before the HEPA filters. The seal pot shall be fabricated from ASTM A 240, Type 304L, using all welded and flanged end construction. (See Level Indication 3.3.4.4)

d) The seal pot shall have a sight glass (with minimum and maximum % full marks indicated) so that the seal pot liquid level can be visually verified during various operations.

e) The seal pot piping materials and construction shall conform to the requirements of ASME B31.3, Chapter III. The piping shall be ASTM A 312, Grade TP 304L and fittings shall be ASTM A 403, Class WP 304L. All piping shall be pressure tested in accordance with the methods of ASME B31.3 as an assembly with the filter housing at an pneumatic test pressure of 2 psig.

f) The drain lines and seal pot shall be heat traced, insulated per Section 3.3.2.14, and weather protected to assure freezing cannot occur under the design conditions of Section 3.2.5.1. The inspection of heat tracing shall be performed before insulation is applied.

g) The drain lines shall be protected by grating, or similar, from personnel standing on the drain lines and damaging the piping, heat trace or insulation. The grating shall not obstruct the ability to access the fill port (or require removal).

3.3.2.14 Thermal Insulation Material Requirements

a) The fan housing, heating system including heater expansion tank, drain system, seal pot, stack, stack flow monitoring sample & pump cabinets, and all stack flow monitoring sample lines (including condensate drain, and lines inside of cabinets) shall be insulated with UV resistant, closed cell insulation to resist retention of, and degradation by, water.

b) The insulation material shall have a minimum "R" value of 7 and shall meet the requirements of the Midwest Insulation Contractors Association (MICA) for materials, design and application and shall not interfere with the operating, testing, maintenance, and service of any components or systems. Insulation shall be removable and re-installable from components requiring periodic maintenance and inspection. The use of lead or asbestos material is not permitted. Insulation material shall be free of halogenated hydrocarbons.

3.3.3 EXHAUSTER ELECTRICAL COMPONENTS

Appendix C contains detailed design sketches of the exhaust skid electrical and instrumentation components. These sketches are intended to supplement the specific design requirements provided in this section of the specification. The sketches will not be updated with changes made during design of exhauster. Note discussion concerning these and other drawings in Section 1.3.

3.3.3.1 Service Power

Electrical components shall meet the requirements of NEC (NFPA 70), UL, and NEMA MG-1 (as applicable), and shall be provided with complete test reports. Utilization equipment rated greater than 1,000 W and lighting equipment with an inductive reactance load component shall have a power factor of not less than 85 percent under rated load conditions. Utilization equipment with a power factor of less than 90 percent shall be corrected to at least 90 percent under rated load conditions.

Electrical service to the exhauster skid shall be 3-phase, 4-wire, 480 VAC. The service disconnect shall be sized as required for the total electrical load and shall be provided in a weatherproof enclosure suitable for outdoor installation. The symmetrical short circuit current rating shall be as required to withstand the available fault current at the point of connection.

Appropriately sized individual fused disconnects in weather proof enclosures shall be provided for the variable speed drive and the glycol heater.

A 480-120/240 VAC single-phase transformer with service disconnect and distribution panel board shall be provided with feeder and branch circuit breakers ampere rating sized for the electrical equipment loads shown on EXHSTR-ELECDIAGRAMS-1 in Appendix C.

3.3.3.2 Mini-Power Zone

A 480-120/240 VAC single phase 10 KVA transformer and panel board with at least 10 single-pole 20 A breaker, and a minimum NEMA 3R rating, shall be provided.

Two duplex convenience receptacles with GFCI shall be mounted to the exterior of the mini-power zone. The convenience receptacle shall be provided with weather caps.

3.3.3.3 Electrical-Non Specified

Electrical materials and equipment shall be UL or FM tested, with label attached, for the purpose intended, whenever such products are available. When there are no UL or FM listed products of the type, testing and certification by another nationally recognized testing agency may be acceptable. Deviations to this requirement shall be evaluated and approved by the buyer on a case-by-case basis.

Butt splicing of wires is not allowed. All wires shall be terminated on terminal strips. Passing a NEC inspection is required prior to shipping. The NEC inspection shall be provided by the buyer.

Provisions shall be made for isolating instruments and equipment from hazardous energy sources during maintenance and repair. Electrical enclosures shall provide means for lock and tag application.

All exposed electrical power terminations >50 V within control cabinets shall have electrical rated barriers to avoid inadvertent contact with energized conductors during maintenance.

3.3.3.4 Specific Electrical/Controls Equipment

The exhauster electrical enclosures shall have a Equipment Identification Number (EIN) as shown on EXHSTR-MECH1 in Appendix B.

The various electrical enclosures required are listed below including minimum required NEMA rating:

1. Main 480-Volt Disconnect Switch (NEMA 4)
2. Exhaust Fan Disconnect Switch (NEMA 3R)
3. Glycol Heater Disconnect Switch (NEMA 3R)
4. Instrument Enclosure (NEMA 4)
5. Control Cabinet (NEMA 4X)
6. Heat Trace Cabinet (NEMA 4X)
7. Mini-Power Zone Cabinet (NEMA 3R)
8. Sample Cabinet (NEMA 4)
9. Field Terminal Enclosure (NEMA 4X)
10. Glycol Heater Controller (NEMA 4)
11. Vacuum Pump Terminal Enclosure (NEMA 4)

12. VFD Enclosure (NEMA 4)
13. Transfer Switch (NEMA 3R)
14. External Signal Connection Cabinet (NEMA 4)

The general arrangement of the electrical enclosures is shown in EXHSTR-MECH3. Items 1, 2, and 3 shall be connected by a wire way. All enclosures shall be weatherproof and suitable for outdoor use. The control cabinet shall be a Hoffman model A-72H3724SSFS custom type with PLC access window as shown on EXHSTR-ENCLOSURE-3.

3.3.3.5 Cabinet Temperature Control

The cabinets shall be controlled to maintain the interior cabinet temperature within the operating limits of installed equipment. The control cabinet temperature and humidity shall be monitored to prevent the system from exceeding operating limits. The Sample cabinent shall include the following:

1) Cooling fan shall be powered with DC voltage.
2) Thermostats shall be rated for outdoor use and mounted externally for temperature changes made without opening cabinets.
3) Internal cabinet shall be displayed on the outside of the cabinent.

3.3.3.6 Wiring Practices and Electrical Safety Requirements

All cabinets shall be fabricated to comply with UL-508, NFPA 70, and NFPA 79. A clear insulating cover shall be placed over energized parts (e.g. terminal blocks, motor starters, and/or relay blocks) if the voltage is above 50 Volts to ground. The purpose of insulating cover is to prevent contact with energized parts. All electrical heaters shall be installed in accordance with the manufacturer's instructions and with proper clearances. All other components are to be installed in accordance with the manufacturer's instructions. Applicable cabinets shall be labeled to indicate UL-508 compliance.

The minimum conductor size shall be as shown in Table 310-16 in NFPA 70, with the exception that the minimum conductor size shall be 14 AWG for power conductors and 16 AWG for control circuits. Lead wires for manufactured components are permitted to be 18 AWG or larger. 16 AWG control circuit wiring shall have either MTW or THHN/THWN insulation. All other wiring shall have THHN/THWN insulation with the exception of the lead wires of an UL or NRTL listed or recognized component. All wires shall be labeled with either a numeric or an

alphanumeric labeling scheme. A wire run list or schedule shall be provided if required. Copper conductors shall be used.

All power and instrumentation circuits shall be routed in separate raceways to ensure electromagnetic interference/frequency (EMI/EMF) noise does not impact the instrumentation, control and alarm circuits.

Where possible all electrical penetrations into the cabinets shall be from the bottom of the cabinet. Wire ways or equivalent methods shall be used to separate power and control wiring from instrumentation wiring. Instrumentation wire pairs shall be terminated side by side (high next to low) and the shield wire shall be terminated next to the low wire.

Electronic modules or relays installed in sockets shall be secured with a spring clip or other restraining device.

The door of the cabinet shall be bonded to the cabinet ground. The grounding conductor coming from the AC power source shall be bonded to the cabinet grounding point as designated by cabinet manufacturer.

3.3.3.7 NEC Inspection

An NEC electrical inspector, provided by the buyer, shall inspect exhaust skids fabricated under this contract. All deficiencies found shall be corrected or dispositioned prior to shipment.

3.3.4 EXHAUSTER INSTRUMENTATION AND CONTOL

Appendix C contains detailed design sketches of the exhaust skid electrical and instrumentation components and Appendix D contains sketches of the stack monitoring system. The sketches in Appendices C and D are intended to supplement this section of the specification. The sketches will not be updated with changes made during design of exhauster. Note discussion concerning these and other drawings in Section 1.3.

All of the exhauster instrumentation shall comply with the NEC.

All transmitters, temperature sensors, and velocity probes shall be capable of 2% accuracy (of full scale) or better.

3.3.4.1 Pressure Monitoring

The exhaust system shall be equipped with a differential pressure (DP) system that measures filter performance. The DP indicating transmitters shall measure the DP across the prefilter, first HEPA filter, and the second

HEPA filter. The exhaust system shall also be equipped with DP indicating transmitters that measure the DP from the inlet plenum to atmosphere and across the heater plenum. A stable atmospheric reference shall be provided for measuring the DP at the inlet plenum.

The DP transmitter signals shall be input to the PLC and shall be indicated on the control panel with digital indicators. The PLC will add the two HEPA filter readings and display the DP for both filters. The system shall also have interlocks to shutdown the exhaust fan on certain abnormal alarm situations and prevent start up on some of those conditions. Alarms shall be indicated on a data message display and illuminate a clear strobe light for abnormal situations.

The heater system shall include a pressure indicating transmitter at the discharge of the circulating pump. The system shall also have interlocks to shutdown the heater system on certain abnormal pump discharge pressure situations.

The exhaust system shall also be capable of monitoring the pressure within the storage tanks in which the system is ventilating. The exhaust system shall communicate with existing pressure instrumentation on the storage tanks.

3.3.4.2 Temperature Monitoring

Exhaust temperature monitoring system shall consist of three 100Ω platinum resistance temperature detector (RTD) probes, one before the heater, one before the first HEPA filter, and one after the second HEPA filter. The RTDs shall be installed in 12" deep thermowells. The RTD signals shall be input to the PLC and shall be indicated on the control panel with digital indicators. The RTD before the first HEPA filter shall have an interlock. Upon detection of a high temperature, and a low temperature differential, alarms shall be indicated on a data message display and illuminate a clear strobe light.

A RTD shall also be provided with the stack flow measurement instrument. This device shall be used to provide temperature compensation for volumetric and mass flow rates.

3.3.4.3 Stack Monitoring

The exhaust stack shall be equipped with flow instrumentation, sample and measuring ports, and a particulate effluent monitoring system as shown on the attached sketches in Appendix D. This portion of the design is *required* to utilize the buyer specified components unless specific written exemption is provided to the seller by the authorized representative

of the buyer. The descriptions provided below are intended to supplement the sketch requirements. Any discrepancy between the two sources shall be addressed to the buyers' representative.

The exhaust stack monitoring system in compliance with 40 CFR 61.93 (b)(1)(i), 40 CFR 61.93 (b)(1)(ii), 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities" and 40 CFR 52 Appendix E, "Protection of Environment". Compliance with these requirements may be shown with data from the W-314 exhausters. The monitoring system shall meet the following requirements:

a) Sample collection system – including probes and transport system shall comply with the requirements of ANSI N13.1. Two sample probes are required. One loop shall be dedicated to the record sample and the other shall supply the sample to the continuous air monitor (CAM). The sample collection probes shall employ shrouded probe technology. The transport lines shall be insulated and heated (inside and outside of cabinets) to preclude the condensation of moisture between the sample point and the entry into the EMS Sample Cabinet, between the EMS Sample Cabinet and the vacuum pumps, and on the return line of the sample pumps to the exhaust stack. The sample collection system shall be designed to operate in a pH range of 10-14, RH of 85% (or optionally use a sample line air dryer if other system components cannot meet humidity requirement), and a temperature range of 27 to 48 °C (80 to 120 °F).

   The sample collection system shall be designed (per ANSI N13.1) to minimize depositional losses. The system layout shown in Appendix B is intended only as a guide. The seller's design shall optimize particulate penetration, and provide justification for each percentage increase in depositional loss. The configuration of the seller's sample transport system design shall be approved by the buyer.

   The sample transport lines shall be provided with fittings that provide a near-seamless connection at all tubing joints. The fittings shall enable a smooth transition of sample flow from the probe assembly to the sample transport line. Most compression-type fittings have step transitions. The above restrictions do not apply to the vacuum return lines which are connected downstream from the CAM heads or the record sample filter holder.

   The sample transport lines (both sample and CAM) shall be designed to include the following features to accommodate maintenance/testing activities: Include "T" fittings with isolation ball valves for connecting vacuum source/pressure indicator, and include in-line isolation ball

valves to aid in testing of low flow alarms.

b) Particulate Record Sampler – The Record Sample loop shall consist of the sample probe, delivery tubing, a modified Gelman Sciences 47mm filter holder, flexible hose/tubing, mass flow controller, vacuum gauge, isolation valves and manifolding into the redundant vacuum pumps. The mass flow controller will provide a flow signal to the PLC and control sample flow rate based upon input from the PLC. The buyer will be using 47-mm diameter Gelman Sciences Versapor® 3000 collection filter paper, which is 0.0025-inches thick.

c) Particulate Beta Continuous Air Monitor (CAM) – The CAM loop shall consist of a sample probe, delivery tubing, the CAM, flexible hose/tubing, mass flow controller, vacuum gauge, isolation valves, and manifolding into the redundant vacuum pumps. The CAM shall be an Eberline model AMS-4 with remote in-line head. The AMS-4 shall be procured with fail-safe alarm logic (fail alarm shall initiate upon loss of power), output relays, and RS-485 host communications port. The seller shall ensure the AMS-4 is qualified by the manufacturer to function at maximum expected sample air stream temperatures, while still meeting detection, accuracy, and response tolerances as described in ANSI N42.18 (NOTE: This may require factory modifications to the in-line sample head). The vendor shall perform calculations to determine the maximum air sample temperature at the CAM given the design conditions in Section 3.1.2.1.

d) Stack Flow Instrumentation – The stack shall be equipped with a Veris Verabar type multi-port flow element with integral RTD (for temperature compensation) and remote mount flow transmitter. The transmitter shall have an integral square root function and transmit a flow proportional 4 to 20mA signal to the skid PLC. The buyer will provide the operational logic and PLC program.

e) Sample Flow Instrumentation – Both sample loops (record and CAM) shall be provided with Hastings model HFC-303, or buyer approved equal, mass flow controllers capable of providing a flow rate signal to the PLC and controlling the flow in proportion to a control signal from the PLC. The mass flow controllers shall operate over a range of 0 to 4 SCFM. The flow controllers shall be mounted such that their flow path is horizontal.

f) Data Collection/Storage Capability - The stack monitoring equipment shall interface with the PLC. The PLC logic shall include the following control functions:

1. Vacuum pump start, stop, and alternating commands (including

interlock with exhauster fan)
2. Control function for sample/monitor mass flow controllers
3. Shutdown of exhauster based on High Radiation or system failures
4. CAM bypass to allow functional testing and filter paper change out while maintaining continuous exhauster operation

Stack flow and sample flow rates shall be input to the PLC. The PLC will compute the total flow volume for each loop and display both rates and totals (regardless of whether in CAM bypass or not). The CAM alarm will have a method to by-pass the High Beta and CAM failure alarms for testing of the CAM. The following data will be displayed on the HMI during by-pass testing of the CAM: Stack Flow (SCFM), Stack Total (SCF), Record Sample Flow (SCFM), Record Sample Total (SCF), CAM Sample Flow Rate (SCFM), and CAM total flow (SCF). All system interlocks will remain in operation and override the by-pass on an alarm condition.

g) Vacuum System – Two sample vacuum pumps shall be provided, each capable of drawing a minimum of 1.42 L/s (3 SCFM) at system static pressure through the sample/monitor loops. The vacuum pumps shall be provided with appropriate motor starters. The discharge from the vacuum pumps shall be routed back to the stack to a point above the sample extraction point. The PLC will control the operation of the vacuum pumps and will alternate lead-lag positions for the pumps in addition to providing an automatic switch from lead to lag upon failure of the lead unit. Valving shall be provided in the delivery systems from the record and CAM loops to individually control the vacuum to each loop for maintenance and filter changing operations. Hour meters shall be provided for both the primary and the secondary vacuum pumps. The hour meters may be mounted in the control cabinet. The hour meter housing shall be rated for the environment where it is mounted.

h) Environmentally Controlled Sample Cabinet – The seller shall provide an enclosure for the effluent monitoring system. The cabinet shall include the record sample filter holder, the CAM detector head, the mass flow controllers for each loop, valving for the loops, and necessary wiring and terminal blocks. The cabinet shall be equipped with environmental controls compatible with the requirements of the equipment contained in the enclosure. The seller shall provide analysis that the maximum and minimum temperatures expected in the cabinets do not fall outside the published operating limits for the included equipment. The cabinet shall be insulated (see Section 3.3.2.14) and its vents shall be easily closeable (e.g., sliding doors/louvers) in winter months.

i) Condensation Collection System – The seller shall provide a condensate collection system, as required, to ensure reliable operation of the flow control valves, stack flow instrumentation, and other sampling components. The condensate collection system shall be designed for ease of operation and removal of collected condensate. The seller shall determine the requirements for the condensate collection, including the collection location(s) and required capacity and type of collection bottle. Condensate collection requirements and supporting calculations shall be documented in the definitive design report.

3.3.4.4 Liquid Monitoring

The seal pot and heater glycol reservoir shall have a level transmitter. The seal pot system will be equipped with low liquid level and high liquid level alarms. The liquid level shall be indicated on the control panel LCD and have latching visual alarms. The seal pot shall also have a sight glass (with minimum and maximum % full marks indicated) so that the seal pot liquid level can be visually verified during various operations.

3.3.4.5 Programmable Logic Controller

The exhauster control system shall consist of a programmable logic controller (PLC) with a Human Machine Interface (HMI) that will monitor and control the exhauster skid and alert personnel of alarm situations. The control system will be located inside the exhauster control cabinet and shall be readily accessible by farm personnel. The control cabinet shall contain Class II, 24 V DC power (for the control loops), Fieldbus to Modbus communication equipment (to monitor instruments external to the exhauster skid), control relays for exhauster control equipment (motor-operated valves, pumps), the PLC unit, and the HMI unit. A heating and air conditioning unit shall provide climate control within the cabinet to prevent the internal climate of the cabinet from exceeding the operating range of the equipment. The PLC shall include a computer controller, I/O slots, and an Ethernet TCP/IP communications port for communicating exhauster data to systems located outside the tank farm. The HMI shall have a color display screen of no less than 15 inches and capable of 256 colors, input keypad for operator input of alphanumeric values, and a pointing device with left and right input buttons.

The control system shall have interlocks to shutdown the exhauster on certain defined alarm situations (see Section 3.3.4.6 and EXHSTR-P&ID-1, in Appendix C). Capabilities of the PLC, in addition to those specified elsewhere in this document, shall include the following. The PLC shall be able to maintain a set fan speed or a set flow rate. The PLC shall have the capability to monitor up to 18 external pressure/flow inputs from storage

tank instruments. The PLC shall have the capability to monitor/output the total runtime for the exhauster fan and total runtime for the air sample vacuum pumps. The air monitoring vacuum pumps shall be interlocked to the exhauster fan, but there shall also be a capability to start the vacuum pumps independently of the exhauster fan, in order to establish flow through the sampling system for low flow alarms and CAM failure. The buyer will provide the seller with the Logic Program for the programmable controller.

A Variable Speed Drive (VSD) for the fan and shall be provided and be compatible with the PLC and shall control exhauster flow rates over the range of 500 – 2000 SCFM. The VSD shall be located in a cabinet separate from the PLC and shall meet the environmental requirements set forth in Section 3.2.5.

3.3.4.6 Off-Skid Instrumentation Wiring

The exhauster control system shall interface with field instrumentation not a part of this design package. The field instrumentation will include up to 18 tank pressure and/or air flow signals. The seller shall route conduit and provide the necessary wiring, connections, and standard terminations between the associated exhauster instrument enclosures and the exhauster's External Signal Connection Cabinet. Interfaces are shown in Appendix E for reference only.

3.3.4.7 Common Interlocks/Set Points

System interlocks and set points described in this section and EXHSTR-P&ID-1 are intended to provide the seller with a general understanding of the operation of the exhauster skid. They are provided to assist the seller when determining operating ranges for instrumentation, however they are estimates and are subject to change. These parameters will be a part of the Logic Program supplied by the buyer and will be verified during testing.

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. The Low DP shall be set at 25 Pa (0.3 in WG). The High High DP on the 1st HEPA filter shall be set at 1345 Pa (5.4 in WG), the 2nd HEPA filter set at 922 Pa (3.7 in WG) and across both HEPA filters set at 1345 Pa (5.4 in WG). The exhauster shall shutdown when receiving a Low DP or High High DP. During system start-up there will be a 30-second time delay allowing the system to clear the Low DP condition. Each HEPA filter shall also have a High DP alarm, with set points of 4.5 in WG for the 1rst HEPA filter, and 3.2 in WG for the 2nd HEPA filter.

The RTD before the 1st HEPA filter shall have a high temperature

interlock set at 220°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 shall be equipped to alarm and interlock (exhauster shutdown) with a low liquid level setting and a high liquid level setting. The liquid level shall be indicated on the control panel HMI. The seal pot interlock will consist of low and high liquid level set at 30% and 80% of the seal pot volume respectively. On detection of seal pot liquid levels outside of the operating parameters, the exhauster fan will be shutdown.

The glycol reservoir, upon detection of less than 40% volume, shall shut down the heater core and glycol recirculation pump, display an alarm and actuate the strobe. A glycol system preheat function shall also be incorporated into the PLC logic to ensure the filter housing maintains a constant temperature greater than ambient and on startup the air will effectively be warmed reducing the humidity to below 70%.

The system shall be equipped to shutdown the exhaust fan upon detection of a high vacuum within the storage tanks. The fan shall shutdown at a pressure differential setpoint adequate to ensure the tank dome space does not exceed allowable limits (typical 241-C tank vacuum limits range from 0.8 to 9 in WG).

See EXHSTR-P&ID-1, in Appendix C, for a preliminary listing of set points for each of the operating modes.

3.3.4.8 Freeze Protection

Freeze protection shall be installed on each of the condensate lines and on the seal pot reservoir. Heat trace shall be separated in at least two separate sections and provide indication that the heat trace is operating correctly. The heat trace system shall be thermostatically controlled to energize when the temperature drops below freezing. Heat trace inspection and testing shall be performed before addition of the insulation.

3.3.5 WELDING

Welding, welding procedures, welder qualifications, and inspections shall be in accordance with ASME AG-1 (or ASME N509). All welding performed by the filter housing manufacturer and/or the filter train fabricator/manufacturer shall be based on published consensus standards such as AWS D1.1, AWS D1.3, AWS D9.1, ASME B31.3.

Weld size and type shall be selected by the filter housing manufacturer and/or the filter train fabricator/manufacturer based on applicable seismic, wind loading and system pressure requirements established within this specification.

Special care shall be taken to limit contamination of stainless steel components with halides, which are common to adhesive products. If necessary, stainless steel components shall be cleaned with neutral detergent and water.

3.3.5.1 Carbon Steel Structural Welding

a) All welders, welder operators and welding procedures shall be qualified in accordance with the requirements of the AWS D1.1, AWS D1.3 and/or AWS D9.1 to the extent that these standards apply to the fabrication and production welding of the vent train base and stack support.

b) All welds shall be visually inspected and documented by a certified welding inspector (CWI) who has received formal certification in accordance with the requirements of AWS QC-1.

c) Welds for these components shall meet the visual acceptance criteria of ASME AG-1, Article AA-6330. As an option the weld acceptance criteria of NCIG-01 may be used in lieu of the criteria of ASME AG-1, Articles AA-6324 and AA-6331.1 for structures and supports fabricated to the requirements of the AISC specification and AWS

D1.1.

d) All load bearing welds, or welds deemed critical by the buyer, shall be required to have magnetic particle weld examinations. The buyer will work with the seller to identify all these weldments at the conceptual design review. An example of a critical weldment is the attachment of the skid lifting lugs to the vent train base.

3.3.5.2 Pressure Boundary and Stainless Steel Structural Welding

a) All welders, welder operators and welding procedures shall be qualified in accordance with the requirements of the ASME boiler and pressure vessel code (BPVC), Section IX.

b) All welders shall be qualified in all positions and with the thinnest gage metal used in production welding. If welder qualification on a single gage of metal qualifies the welder to a "range" of thickness (including the thinnest gage) utilized in production welding in accordance with the requirements of the ASME BPVC, Section IX, then qualification of the thinnest gage is not required.

c) All welds shall be visually inspected and documented by a certified welding inspector (CWI) who has received formal certification in accordance with the requirements of AWS QC-1.

d) Performance qualification test samples for materials used in "pressure boundary" construction shall be inspected with liquid penetrant on both root and face surfaces in accordance with the ASME BPVC, Section V.

e) All HEPA filter element holding frame welds, where failure could result in process media bypassing the filter element, shall be inspected with liquid penetrant in accordance with the ASME BPVC, Section V.

f) Stainless steel piping, seal pot, and heater reservoir welds shall be per ASME B31.3. Dye penetrant test all welds in drain piping and seal pot at final pass.

g) Stainless steel sheet metal shall be welded per AWS D9.1. Dye penetrant test all welds in ducting and transitions in contact with the exhauster airstream at final pass.

h) All load bearing welds, or welds deemed critical by the buyer, shall be

required to have liquid penetrant weld examinations. The buyer will work with the seller to identify all these weldments at the conceptual design review. Examples of critical weldments are the fan and ductwork connections that are deemed critical by the structural and applied loads analyses.

i) If a bimetal weldment joint exists between the fan condensate drain connection and the stainless steel condensate drain system a welding procedure prepared by the seller and approved by the buyer shall be completed.

j) Acceptance criteria for welds shall be in accordance with the applicable design codes.

k) Welds for those components not required to be fabricated to a specific ASME design section of the BPVC may utilize the visual acceptance criteria of NCIG-01.

l) If the filter housing manufacturers visual weld inspection procedures defining specific weld acceptance criteria are based on, include or exceed this specification's referenced requirements (3.3.5.5) of ASME AG-1 (or N509, section 7.3), then a copy of their procedure, marked to indicate the applicable requirements, shall be submitted as part of the NDE operational procedures package for approval prior to the start of fabrication.

3.3.5.3 Weld Materials

All welding filler metals and fluxes used in the fabrication and repair of the exhauster components shall be in accordance with the requirements of ASME, SEC II, Part C. Material does not have to be purchased from an ASME supplier.

3.3.5.4 Welding Procedures and Qualifications

The seller shall prepare written welding procedures. Welding procedures and personnel shall be qualified in accordance with the applicable AWS or ASME specifications as specified. The seller shall submit copies of all welding procedures, procedure qualification records for the performance of this purchase order. Buyer approval is required prior to the start of fabrication. Data and changes thereto shall be submitted to the buyer. Procedures and procedure qualification records shall be in the form of clear, reproducible prints, and shall be produced on forms, as specified in AWS D1.1, or on forms of equivalent format. The seller's quality control

procedures shall include the requirement that no welders shall have in their possession more than one type of filler metal at any one time, an exception is that welders may have both bare wire and covered electrodes that deposit weld metal of the same A-number class.

3.3.5.5 Weld Inspection Requirements

a) Personnel performing visual weld inspections shall be certified as a certified weld inspector (CWI) in accordance with the requirements specified in AWS QC-1. The following documentation shall be submitted prior to the start of fabrication:

   1) Current AWS CWI certificates.

   2) Current and valid visual acuity examination. The examination must be performed annually.

   3) Visual weld inspection procedures.

   Approval shall be obtained from the buyer prior to start of fabrication. To meet code requirements, it must be shown that:

      i. Inspectors performing visual inspections to ASME B31.3 requirements shall have natural corrected near-distance acuity in at least one eye, as demonstrated by the ability to read the Jaeger number 1 type on a standard Jaeger test at a distance of 12 inches or more, or equivalent. Also, inspectors performing visual inspections to AWS code requirements shall receive an examination for far-distance acuity, such as a Snellen test at 20 feet or equivalent. The minimum acceptable natural or corrected far-distance acuity shall be a Snellen fraction of 20/40 or equivalent for AWS.

      ii. Inspectors shall be capable of distinguishing contrast between colors when using Ishira color plates, or equivalent results if another method is used. Color visual is considered normal as indicated by the inspector identifying 19 or 25 Ishira color plates or equivalent.

b) Nondestructive examination processes required within this purchase

order shall require review and approval of seller's:

1) Personnel certification procedure.

2) Personnel certifications.

3) The NDE operational procedures.

This approval shall be obtained from the buyer prior to start of fabrication.

c) The personnel certification procedure shall accurately reflect the requirements embodied in the applicable issue of SNT-TC-1A plus any other requirements of the seller.

d) The personnel certification package shall contain:

1) A letter of certification signed by an officer of the seller's company.

2) Objective evidence of the certified person's educational level.

3) Objective evidence of the required training and the successful completion thereof.

4) Evidence of claimed experience.

5) Hire-rehire dates, if applicable.

6) Valid, current eye examination results.

e) The NDE operational procedures shall contain all applicable requirements of the documentation referenced in the purchase order including:

1) Reference standard or image quality indicator information.

2) Chemical purity requirements.

3) Calibration requirements.

4) Report forms, as a minimum.

f) When radiography is required, demonstration radiographs shall be provided for review.

g) Seller's authorized personnel shall approve NDE practices, procedures, reports, etc., for release. The functions and position of the person approving the release shall be described in the seller's quality assurance program. Approval signatures shall be accompanied by the signer's typed or printed signature and title.

h) The seller is responsible for and shall certify to nondestructive examination (NDE) specification compliance by their organization and their subtier sellers for those special processes listed in the purchase order. Objective evidence shall be maintained at the seller's facility and be available for audit by the buyer. Each shipment shall be accompanied by legible, reproducible copies of certification stating that the process(es) was performed in accordance with specification requirements. A signature and certification level. The certification and the NDE report shall identify the applicable specification and revision to which the special process conforms; the name of the agency that performed the special process, if other than the seller; the date and the signature of the seller's representative. When parts are serialized, the serial numbers shall appear on the certification and NDE report.

i) Data and changes thereto shall be submitted to the buyer as identified in the purchase order.

j) Personnel performing NDE (RT, PT, UT, ET, LT, AC or MT) shall be qualified/certified to SNT-TC-1A, current edition unless otherwise specified. The recommended practices in SNT-TC-1A are mandatory requirements for this purchase order.

k) Weld inspection and records including a weld map shall be assembled into data packages for each weld and submitted to the buyer. The weld map shall consist of an electronic drawing with initials of welders who performed the welds and identify the acceptance procedure utilized.

3.3.5.6 Workmanship

Acceptable workmanship shall be based on satisfactory completion of the following inspections, and those required by the drawings:

- Overall dimensional check for compliance with the drawings
- All interface dimensions checked and verified to meet drawing requirements
- Satisfactory completion and acceptance of all specified nondestructive examinations
- Visual inspection and acceptance of welded components to specified standards; (e.g., no undercutting, cracks, crevices)
- Surface finishes per drawing requirements, ensuring that no scratches or gouges that violate these finishes are present
- Cleanliness in accordance with specified requirements
- Fabrication inspections stamped or signed off by the seller's quality control organization.
- Completed weld map(s) per applicable industry standard.

3.3.5.7 Additional Welding Requirements

- All tools used for stainless steel shall be kept separate from any tools previously used or currently being used for cleaning carbon steel components. For example, tools for stainless steel shall be used only on stainless steel surfaces.
- All areas from which temporary attachments have been removed shall be examined by the liquid penetrant method after the surface has been restored.
- Preparation for welds shall be by non-thermal methods where practical.
- Thermally cut surfaces shall be ground to provide slag-free metal and fit-up equivalent to machining.

- Where welding destroys protective plating on hardware items, the weld and surrounding area shall be thoroughly cleaned, primed, and painted.

- Ensure insulation is dry before welding around insulation, and control heat to prevent material damage.

3.3.6 CLEANLINESS

Before assembly, all components shall be clean to the extent that extraneous materials, such as those listed below, are not present:

- Metals poly dusts (shop dust), chips, and turnings
- Abrasive particles
- Rust and other loose corrosion products
- Magnetic/liquid penetrant residues, dye check, etc.
- Foreign material, such as paper, plastic, and wood
- Cutting oils
- Excess lubrication grease and oil
- Marking dyes
- Adhesives

3.3.7 IDENTIFICATION AND MARKINGS

3.3.7.1 Nameplates/Labels

Nameplates shall be provided on all major components as specified in the specific sections of ASME AG-1. Additionally, the seller shall affix a permanent stainless steel nameplate on the exhauster that is affixed in such a manner that it cannot be removed without destroying or defacing it and shall include the following information stamped or etched in 1/2 -in. characters:

- Manufacturer
- Date of manufacture
- Buyer's purchase order number
- Buyer's specification number and revision
- Serial identification number
- Maximum Weight
- Electrical power requirements (volts, phase, cycles).

3.3.7.2 Identification Tags and Numbers

Valves, instruments, equipment, and electrical connectors shall be identified by permanently affixed identification tags with unique identification numbers. Component and instrument identification numbers are provided on the P&ID sketches in Appendix C.

3.3.7.3 Labeling.

Labeling shall be legible and conform to human visual capabilities and limitations in regard to physical characteristics, (e.g. letter and symbol size, contrast, font, simplicity, spacing, and stroke width). Component labeling shall be in accordance with buyer-supplied procedures.

3.3.8 PAINTING AND COATING

Painting and coating shall comply with Sections 3.3.1.5 and 3.3.2 of this specification. Prepare and paint all exposed carbon steel surfaces with one coat of fast dry industrial rust inhibitive primer and two finish coats of fast dry industrial enamel. Finish color shall be gray. The minimum paint thickness shall be 0.004". Paint shall be applied per manufacturer's recommendation. 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. Flange faces and threaded surfaces shall not be painted. The lifting lugs shall be painted yellow and identified using 1" high black characters.

The exhauster skids shall be weighed and marked on each side of the frame with "GROSS WT xxxxx LBS". Apply with 2" high black letters on a yellow background. Use sign painters enamel paint or fast dry alkyd industrial enamel paint. Apply per manufacturer's specifications.

3.3.9 HUMAN ENGINEERING

The seller's design shall apply the principles of human engineering regarding installation, operation, and maintenance of the equipment. Factors to be considered include, but are not limited to,

Accessibility of equipment for maintenance and repair (i.e. bearings requiring lubrication shall be accessible without disassembly).

Gauge visibility.

Accessibility of valves and controls.

Storage requirements for maintenance and repair equipment.

Minimizing the loads required by operators (operator effort of less than 35-50 lbs) while operating the equipment.

3.3.9.1 Noise Levels

The stack and mechanical equipment noise emissions at the maximum flow rate condition (2000-SCFM) shall not create noise levels equal to or greater than 85 dBA 8-hour time weighted average, or equivalent noise dose. This shall be measured by a calibrated noise meter at 1 meter.

3.3.10 DRAWINGS

All design drawings produced for the Exhauster and associated equipment shall utilize AutoCAD[1] Release 2002 or higher for all drawings produced for this specification. All equipment designs shall comply with ANSI Y14.5M, "Dimensioning and Tolerancing." Drawings shall meet all the requirements of buyer-supplied procedures as well as the following:

- ISA 5.1 Instrumentation Symbols and Identifications
- ISA 5.4 Instrument Loop diagrams

4.0 QUALIFICATION AND VERIFICATION

The objective of the qualification and verification matrix is to define a method for ensuring that all requirements have been included and that the engineering development of the exhauster system is complete. The seller shall functionally test all indicators, alarms, and interlocks via a Acceptance Test Procedure (ATP).

4.1 TESTING

The seller shall be responsible for the completion of all tests, identified in Table 4-1, "Verification Matrix," (Section 4.3). The testing shall include acceptance test, feature tests, analysis, engineering evaluations, and inspections. The seller shall submit an acceptance test procedure that covers all identified tests to the buyer for approval. Analyses, engineering evaluations, and inspections shall be reviewed with the buyer prior

[1] AutoCAD is a trademark of Autodesk, Inc.

to initiation of the tests as applicable. The buyer or buyer's representative shall be present to witness the performance of the testing required by this specification.

4.1.1 POWER SYSTEM TEST

This test will verify that electrical power is properly distributed to all exhauster systems, and that applicable codes and standards were adhered to during assembly.

4.1.2 ROTATING EQUIPMENT BALANCING AND VIBRATION CRITERIA

The following rotating components are applicable to this section:

3) The drive motor rotating element
3) The fan wheel and shaft assembly

The drive motor rotating element shall be dynamically balanced as a minimum to the requirements of ISO 1940, G 2.5. All attempts by the balancing service provider to balance the drive motor rotating element to as close to the requirements of ISO 1940 G 1.0 as attainable shall be made. The fan wheel and shaft assembly shall be dynamically balanced as a minimum to the requirements of ISO 1940, G 6.3. All attempts by the balancing service provider to balance the fan wheel and shaft assembly to as close to the requirements of ISO 1940 G 2.5 as attainable shall be made. Balancing services may be performed by component O.E.M. or by a seller selected balancing company. When vibration readings are taken, the exhauster shall be on a concrete pad free of major cracks.

4.1.3 FILTER HOUSING TESTING

a) The filter housing assembly, including inlet/outlet transitions, shall be visually inspected in accordance with the requirements of ASME AG-1 (or ASME N510, section 5). Observed deficiencies shall be documented on the inspection checklist and as a non-conformance report (NCR) if needed. A corrective action shall be noted and re-inspection results documented on the inspection checklist and on the NCR disposition.

b) The filter housings/test sections shall be tested for airflow distribution in accordance with the requirements of ASME AG-1 (or ASME N510, section 8). If similar equipment (duplicate in design, layout and fabrication) has previously been qualified by this test, the results of this testing may be used to demonstrate airflow distribution qualification. Acceptance criteria shall be as given in ASME AG-1 (or ASME N510, section 8).

c) The filter housings/test sections shall be tested for air-aerosol mixing uniformity in accordance with the requirements of ASME AG-1 (or ASME N510, section 9). Qualification testing of sampling manifolds shall be conducted in accordance with ASME AG-1 (or ASME N509, Appendix D). Qualification testing of challenge aerosol injection manifolds shall be performed in accordance with ASME AG-1 (or ASME N510, section 9). If similar equipment (duplicate in design, layout and fabrication) has previously been qualified by these tests, the results of this testing may be used to demonstrate manifold and air-aerosol mixing uniformity qualification. Acceptance criteria shall be as given in ASME AG-1 (or ASME N510, section 9).

d) The filter housing/test sections (including heater housing and transition section) shall undergo a structural capability test in accordance with ASME AG-1 (or ASME N510, section 6). The structural capability pressure shall be as defined in ASME AG-1 (or ASME N509, section 4.6.6.1).

e) HEPA filter element holding frames at each filter position shall be pressure decay leak tested. The leak rate shall not exceed 0.1% of the housing volume per hour at the system leak test pressure as defined in ASME N509, Section 4.6.4.

f) The filter train, drain piping, and seal pot shall be pressure decay leak tested before pre-filter and HEPA filters are installed. The leak rate shall not exceed 0.1% of the housing volume per hour at the system leak test pressure as defined in ASME N509, Section 4.6.4.

g) A buyer's representative shall be present to witness the decay leak test of the assembly. The seller shall give a minimum of five (5) days advance notice prior to performing the test(s).

4.1.4 EXHAUST FAN AND EXHAUST TRAIN FLOW TESTING

This test will verify that the exhauster fan and drive motor operate freely, rotate in the correct direction, and operate within defined vibration limits. Filters shall be installed to perform the following tests. The three tests (a, b, and c) may be performed concurrently as a single test.

a) **Clean System Airflow**

The following test shall be performed over the entire fan operating speed in a maximum of 30-RPM increments, thus ensuring the fan does not pass through a resonance frequency at a lower operating speed. In instances

where vibration readings approach the acceptance criteria the increments shall be lowered to 10-RPM.

1) Install a device (orifice plate, valve, etc.) to generate a 12 ±0.5 in WG pressure loss to simulate the permanent system pressure losses.

2) Start the system fan and verify stable (no surging) fan operation for a minimum 15 minutes. Adjust fan speed and pressure device to create 12 ±0.5 inWG pressure loss at the lower fan operating speed.

3) Record system airflow, housing differential pressure, HEPA filter differential pressure, fan drive motor current, and fan shaft and motor shaft rpm.

4) Record vibration data on the fan shaft bearings in all three planes (horizontal, vertical and axial) – acceptance criteria,have less than 0.25 IPS peak velocity unfiltered (overall).

5) Record vibration data on the motor bearings in all three planes (horizontal, vertical and axial) – information only, peak velocity (IPS) filtered to the motors fundamental frequency (x1 rpm) and peak velocity unfiltered (overall).

6) Increase fan speed while maintaining 12 ±0.5inWG pressure loss and record all required information.

b) **Maximum Housing Component Pressure Drop Airflow**

The following test shall be performed at the fan system nominal flowrate of 2000 ACFM.

1) Install a device (orifice plate, valve, etc.) that can generate a sequential pressure from 12 ±0.5 in WG (to simulate the permanent system pressure loss) up to 19 ±0.5 in WG to simulate fully loaded HEPA and pre-filters.

2) Start the system fan and verify stable (no surging) fan operation for a minimum of 15 minutes.

3) Manipulate the device that is generating the artificial pressure loss

on the exhauster system such that initially, only the system pressure loss is applied. Record system airflow, housing differential pressure, HEPA filter differential pressure, fan drive motor current, and fan shaft and motor shaft rpm.

4) Record vibration data on the fan shaft bearings in all three planes (horizontal, vertical and axial) – acceptance criteria, have less than 0.25 IPS peak velocity unfiltered (overall).

5) Record vibration data on the motor bearings in all three planes (horizontal, vertical and axial) – information only, peak velocity (IPS) filtered to the motors fundamental frequency (x1 rpm) and peak velocity unfiltered (overall).

6) Increase pressure loss in 1 in WG increments and record all required information until 19 in WG (corresponding to loaded HEPA and pre-filters) is applied.

c) **Zero Airflow Test**

1) Install an isolation valve on the inlet

2) Start the system fan and verify stable (no surging) fan operation for a minimum of 15 minutes.

3) Slowly adjust isolation valve to the fully closed position. **Caution: At no time shall the pressure developed within the filter housing exceed the structural capability pressure as defined in ASME AG01 (or ASME N509, section 4.6.6.1).**

4) Record system airflow, housing differential pressure, HEPA filter differential pressure, fan drive motor current, and fan shaft and motor shaft rpm.

5) Record vibration data on the fan shaft bearings in all three planes (horizontal, vertical and axial) – acceptance criteria, have less than 0.25 IPS peak velocity unfiltered (overall).

6) Record vibration data on the motor bearings in all three planes (horizontal, vertical and axial) – information only, peak velocity (IPS) filtered to the motors fundamental frequency (x1 rpm) and peak velocity unfiltered (overall).

4.1.5 HEAT TRACE CHECK

This check will verify that the Heat Trace functions properly and in a safe manor.

4.1.6 INTERLOCK ALARM CHECK

This check will verify that interlocks perform as required to specific alarm conditions.

4.1.7 GLYCOL HEATER CHECK

This check will verify that the Heater and Glycol Circulation Pump function properly. This will also perform a capacity check of glycol pump to verify the pump is operating within the limits of its pump curve.

4.1.8 STACK PRESSURE DECAY TEST

This test will verify the integrity of the exhaust stack assembly air boundary (including the flex duct) in accordance with ASME AG-1/N509/N510.

4.1.9 SAMPLING SYSTEM LEAK TEST

The stack sampling system shall be inspected for leaks at the time of installation in accordance with ANSI N13.1, section 6.9.

4.2 VERIFICATION METHODS

4.2.1 INSPECTION

The inspection method shall be defined as visual or other means of determining that the requirement was achieved. It can include standard measurement or laboratory instruments to achieve the required accuracy of the inspection.

4.2.2 ANALYSIS

The analysis method shall be defined as engineering calculations using recognized standards and identified assumptions to prove that a requirement can be achieved.

4.2.3 ENGINEERING EVALUATION

The engineering evaluation method shall be defined as an evaluation of design approaches or comparison of requirements to the design that cannot be analyzed by established standards/assumptions. The use of engineering evaluation requires the concurrence of the buyer to establish if the requirement has been met.

4.2.4 FEATURE TEST

The feature test shall be defined as a bench test; component tests; or tests that must be conducted to gather data to ensure that the design will meet its requirement. Feature test plans shall be reviewed and approved by the buyer. Feature tests not identified in the verification matrix, but that the seller deems necessary, shall not be required to be reviewed by the buyer. Feature testing may be incorporated in the acceptance test after discussions with the buyer.

4.2.5 ACCEPTANCE/SYSTEM TEST

The acceptance test shall be defined as the system test that demonstrated the requirements that can only be tested as a unit or an assembly. The Acceptance test shall confirm that the system operates as designed.

4.3 VERIFICATION MATRIX

TABLE 4-1 - VERIFICATION MATRIX

SPECIFICATION PARAGRAPH	REQUIREMENT DESCRIPTION	INSPECTION	ANALYSIS	ENGINEERING EVALUATION	FEATURE TEST	ACCEPTANCE OR SYSTEM TEST
3.1.2.1	Airstream Design Conditions		X and	X		
3.1.2.2	Electrical Connection	X				
3.1.2.3	Seal Pot Condensate Drain	X				
3.1.2.4	Exhauster Inlet Flange Connection	X				
3.1.2.5	Exhaust Skid Structural Installation	X				
3.2.1	Performance		X or			X
3.2.2	Design Life			X		
3.2.3	Space Envelope	X				
3.2.4.1	Accessibility	X or		X		
3.2.4.2	Decontamination	X or		X		
3.2.4.3	Special Tools	X				
3.2.5.1	Climate		X or	X or	X	
3.2.5.2	Electromagnetic Noise/Radiation				X or	X
3.2.6.1	Seismic		X or		X	
3.2.6.2	Wind Loads		X			
3.2.6.3	Snow Loads		X			
3.2.6.4	Ashfall Events		X			
3.2.6.5	Dead Loads		X			
3.2.6.6	Thermal Forces		X			
3.2.6.7	Load Combinations and Allowable Stresses		X			

SPECIFICATION PARAGRAPH	REQUIREMENT DESCRIPTION	INSPECTION	ANALYSIS	ENGINEERING EVALUATION	FEATURE TEST	ACCEPTANCE OR SYSTEM TEST
3.2.7	Storage	X and	X			
3.2.8	Transportation Accelerations		X			
3.2.9	Electrical Grounding	X				
3.3.1.1	Quality	X				
3.3.1.2	High-strength and Heat Treatments	X				
3.3.1.3	Structural	X or		X		
3.3.1.4	Metallic	X or		X		
3.3.1.5	Deterioration and Protection	X or		X		
3.3.1.6	Fasteners	X				
3.3.1.7	Edges	X				
3.3.2	Exhauster Mechanical Components	X				
3.3.2.1	HEPA Filter Housings	X and			X	
3.3.2.2	Prefilter Section	X and			X	
3.3.2.3	Test Sections	X and			X	
3.3.2.4	Heater Section	X and			X	
3.3.2.5	Transition Ducting Sections	X and			X	
3.3.2.6	Vent Train Base	X and	X			
3.3.2.7	Inlet Spool Section	X and			X	
3.3.2.8	Flexible Ductwork	X and			X	
3.3.2.9	Isolation Valves	X and			X	
3.3.2.10	Heater System	X or	X or		X or	X
3.3.2.11	Exhaust Fan and Motor	X and	X and		X	
3.3.2.12	Exhaust Stack	X and	X or	X or	X	
3.3.2.13	Condensate Drain & Seal Pot System	X and	X or	X		

SPECIFICATION PARAGRAPH	REQUIREMENT DESCRIPTION	INSPECTION	ANALYSIS	ENGINEERING EVALUATION	FEATURE TEST	ACCEPTANCE OR SYSTEM TEST
3.3.2.14	Thermal Insulation Material Requirements	X or		X		
3.3.3.1	Service Power	X or		X		
3.3.3.2	Mini-Power Zone	X				
3.3.3.3	Electrical-Non Specified	X or		X		
3.3.3.4	Specific Electrical/Controls Equipment	X				
3.3.3.5	Cabinet Temperature Control	X and	X			
3.3.3.6	Wiring Practices and Electrical Safety Requirements	X				
3.3.3.7	NEC Inspection	X				
3.3.4	Exhauster Instrumentation & Control	X or		X		
3.3.4.1	Pressure Monitoring	X or				X
3.3.4.2	Temperature Monitoring	X or				X
3.3.4.3	Stack Monitoring	X and	X and			X
3.3.4.4	Liquid Monitoring	X or				X
3.3.4.5	Programmable Logic Controller	X and				X
3.3.4.6	Off-Skid Instrumentation Wiring	X				
3.3.4.7	Common Interlocks/Set Points					X
3.3.4.8	Freeze Protection	X			X or	X
3.3.5	Welding	X or		X		
3.3.5.1	Carbon Steel Structural Welding	X				
3.3.5.2	Pressure Boundary and Stainless Steel Structural Welding	X or		X		
3.3.5.3	Weld Materials	X				
3.3.5.4	Welding Procedures & Qualifications	X				
3.3.5.5	Weld Inspection Requirements	X				

SPECIFICATION PARAGRAPH	REQUIREMENT DESCRIPTION	INSPECTION	ANALYSIS	ENGINEERING EVALUATION	FEATURE TEST	ACCEPTANCE OR SYSTEM TEST
3.3.5.6	Workmanship	X				
3.3.5.7	Additional Welding Requirements	X				
3.3.6	Cleanliness	X				
3.3.7.1	Nameplates/Labels	X				
3.3.7.2	Identification Tags & Numbers	X				
3.3.7.3	Labeling	X				
3.3.8	Painting & Coating	X				
3.3.9	Human Engineering	X or		X		
3.3.9.1	Noise Levels				X	
3.3.10	Drawings	X				
4.1.1	Power System Testing					X
4.1.2	Rotating Equipment Balancing & Vibration Criteria				X or	X
4.1.3	Filter Housing Testing				X or	X
4.1.4	Exhaust Fan & Exhaust Train Flow Testing					X
4.1.5	Heat Trace Check					X
4.1.6	Interlock Alarm Check					X
4.1.7	Glycol Heater Check					X
4.1.8	Stack Pressure Decay Test					X
4.1.9	Record Sample Filter Holder Leak Test					X

5.0 PROJECT MANAGEMENT

5.1 DESIGN

5.1.1 CONCEPTUAL DESIGN

The seller shall complete a conceptual design in accordance with the requirements of this specification.

This task shall consist of conceptual design identifying design features that drive the system cost and manufacturing complexity, interfaces, layouts, and appropriate analyses for all systems/components. The conceptual design shall address all of the specification requirements; verification testing and technical issues shall be identified and evaluated in a conceptual design review and report. The conceptual design task shall include an independent oral review of the design to be presented by the seller at the buyer's facility.

5.1.1.1 Conceptual Design Report

The conceptual design summary report shall include, as a minimum, the following:

- Layout drawings, or arrangement of major component drawings
- Design assumptions and rationale
- Draft assembly drawings showing major items, subassemblies, and estimated component weights.
- Manufacturer's certification of components for explosive atmosphere operation. This includes all components in contact with exhaust airstream with exception to the CAM, sample flow control valves and sample vacuum pumps.
- Fan performance curves
- Sellers QA Program showing compliance with ASME NQA-1
- Design feature selection rationale, preliminary calculations of seismic analyses and analyses supporting concept selection. Features incorporated for leak-check, lifting and handling, etc. Preliminary interface control documentation that identifies all required interfaces.

5.1.2 DEFINITIVE DESIGN

This effort will include the detailed design of the Exhauster System and all associated hardware. The seller shall be responsible for all design activities required to complete all design documentation and analyses, including detail and assembly drawings in sufficient detail to determine interfaces, assembly, and disassembly sequences. The drawing shall include section views that show system details. Structural and seismic analyses will be completed and provided to demonstrate that the chosen design(s) can withstand the load conditions.

The definitive design must be reviewed and approved by the buyer before fabrication can be initiated. The buyer will review and approve the preliminary Definitive Design Report (DDR), and the seller shall successfully complete a independent oral design review at the buyer's facility with completion of action items to the buyer's satisfaction prior to initiation of fabrication. The buyer will review the release of long lead manufactured items on a case by case basis.

5.1.2.1 Definitive Design Report (DDR)

The seller shall furnish the buyer a final DDR that demonstrates that the seller's design satisfies all the requirements of this specification. As a minimum, this report shall contain, but is not limited to, all the design and supporting analyses conducted, quality assurance (QA) requirements, testing methods and or analysis of materials, lifting and handling analyses, the acceptance criteria for tests, and all results of completed tests. Identification of all manufacturing equipment and processes, manufacturing tooling, applicable QA inspection requirements, and equipment calibration results shall also be contained in a separate data package that shall accompany the final DDR.

Calculations shall meet buyer supplied procedures and be organized in the following order:

a) Objective
b) Design inputs (criteria and source, given/known data, assumptions, methods used, computer programs used, reference sources)
c) Calculations
d) Findings and conclusions

Calculations and drawings shall be stamped by a licensed engineer of the appropriate discipline. The stamp shall be recognized by the Washington State Professional Engineers Department.

The DDR shall include legible, reproducible copies of inspection/test reports. The report(s) shall include the following:

a) Identification of the applicable inspection and/or test procedure utilized.

b) Resulting data for all characteristics evaluated, as required by the governing inspection/test procedure.

c) Traceability to the item inspected/tested, (i.e., serial number, part number, lot number, etc.).

d) Signature of the seller's authorized representative or agency that performed the inspections/tests.

e) The seller shall provide a legible/reproducible certification of compliance (C of C). The C of C shall be signed by the seller's authorized representative. This C of C shall, as a minimum:

    1) Identify the appropriate buyer purchase order number under which the material, equipment, item, or service is being supplied.

    2) Provide traceability by means of positive identification from the material, equipment, item, or service to the C of C. The certificate of compliance shall be signed or otherwise authenticated (e.g., initialed, stamped) by a person who is responsible for this quality assurance function and whose function and position are described in the supplier's quality assurance program.

    3) Identify the specific procurement requirements met by the material, equipment, item or service supplied, such as codes, standards, and other applicable specifications. The procurement requirements identified shall include any approved changes, waivers, or deviations applicable to the subject material, equipment, item, or service.

    4) Identify any procurement requirements not met, together with an explanation and means for resolving the non-conformances.

In addition, this report shall contain, but is not limited to, the

documentation listed in Table 5-1.

TABLE 5-1 DEFINITIVE DESIGN REPORT DOCUMENTATION

DOCUMENTATION ITEM	DOCUMENT REQUIRED
Design	Design documentation applicable to the exhauster unit fabrication and testing as required by ASME AG-1, N509, and N510, including the applicable sections thereof identified throughout this specification.
	ASME AG-1 design verification matrix.
	Documentation to certify that stack design complies with ANSI N13.1 and that the CAM accuracy meets ANSI N42.18 at sample airstream temperatures. This includes test reports/results qualifying sampling location per the methodology described in ANSI N13.1, Table 4.
Design Analysis	Calculations, Acceptance Test Report or Qualification Test Data supporting assembly seismic qualification.
	Acceptance Test Reports or Qualification Test Data supporting aerosol testing (ASME AG-1 or ASME N510, section 10) during shake table test.
	Calculations, Acceptance Test Report or Qualification Test Data supporting assembly induced loading qualification.
	Airstream heater design supporting calculations including psychometric requirements and heat transfer.
	Fan calculations and curve including static pressure requirements.
	Seal pot drainage calculations including pot size and drainage into seal pot when fan is operating. These calculations shall include both gravity drain operations, and the maximum head available at the condensate pump discharge line flange connection.
	Exhaust stack design support calculations including size and sampling analysis.
	Sampling system vacuum pump sizing calculations.
	Record sample filter holder leak rate.
	Exhauster assembly design life evaluation.
	Electrical and instrument cabinet temperature control calculations including both summer and winter analysis.

DOCUMENTATION ITEM	DOCUMENT REQUIRED
	Transportation loading support calculations and lifting point calculations for the exhauster and stack.
	Exhauster skid electrical load and sizing analysis.
Drawings	Filter Housings – details showing location, size, configuration of doors, door hardware, filter element mounting frames.
	Test Sections – details showing location, size, configuration of apparatus and devices used for sampling, mixing and aerosol injection.
	Filter Element Clamping Device – details showing location and configuration.
	Arrangement Drawings.
	Assembly Drawings.
	Detail Drawings – component drawings showing fabrication details.
	Interface Control Drawings.
	CAD Electronic Data Set.
	Design field changes showing any approved deviations from the definitive design drawings and specifications.
Welding and Weld Examination	Welding procedures.
	Welder/Welder operator qualifications.
	Visual weld inspection procedures.
	Certified weld inspector (CWI) certification and valid eye examination.
	Weld qualification records, procedures, and results.
	NDE certification procedures.
	NDE personnel certification and valid eye exams.
	NDE operation procedures.
	Identification of welds, weld map, and the results of the NDE of each.
	Welding visual inspection report.
	Pressure boundary qualification weld test sample NDE report.

DOCUMENTATION ITEM	DOCUMENT REQUIRED
	Filter element holding frame weld NDE report.
Inspection/Test Procedures/Reports	Exhauster system Acceptance Test Procedure (ATP).
	Exhauster system Acceptance Test Report (ATR).
	Visual inspection check list per ASME AG-1 or ASME N510 section 5.
	Airflow distribution test per ASME AG-1 or ASME N510 section 8.
	Air-aerosol mixing uniformity test per ASME AG-1 or ASME N510 section 9.
	Filter element holding frame decay leakage test per ASME AG-1 or ASME N510 section 7.
	Assembly decay leakage test per ASME AG-1 or ASME N510 section 6.
	Exhaust fan and exhaust train flow testing.
	Rotating component balancing reports.
	Record sample filter holder leak test reports.
	Test procedure demonstrating that stray electromagnetic radiation/noise (i.e. RF, cellular phones, power) does not interfere with the control circuit function per Section 3.2.5.2.
	Leak test procedure for the stack sampling system in accordance with ANSI N13.1, section 6.9
QA	Sellers program shows compliance with ASME NQA-1.
	All NCR's will be submitted.
	Supplier certification and release completed.
	C of C stating seller has met requirements of this specification.
	C of C stating NDE requirements of this specification have been met.
	Objective evidence showing procured assemblies (i.e., gages, valves, etc....) were provided from the original equipment manufacture and received at sellers facility in an acceptable condition to perform its intended function.
System Procedures/Manuals	Operation procedure/manual.

DOCUMENTATION ITEM	DOCUMENT REQUIRED
	Maintenance/storage procedure.
	Spare parts list.
	Special handling and loading procedures.
System Equipment	Catalog cuts of exhauster assembly components and instrumentation in organized notebook.
	Warranties.

5.2 WORK PLAN

The seller shall ensure all work is consistent with the requirements of the purchase order terms and conditions, and this specification.

A work plan describing all deliverable dates shall be submitted to the buyer. The work plan must include a complete project schedule. The deliverable schedule must meet the overall project schedule listed in the request for proposal and/or purchase order.

This schedule will be updated as required for the monthly status reporting. Any changes to the work plan will require written concurrence of the buyer.

5.2.1 MONTHLY STATUS REPORTS

On the fifth working day of the month, the seller shall submit to the buyer a simple summary of accomplishments, upcoming events, issues that require resolution, and technical and programmatic problems encountered during the previous month. The monthly input shall be organized according to the seller's work plan. Included in each monthly report shall be a status schedule for the entire program.

5.2.2 CONTRACT KICKOFF MEETING

A kickoff meeting will be held between the buyer and seller at the seller's manufacturing location at the time of the contract award. This meeting will focus on the seller's scope, line by line discussions of the specification, deliverables, information transfer, reviews, meetings, reporting, etc.

5.2.3 COMMITMENT TRACKING LIST

The seller shall maintain a listing of all buyer-seller review comments generated during the design, fabrication, and testing process. The seller shall track the status of comment disposition until all comments are satisfactorily incorporated into the design or otherwise resolved.

5.3 FABRICATION

The fabrication includes equipment procurement, component fabrication, assembly and fabrication inspection. The seller shall be responsible for the manpower, facilities, and equipment to complete purchasing, fabrication, assembly, checkouts, and delivery of the Exhauster System. The seller shall also manage the fabrication activities, which include creating and maintaining production scheduling, and the quality assurance plan (QAP). Manufacturing activities include manufacturing and documentation for component fabrication, assembly, purchasing, storage, and spare parts. Additional manufacturing activities include transportation and packaging, tooling design, tooling documentation, and fabrication as required. Engineering support includes design documentation, design analysis, logistics, engineering support, and configuration management. The seller shall provide all special tools and calibrated equipment necessary for assembly, operation, and maintenance.

5.3.1 GENERAL REQUIREMENTS

a) Distributors furnishing items on this purchase order to the seller shall obtain said items directly from the original manufacturer of the items. The distributor shall provide legible and reproducible documentation to the seller that provides objective evidence that the items were provided by the original manufacturer. These may include the purchase order to the original manufacturer, shipping documentation, or manufacturer invoice; each of which identifies the items obtained from the original manufacturer.

b) The seller shall submit, with or prior to item shipment, a recommended spare parts list. The list shall provide the name and address of the original supplier

of the replacement part, and the part's drawings, specification, or catalog identity including applicable change or revision information.

c) Seller shall warrant that all items furnished under this purchase order are genuine (i.e., not counterfeit) and match the quality, test reports, markings and/or fitness for use required by the purchase order.

d) Any materials furnished as part of this purchase order which have been previously found to be suspect/counterfeit by the buyer or any U.S. Government agency shall not be accepted.

e) Further information about suspect/counterfeit products may be obtained directly from the Department Of Energy.

5.3.2 SUBCONTRACTOR IDENTIFICATION

The seller shall include a list of subcontractors if required for specialized design/analysis or fabrication tasks. The seller shall provide relevant information regarding the experience, management and personnel. The seller's subcontractor will be bound by the same welding, inspection, and submittal requirements as the seller.

5.3.3 FABRICATION AND INSPECTION PLAN

The seller shall provide to the buyer for review and approval a Fabrication and Inspection Plan to include a sequential listing of major fabrication steps and the associated inspections required for compliance with this contract. The seller's fabrication plan shall identify fabrication activities, with a production schedule, and manufacturing activities such as tooling design and fabrication. The quality assurance plan shall define the approach for manufacturing, documentation for component fabrication, assembly, purchasing, storage, spare parts, control of nonconforming items, and configuration management. The fabrication plan will define all inspect hold points and critical items or features as defined from the design to be inspected. The buyer shall reserve the right while reviewing this plan to identify in writing to the seller inspection or testing activities to be witnessed by the buyer representative. The buyer retains the right to witness any and all critical items/feature inspections. The seller shall notify the buyer no later than 10 working days prior to any specified witness points.

5.4 TESTING AND EVALUATION

The exhauster assembly shall be shop tested at the seller's facility as a complete unit prior to shipment. A buyer's representative shall witness and accept final shop test prior to shipment. The acceptance test will serve as design verification. Acceptance testing will demonstrate all alarm circuits, the ability of the exhauster to operate continuously over the full range of design basis flow rates, and the capability of monitoring instruments at minimum and maximum flow rates.

The seller shall submit all analyses and engineering evaluations required by the verification matrix to the buyer for review and approval.

5.4.1 ACCEPTANCE TEST PLAN

The acceptance test plan shall include the test objectives, schedules for testing, test matrix, test acceptance criteria, test facilities, special test equipment, calibrated instrumentation, and data reduction requirements, if appropriate. All required testing instrumentation shall be provided by the seller unless otherwise noted. Any special test equipment required for testing shall also be identified and provided by the seller. Special test equipment will be designed and developed by the seller as required to complete acceptance and verification testing. The buyer will review and approve the acceptance test plan.

The seller shall identify in his plan if any feature testing required by the verification matrix has been previously completed for another program or activity. This use of similar or previously collected data that directly applies to the specification requirement(s) will be allowed as approved by the buyer.

5.4.2 ACCEPTANCE TEST PROCEDURE (ATP)

The seller shall submit an acceptance test procedure (ATP) that includes tests identified in the verification matrix to the buyer for approval. The seller is responsible for all equipment required for the ATP. The seller shall notify the buyer two weeks prior to starting the ATP. The seller shall assure the buyer that all of the tests can be performed satisfactorily before scheduling the official ATP. At conclusion of the testing a NEC certification sticker shall be applied to the exhauster.

5.4.3 ACCEPTANCE TEST REPORT (ATR)

The seller shall assemble the results of the acceptance tests into an ATR to be

submitted as part of the record package. The ATR shall summarize the results of the acceptance tests and shall contain the test results and test exceptions with their dispositions.

5.5 OPERATION/MAINTENANCE PROCEDURES

5.5.1 OPERATION PROCEDURE/MANUAL

The seller shall provide an Exhauster System operating procedure/manual. The buyer will review and approve the operation procedure/manual. The operations procedure/manual shall provide detailed information for operation of all equipment including one-line diagrams for electrical, piping and instrumentation. The seller's procedure/manual shall include sketches as appropriate utilizing isometric figures to the greatest extent possible. The operations procedure/manual shall include trouble shooting of all systems and discuss all control system faults and appropriate operator actions for those faults. The procedure/manual shall be bound in a binder with weather resistant page protection.

5.5.2 MAINTENANCE/STORAGE PROCEDURES

The maintenance procedure shall include information for the maintenance, repair, assembly, and disassembly of the Exhauster System and all ancillary equipment. The procedure may refer to manufacturers manuals for the servicing of commercial items and must include these manuals and instructions as part of the maintenance procedure. The seller's manual shall identify removal/assembly sequences, lubrication schedules, isometric sketches of equipment and weights, lifting points and approximate centers of gravity, identification of consumable items (such as seals/gaskets), and the use of special tooling for the procedure.

The seller shall provide a master list of all equipment requiring maintenance. The list shall include the manufacturers' recommendations, instructions, and intervals for maintaining the equipment. Particular emphasis shall be placed on the type of maintenance (preventive, predictive, or corrective) and the manufacturers' specific recommendations. The maintenances procedure shall apply the principles of reliability-based analysis for maintenance task identification for components that are worthy of the rigors of Reliability Centered Maintenance (RCM) analysis. The buyer will review and approve the maintenance procedures.

Seller shall provide a list of recommended spare parts, identifying each specific subassembly at which it applies. Seller shall indicate the minimum recommended inventory of the spare parts for installation, start-up, and maintenance for a one (1) year period based on 8700 hours of operation per year. Seller shall state whether

the recommended spare part is stock item or a special item, and shall furnish name and location of the nearest supplier.

The seller shall also provide a storage procedure for the Exhauster System. The storage procedure shall identify if any special storage precautions are required for winter, or summer storage and how to protect the electronics and control systems from damage during storage. The storage procedure shall also ensure rotating equipment is protected during storage. The buyer will review and approve the storage procedures.

5.6 SUBMITTALS

Table 5-2 contains the submittal schedule for the contract and the following sections provide a description of the required submittals. Four copies of submittals shall be provided if not otherwise specified. All submittals shall be in English. Electronic copies of submittals will be provided whenever practical

5.6.1 SUBMITTALS REQUIRED WITH PROPOSAL

5.6.1.1 Preliminary List of Drawings and Documentation

The seller shall provide a preliminary list of drawings and documentation that will be provided as part of the contract. Typical drawings include:

- System Schematics or P&ID
- Assembly Drawings
- Subassembly Drawings
- Connection Diagrams
- Wire Run Lists
- One Line Electrical Diagrams
- Elementary Diagrams
- Instrument Loop Diagrams
- Outline Drawings
- Panel Schedules
- Instrument Set Point/Program Set-Up List

5.6.1.2 Quality Assurance Program

The seller shall provide a copy of their Quality Assurance Plan.

5.6.1.3 Identification of Subcontractors

The seller shall provide a list of proposed subcontractors.

5.6.1.4 Preliminary Welding and NDE Submittals

Qualified Welding and NDE Procedures and Certified Procedure Qualification Records shall be submitted with the proposal by the seller for each type of weld and each characteristically different welding joint.

5.6.1.5 Preliminary Schedule

The seller shall provide a schedule assuming that the start date is the receipt of the order. The schedule shall contain a summary of activities required to design, fabricate, test, and ship the exhauster System.

5.6.2 SUBMITTALS REQUIRED AFTER RECEIPT OF ORDER

5.6.2.1 Work Plan

The seller shall submit a work plan per Section 5.2 of this specification.

5.6.2.2 Detailed Schedule

The seller shall provide a detailed schedule showing the activities required to design, fabricate, test, and ship the Exhauster System.

5.6.2.3 Written Status Reports

The seller shall provide written status reports on a monthly basis during the execution of this contract. The status reports shall summarize the activities completed during the last reporting interval and provide schedule status (e.g. schedule slippage).

5.6.3 SUBMITTALS REQUIRED PRIOR TO FABRICATION

5.6.3.1 Conceptual Design Report

The seller shall submit a conceptual design report per Section 5.1.1 of this specification.

5.6.3.2 Preliminary Definitive Design Report

The seller shall submit a preliminary definitive design report per Section 5.1.2 of this specification. This report shall consist of all items listed in Table 5-1 that can be completed prior to fabrication. Report to include all design analysis and fabrication drawings.

5.6.3.3 Fabrication and Inspection Plan

The seller shall submit a fabrication and inspection plan per Section 5.3.3 of this specification.

5.6.3.4 Welding and NDE

Qualified Welding Procedures and Certified Procedure Qualification Records shall be submitted by the seller for each type of weld and each characteristically different welding joint listed in the plan for welding and NDE.

Certified records of qualified personnel who will perform or verify the welding or NDE, if not already provided with the proposal, shall be submitted by the seller.

5.6.3.5 Preliminary Operation and Service Procedures/Manuals

The seller shall provide a preliminary version of the procedures/manuals required in Section 5.8 of this specification.

5.6.3.6 Other Information and Design Data to Evaluate Design

The seller shall submit sufficient information and design data that is necessary to support proposed design.

5.6.4 AUTHORIZATION TO START FABRICATION

The seller shall not start fabrication until written authorization has been received from the buyer.

5.6.5 SUBMITTALS REQUIRED TO START TESTING

5.6.5.1 Acceptance Test Plan

The seller shall submit to the buyer the Acceptance Test Plan per Section 5.4.1 of this specification.

5.6.5.2 Acceptance Test Procedure (ATP)

The seller shall submit to the buyer the ATP per Section 5.4.2 of this specification.

5.6.6 SUBMITTALS REQUIRED FOR CONTRACT COMPLETION

The seller shall not ship the Exhauster System and ancillary hardware until all tests and inspections have been performed and the documentation data package is complete and approved by the buyer. A separate data package (consisting of the documents identified in this section) shall be provided for each exhauster unit purchased. The documents shall be traceable to the exhauster unit (e.g., contain the exhauster unit's identification number). All software used/delivered shall be registered in the buyer's name prior to turnover of the exhauster.

5.6.6.1 Final Design Analysis Report

The seller shall submit a Final Design Analysis Report that includes all items listed in Table 5-1 as a minimum.

5.6.6.2 As-Built Drawings and Specifications

The seller shall deliver to the buyer eight (8) copies of the final fabrication level as-built drawings and specifications accurately depicting the product delivered. Drawings shall include dimensional layouts, dimensioned subassemblies, dimensioned component details (if not included on manufacturers' cut sheets), flow and electrical diagrams, material and fastener sizes, descriptions, weld symbols and notes. The designer's name, responsible engineer's name, bill of materials, and drawing numbers shall appear on the index (cover sheet).

Drawing size shall be per ANSI Y14.1. Bills of material on drawings shall include quantity, manufacturer, material type, electrical characteristics, size, and general descriptions. All component parts shall refer to applicable material specifications, such as the Military, ASME, ASTM, Federal, or other specifications. As-Built Drawings shall be verified in accordance with Quality Assurance Program Controls of Section 5.9.2 prior to submittal, and shall be in accordance with buyer supplied drawing procedures.

Drawings shall be prepared using AutoCAD compatible drafting software. A copy of all as-built drawing files (one of which shall be an electronic AutoCAD release 12, 13, or 14 compatible file format) shall be included in the final drawing package. Drawings shall use the ROMANS AutoCAD text font and the minimum text height shall be 1/8 inch.

5.6.6.3 Final Calculations

Reviewed and approved calculations shall be legible and prepared on 8 ½" by 11" sheets with all pages numbered and bound in hard cover binder. Calculations shall be organized as described above in Section 5.1.2.1. The calculations listed in Table 5-1 under "Design Analysis" shall be provided as a minimum.

5.6.6.4 Inspection & Testing Reports

Inspections, examinations, and testing activities, including the completed ATP and ATR as described in Section 5.4, shall be documented and the documentation delivered before shipment of the product. Inspection Reports shall provide actual inspection results, specifying what was inspected, who inspected it, the characteristics inspected, and the acceptance criteria.

5.6.6.5 Certified Test Reports

The seller shall provide the buyer with Certified Material Test Reports for the structural materials, tubing, fittings, and material used in welding applications, as well as a certificate of compliance for the system.

- Certified Material Test Reports shall list all specification numbers (including revision status) to which the material is required to conform. Each certification shall contain the substance of the following statement; "It is hereby certified that the material identified herein conforms to the listed specifications."

- The Certificate of Compliance shall describe the product and identify contract requirements met, including reference to codes, standards, specifications, (including revision status), written change orders and any buyer-approved Contractor Non-Conformance Requests. The Certificate of Compliance shall describe the quality assurance function and position of the person attesting to its accuracy.

5.6.6.6 Operation and Service Procedures/Manuals

The seller shall provide the procedures/manuals required in Section 5.5, Operations/Maintenance Procedures, of this specification.

5.6.6.7 Calibration Reports

The seller shall provide instrument factory calibration data sheets and

calibration reports for the measuring and test equipment provided with the product. The reports shall contain the parameters calibrated, acceptance criteria and the actual calibration results. The seller shall certify that the supplies tendered for acceptance have been calibrated using standards whose calibration is (a) traceable to the NIST (or other nationally recognized standards acceptable to the buyer), (b) derived for accepted values of natural physical constants, or (c) derived by the ratio type of self-calibration techniques.

5.6.6.8 Packaging And Shipping Plan

The seller shall submit the packaging and shipping plan required in Section 5.12 of this specification.

5.6.6.9 Records Maintenance, Control, and Disposition

The seller shall collect, identify, and maintain originals of records generated for this contract and included in Table 5-2, Deliverables and Schedule. Where contract records include generic procedures such as welding or NDE procedures, reproducible copies may be submitted instead of originals if validated.

Where submittals are required during the term of the contract for the buyer's review, copies shall be submitted. Within 10 days of contract completion, however, the originals (or validated reproducible copies) of the records shall be delivered to the buyer at a location specified by the buyer's Contract Specialist. The originals of records which are not of reproducible quality shall be so identified.

All records shall be protected against damage, deterioration, loss or unauthorized use. All records shall meet the following standards:

1) Signed, initialed, or otherwise authenticated and dated. Handwritten signatures are not required if a statement from the reporting individual or organization identifies the record.
2) Traceable to the item or activity.
3) Legible, accurate, reproducible, and complete.
4) Corrected, if necessary, by the record originator, who shall mark out the incorrect information with a single line, enter the correct information and then initial and date the correction. If the reason for the change is not obvious, then it must be stated.

5.7 DOCUMENT CONTROL

5.7.1 CHANGES TO BUYER'S DOCUMENTS

Changes to buyer's purchase order requirements will be documented by issuance of buyer's Purchase Order Modification that will be transmitted to seller for determination of impact on cost and schedule.

5.7.2 CHANGES TO SELLER'S DOCUMENTS

Changes to seller's approved design shall be controlled by change control process approved by buyer. Seller shall notify buyer of proposed change. Detailed description of change, including justification for change, shall be included.

5.7.3 OWNERSHIP OF DESIGN MEDIA

At contract closeout, all contract data (e.g. prints, computer files, procedures, vendor data, etc.) shall become the property of the buyer. The buyer shall have unlimited rights to use, duplicate, disclose to others, or modify any part or all of the supplied contract data.

5.8 CORRESPONDENCE

The seller shall deliver legible copies, as required by document submittal. The seller shall send these and all other documents to:

CH2M HILL Hanford Group
P.O. Box 1500
Richland, WA 99352

ATTN: (Buyer's name and MSIN as it appears on the purchase order)

5.9 QUALITY ASSURANCE PROGRAM

The seller shall have in place a Quality Assurance Program (QAP) that satisfies the criteria of ASME NQA-1 as specified in the contract. The seller shall furnish a matrix that cross-references the plan with the corresponding requirements listed.

5.10 PRE-AWARD SURVEYS

A pre-award survey will be conducted by the buyer on each of the sellers who are determined to be in the competitive range. This survey shall be scheduled by the buyer's representative and shall encompass the seller's and identified major subcontractors'

technical, quality assurance, production, or financial capability.

5.11 RIGHT OF ACCESS

The seller shall permit and make arrangements in writing for the buyer to enter all areas of the seller's or subcontractor's facilities associated with producing the exhauster equipment, for the purpose of examining the materials, equipment, processes, and procedures employed during the design, fabrication, assembly, testing, and shipment of the equipment. The seller shall permit photograph and video records by the buyer in the seller's facilities associated with producing the exhauster equipment.

5.12 A SUBMITTAL COMPLIANCE REQUIREMENTS

The seller shall comply with the inspection and test plans and welding and Non-Destructive Examination (NDE) procedures and plans submitted and approved by the buyer and utilize, except as authorized by the buyer in writing, only those qualified personnel to perform or verify the special processes and operations for whom certified records were reviewed and approved by the buyer.

5.13 PACKAGING AND SHIPPING PLAN

The seller shall recommend the preferred transportation method to provide the best protection of the Exhauster System during transit. The final plan shall be completed at the conclusion of the design with approval by the buyer.

5.13.1 CLEANING, PACKAGING AND SHIPPING

The seller shall submit for buyer approval a packaging and shipping plan which contains seller's procedures for packaging, marking, and shipping the exhauster to the buyer. Buyer approval of the plan is required before packaging and shipment. If a special type of transportation to protect the electronics is required, or special handling devices are needed for assembly or installation of equipment, those devices shall be part of the seller's package and identified as special equipment.

Each item of equipment shall be packaged to eliminate damage due to outside storage for up to one year, or damage due to shipping and handling by forklift or hoist. Packages or skids shall be marked at the seller's site with the buyer's purchase order number. Equipment shall be dismantled only as necessary for shipment, and dismantled equipment shall require the approval of the buyer. Each component to be shipped loose shall be marked at the seller's site with the buyer's

purchase order number and the identifying number of its respective component. Lift points or centers of gravity shall be marked on shipping crates.

Filter housings shall be packaged and shipped in accordance with the requirements of ASME N509 from the manufacturer's plant to the seller's point of installation.

Material not shipped in a weatherproof vehicle shall be protected from the weather in a manner acceptable to the buyer. The shipping procedures shall define the method of protecting exhauster components from the weather.

TABLE 5-2 – DELIVERABLES AND SCHEDULE

Item	Title	Copies	Action	Schedule
1	Preliminary List of Drawings and Documentation	4	Evaluation	With Proposal
2	Quality Assurance Program	2	Approval	With Proposal
3	Identification of Major Subcontractors	4	Evaluation	With Proposal
4	Preliminary Welding and NDE Submittals	2	Evaluation	With Proposal
5	Preliminary Schedule	4	Evaluation	With Proposal
6	Kickoff meeting minutes/action items between buyer and seller	4	Evaluation/ Approval	Upon Receipt of Order
7	Work Plan	4	Evaluation	10 Days After Receipt of Order
8	Detailed Schedule	4	Information	10 Days After Receipt of Order
9	Written Status Reports	4	Information	After Receipt of Order at 1 Month Intervals
10	Conceptual design review/report/action items	4	Approval	Prior to Fabrication
11	Preliminary Definitive Design Report and final design review meeting action items	4	Approval	Prior to Fabrication
12	Preliminary Fabrication and Inspection Plan	4	Review & Comment	4 weeks prior to fabrication
13	Approved Fabrication and Inspection Plan	4	Approval	2 weeks prior to fabrication
14	Applicable nondestructive examination procedures, personnel qualification/ certification procedures, and personnel certification records	2	Approval	2 weeks prior to start of fabrication

Item	Title	Copies	Action	Schedule
15	Weld inspection personnel certification	2	Approval	2 weeks prior to start of fabrication
16	Governing welding procedure specifications, procedure qualification records	2	Approval	2 weeks prior to start of fabrication
17	Weld repair procedures	2	Approval	2 weeks prior to start of fabrication
18	Preliminary Operation and Service Procedures/Manuals	4	Review & Comment	Prior to Fabrication
19	Acceptance Test Plan	4	Approval	Prior to Testing
20	Acceptance Test Procedure (ATP)	4	Approval	2 weeks prior to performing first test
21	Final Definitive Design Report	4	Approval	Prior to final acceptance
22	As-Built Drawings and Specifications	4	Approval	Prior to final acceptance
24	Final Calculations	4	Approval	Prior to final acceptance
25	Inspection & Testing Reports (Completed ATP and ATR)	4	Approval	Prior to final acceptance
26	Certified Material Test reports	4	Approval	Prior to final acceptance
27	Certificate of Compliance for System	4	Approval	Prior to final acceptance
28	Operation and Service Procedures/Manuals	4	Approval	Prior to final acceptance
29	Calibration Reports	4	Approval	Prior to final acceptance
30	Packaging and Shipping Plan	4	Approval	Prior to final acceptance

Item	Title	Copies	Action	Schedule
31	Fabrication completion documentation data package (Catalog Cut Sheet Notebooks)	4	Approval	
32	NEC Records	4	Information	2 week prior to shipment

APPENDIX A

SUSPECT/COUNTERFEIT FASTENER HEADMARK LIST

APPENDIX B

MECHANICAL COMPONENT DESIGN SKETCHES

APPENDIX C

ELECTRICAL AND INSTRUMENTATION DESIGN SKETCHES

APPENDIX D

STACK MONITORING DESIGN SKETCHES

APPENDIX E

OFF-SKID INSTRUMENTATION CONNECTION SKETCHES (REF ONLY)