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SYSTEM DESIGN DESCRIPTION FOR AN TANK FARM VENTILATION TANK ANNULUS SYSTEM
RECORD OF REVISION

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This system design description for AN Tank Farm Ventilation Tank Annulus System is intended to be a living compendium of design requirements, design bases, and system descriptions. The system design description includes references to relevant procedures, drawings, calculations, and supporting documents. It is written to the outline provided in DOE-STD-3024-2011, *Content of System Design Descriptions*. All section headings from DOE-STD-3024-2011 are included. If no information is available or relevant for a section heading, the heading is included as a placeholder, and the statement “*information not readily available*” is inserted. If the information becomes available or required at a later time, it will be included to the extent possible.
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1.0 INTRODUCTION

1.1 SYSTEM IDENTIFICATION

This system design description (SDD) addresses the Ventilation Tank Annulus (VTA) system for the AN Tank Farm double-shell tanks (DST). The seven DST annuli in the AN Tank Farm are ventilated by a common exhaust system. The following interfacing systems are not covered by this SDD:

- Waste storage tank annulus (WSTA) system
- Raw water system
- Electrical distribution system (EDS)
- Waste transfer system.

A simplified system diagram for the AN Tank Farm VTA system is shown in Figure 1. System boundaries are identified on Figure-2 in Chapter 4.0.

1.2 LIMITATIONS OF THIS SYSTEM DESIGN DESCRIPTION

The SDD is a central coordinating link among the engineering design documents, the facility Safety Basis, and the implementing procedures. The SDD is a compilation of information intended primarily for use by facility operation, maintenance, and technical support personnel. The SDD is not a part of the Safety Basis.

The SDD is formatted to be consistent with Department of Energy (DOE) standard DOE-STD-3024-2011, Content of System Design Descriptions, and is based on the best available information, including interviews with knowledgeable personnel. This SDD was written after the system was designed and installed, and operations had begun. It necessarily relies on historic information. Where information was not available or was judged too difficult or impossible to recover or recreate, the following statement is included in the standard format as a placeholder: **Information not readily available.** If a future user of the SDD discovers, recovers, or recreates the missing information, they should forward that information to the SDD owner for incorporation.

Chapter 3.0 of this SDD addresses the system requirements, bases, and an assessment of how the design meets the requirements. A formal assessment of how the actual as-built structures, systems, and components (SSC) in the field meet the requirements is beyond the scope of the SDD, even though some “walk-downs” were made during the preparation of the SDD.

This SDD includes all SSCs for the system that are actually installed in the field, whether or not they are or ever were in operation. Designed or planned facility modifications and additions for on-going projects were not included in the SDD. The intent is to update or replace this SDD...
with new project information as part of the project turnover to Operations personnel for beneficial use.

1.3 OWNERSHIP OF THIS SYSTEM DESIGN DESCRIPTION

The owner of this document is the Design Authority for the system described herein who has been formally assigned responsibility by the Engineering Management of the Tank Farm Contractor. Any changes to this SDD document shall be approved by the assigned Design Authority.

1.4 DEFINITIONS/GLOSSARY

Administrative Controls. Administrative Controls (AC) are the provisions relating to organization and management, procedures, recordkeeping, assessment, and reporting; the safety management programs; and the directed action SPECIFIC ADMINISTRATIVE CONTROLS (SAC) and AC Key Elements necessary to ensure safe operation of a facility. The ACs include administrative requirements that ensure Technical Safety Requirement (TSR) requirements are met in the operation of the facility, and the procedures that are followed should a TSR not be met. Also included in the ACs are commitments to maintain safety management programs. Details of the safety management programs are described in the programmatic chapters of RPP-13033. SACs and AC Key Elements are derived from the hazard and accident analyses in RPP-13033, Chapter 3.0.

ALARA. The philosophy of making every reasonable effort to maintain exposures to radiation as low as reasonably achievable (ALARA).

ALARACT. The use of radionuclide-emission as low as reasonably achievable control technology (ALARACT) that achieves emission levels that are consistent with the philosophy of ALARA.

Confinement. Engineered barriers (e.g., ventilation systems) designed to prevent or minimize the spread of radioactive and other hazardous materials contained within a nuclear facility or within the normal or off-normal facility effluents.

Confinement Ventilation. In a facility that contains radioactive or other hazardous materials, negative pressure is maintained by a ventilation system. A controlled, continuous airflow pattern is thus maintained from the environment into the facility and out through a filtered exhaust system that traps any entrained radioactive particulate.

Continuous Air Monitor. An instrument that monitors the radioactivity level in the exhaust air stream. A small fan draws a representative sample of the exhaust air stream through the continuous air monitor (CAM) detection chamber, particulates are captured on a filter, and the radioactivity on the filter is measured.
Derived Requirement. A requirement that is further refined from a primary source requirement or from a higher level derived requirement, or a requirement that results from choosing a specific implementation for a system element.

Design Authority. The organization responsible for establishing the design requirements and ensuring that design output documents appropriately and accurately reflect the design basis. The design authority is responsible for design control and ultimate technical adequacy of the engineering design process. These responsibilities are applicable whether the process is conducted fully in-house, partially contracted to outside organizations, or fully contracted to outside organizations. The Engineering organization fills the role of the “Design Authority” for Tank Farm facilities. All references to Design Authority in other documents shall be interpreted as a reference to the Engineering organization (TFC-PLN-03, Engineering Program Management Plan).

Design Feature. Design Features means the design features of a nuclear facility specified in the TSRs that, if altered or modified, would have a significant effect on safe operation. Design Features are normally passive characteristics of the facility not subject to change by operations personnel, and do not require, or infrequently require, maintenance or surveillance. For additional information on Design Features please see HNF-SD-WM-TSR-006, Tank Farms Technical Safety Requirements, Section 1.12, “Design Features”.

Designated Stack. A radioactive air emission stack is designated in accordance with Title 40, Code of Federal Regulations (CFR), Part 61, “National Emission Standards for Hazardous Air Pollutants” (40 CFR 61), Subpart H, if it has a potential to emit that could cause an off-site dose that exceeds 0.1 mrem/yr., and it is non-designated if it does not have that potential. These stacks also are referred to as major and minor stacks, respectively. See RPP-16922, Environmental Specifications Requirements, Section 2.1.1, “Tank Farm Emission Unit Designations.”

Double-Shell Tank. A tank designed for storage of the highly radioactive and hazardous waste produced at the Hanford Site. The primary tank shell contains the waste and is surrounded by a secondary shell to provide waste containment if the primary shell develops a leak.

Flammable Gas. Primarily hydrogen and ammonia gas that may be released from the tank waste. See RPP-6664, The Chemistry of Flammable Gas Generation, for more details.

Fugitive Emissions. Fugitive emissions are radioactive air emissions that do not and could not reasonably pass through a stack, vent, or other functionally equivalent structure and that are not feasible to directly measure and quantify.

Functional Test. Functional tests are developed to evaluate the performance of the safety-significant SSCs. Functional tests are performed on selected safety-significant SSCs where it is practical to verify system functional safety criteria.

Hanford Site. A 1518 km² (586 mi²) nuclear processing site located in south-central Washington State and operated by the U.S. Department of Energy.
Head Space. The vapor-containing portion of a waste tank from the top of the waste surface to the top of the tank dome.

High-Efficiency Particulate Air (HEPA) Filters. A throwaway, extended-media dry-type filter with a rigid casing enclosing the full depth of the pleats. The filter shall exhibit a minimum efficiency of 99.97% when tested with an aerosol of essentially monodispersed 0.3 μm diameter test aerosol particles (quoted from ANSI/ASME AG-1, *Code on Nuclear Air and Gas Treatment*, Section FC-1130).

Job Control System. The corrective and preventive maintenance system used to control and coordinate all maintenance activities on the Hanford Site.

Limiting Conditions for Operation. LCOs are the lowest functional capability or performance level of safety SSCs (and their support systems) required for normal, safe operation of the facility. All safety-significant SSCs were developed as Design Features; therefore, there are no LCOs for SSCs in the TSR. Consistent with DOE-STD-1186-2004, SACs that are identified to prevent or mitigate an accident scenario and that have a safety function that would be safety class or safety significant if the function were provided by an SSC may also be included in the TSRs as LCOs. The LCOs identified for tank farm facilities are identified in RPP 13033. Detailed bases for the LCOs are provided in the referenced Chapter 4.0 of RPP13033 and the TSR document.

Limiting Control Settings. Limiting Control Settings (LCS) are set-points on safety systems that control process variables to prevent exceeding safety limits (SLs). The specific set-points are chosen such that, if exceeded, sufficient time is available to automatically or manually correct the condition before exceeding SLs.

Lower Flammability Limit. The minimum flammable gas concentration at which deflagration could occur.

Major Stack/Minor Stack. See definition for designated stack/non-designated stack.

Mode. Modes are used (1) to determine SL, Limiting Control Setting (LCS), LCO, and Administrative Control (AC) applicability; (2) to distinguish facility operational conditions; and (3) to provide an instant facility status report. Facility operational MODES are not defined for the tank farm TSRs.

Record Sampler. A device for measuring radioactive particulate in gaseous effluents. A small air pump draws a representative sample of the exhaust air stream through a small filter, which traps particulate. The filter can be removed periodically and analyzed for radioactive content.

Safety Basis. The documented safety analysis and hazard controls that provide reasonable assurance that a U.S. Department of Energy (DOE) nuclear facility can be operated safely in a manner that adequately protects workers, the, the public, and the environment. The tank farms Safety Basis is documented in RPP-13033, *Tank Farms Documented Safety Analysis*. (10 CFR 830.3, “Nuclear Safety Management,” “Definitions.”)
Seal Pot. An engineered feature of the condensate collection subsystem that prevents vapor from the tank annulus from bypassing the high-efficiency particulate air filters (HEPA) through the condensate drain lines. Condensate drains into the seal pot below the liquid level in the seal pot. The liquid seals the drain lines to air flow.

Surveillance Requirements. Surveillance Requirements (SR) are requirements relating to testing, calibration, or inspection of safety structures, systems, and components (SSC) or conditions. The purpose of SRs is to confirm the availability, operability, and quality of safety SSCs, or to verify that specific plant conditions exist that are required to maintain the facility’s operations within the Safety Limits (SLs), Limiting Control Settings (LCSs), and Limiting Condition for Operations (LCOs). SRs ensure that safety SSCs will function when required or that parameters are within limits (e.g., temperature) to preserve the validity of the safety analysis and the resulting safety envelope. If a safety SSC is out of service or is inoperable, it cannot perform its required safety function.

System Engineer. The engineer designated by the organization to each system to which the System Engineer Program applies. The system engineer maintains overall cognizance of the system and is responsible for system engineering support for operations and maintenance. The system engineer provides technical assistance in support of line management safety responsibilities and ensures continued system operational readiness. (DOE-STD-1073-2003)

Technical Safety Requirements. The limits, controls, and related requirements necessary for the safe operation of a nuclear facility and, as appropriate for the work and the hazards identified in the documented safety analysis for the facility, includes safety limits, operating limits, surveillance requirements, administrative and management controls, use and application provisions, and design features, as well as a bases appendix. For the tank farms at the Hanford Site, technical safety requirements (TSR) are found in HNF-SD-WM-TSR-006, Tank Farms Technical Safety Requirements.

Waste Storage. Tanks receive and store waste either from processing activities or from other tanks.

Waste Transfer. Movement of waste through piping systems between storage tanks and/or facilities.

1.5 ACRONYMS

AC administrative control
ACGIH American Conference of Government Industrial Hygienists
ALARA as low as reasonably achievable
ALARACT as low as reasonably achievable control technology
ANSI American National Standards Institute
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>CAM</td>
<td>continuous air monitor</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>CH2M HILL</td>
<td>CH2M HILL Hanford Group, Inc.</td>
</tr>
<tr>
<td>DID</td>
<td>defense in depth</td>
</tr>
<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
</tr>
<tr>
<td>dP</td>
<td>differential pressure</td>
</tr>
<tr>
<td>DST</td>
<td>double-shell tank</td>
</tr>
<tr>
<td>Ecology</td>
<td>Washington State Department of Ecology</td>
</tr>
<tr>
<td>EDMS</td>
<td>Engineering Document Management System</td>
</tr>
<tr>
<td>EDS</td>
<td>electrical distribution system</td>
</tr>
<tr>
<td>ENV</td>
<td>environmental (requirement)</td>
</tr>
<tr>
<td>ERDA</td>
<td>Energy Research and Development Administration</td>
</tr>
<tr>
<td>GEN</td>
<td>general (requirement)</td>
</tr>
<tr>
<td>HEPA</td>
<td>high-efficiency particulate air (filter)</td>
</tr>
<tr>
<td>IPR</td>
<td>initial project requirement</td>
</tr>
<tr>
<td>LCO</td>
<td>limiting condition for operation</td>
</tr>
<tr>
<td>LCS</td>
<td>limiting control setting</td>
</tr>
<tr>
<td>MC</td>
<td>mission critical (requirement)</td>
</tr>
<tr>
<td>OSD</td>
<td>operating specification document</td>
</tr>
<tr>
<td>RILS</td>
<td>Rim Information Locator System</td>
</tr>
<tr>
<td>RPP</td>
<td>River Protection Project</td>
</tr>
<tr>
<td>SAC</td>
<td>specific administrative control</td>
</tr>
<tr>
<td>SC</td>
<td>Safety Class</td>
</tr>
<tr>
<td>SDD</td>
<td>system design description</td>
</tr>
<tr>
<td>SMACNA</td>
<td>Sheet Metal and Air Conditioning Contractors National Association</td>
</tr>
<tr>
<td>SS</td>
<td>Safety Significant</td>
</tr>
<tr>
<td>SSC</td>
<td>structure, system, and/or component</td>
</tr>
<tr>
<td>SST</td>
<td>single-shell tank</td>
</tr>
<tr>
<td>TMACS</td>
<td>Tank Monitor And Control System</td>
</tr>
<tr>
<td>TSR</td>
<td>technical safety requirement</td>
</tr>
<tr>
<td>VTA</td>
<td>ventilation tank annulus</td>
</tr>
<tr>
<td>WAC</td>
<td>Washington Administrative Code</td>
</tr>
<tr>
<td>WSTA</td>
<td>waste storage tank annulus</td>
</tr>
</tbody>
</table>
2.0 GENERAL OVERVIEW

2.1 SYSTEM FUNCTIONS/SAFETY FUNCTIONS

The main functions of the AN Tank Farm VTA are as follows:

Safety Functions

- No safety functions are identified for the VTA system.

Environmental Functions

- Provide for continuous air monitoring of the annulus space exhausted air via the leak-detector CAMs.

Process Functions

- Remove moisture from the tank annulus space and minimize the potential for condensation to form on the tanks, thus reducing the potential for corrosion on the outer primary tank wall and the secondary steel tank liner.

- Remove heat to maintain DSTs within applicable temperature limits.

2.2 SYSTEM CLASSIFICATION

The analyses of offsite radiological consequences are documented in RPP 13033, Documented Safety Analysis, Section 3.4.2, per these analyses, no safety-class SSCs are required for tank farms. The same document, RPP-13033, Section 3.3.2.3,” Hazard Evaluation ,” determines that the VTA systems are not classified as Safety Significant (SS), The VTA system is classified as Mission Critical (MC) for corrosion mitigation to reduce the potential for tank failures caused by corrosion. The system is subject to Technical Safety Requirement (TSR), Administrative Control (AC) 5.6, “Safety Management Programs”.

2.3 BASIC OPERATIONAL OVERVIEW

Moisture can accumulate in the DST annulus from condensation and from water intrusion. Corrosion caused by this moisture can jeopardize waste tank integrity and decrease the useful life of the tank. The VTA system minimizes this corrosion by preventing condensation and removing accumulated moisture through evaporation. The ventilation air accelerates the evaporation rate by providing outside air to the annulus that has a lower relative humidity and through forced air convective mass transfer. The ventilation air also dilutes and removes any flammable gas generated within the annulus by waste leaked into the annulus from the primary tank.
The AN Tank Farm VTA system has two exhaust units, A Train and B Train. The A Train unit normally ventilates the annuli of Tanks 241-AN-101, 241-AN-102, and 241-AN-103. The B Train unit normally ventilates only the annuli of Tanks 241-AN-104, 241-AN-105, 241-AN-106, and 241-AN-107. The system’s exhaust fan draws outside air into an air inlet. The air is distributed to a central air-distribution chamber below the primary tank. The air flows from the distribution chamber through the air-distribution grid to the annulus. Exhaust air then is drawn out of the annulus through underground ducts. The ducts merge to form a common header from each tank. For leak-detection purposes a vacuum pump extracts an air sample from the header and feeds it to a CAM. The underground headers merge into a single header that is routed to above grade. The exhaust air continues through a demister and heating coil and then passes to a filter housing that contains two banks of HEPA filters in series. Filtered air exits the VTA system through the exhaust fan and stack and is released to the environment. The stack is sampled and monitored for radioactive emissions. A record sampler system is provided to sample the air stream for radioactive particulates. Sample line flows and exhaust flows are monitored to provide information necessary to document the emissions. Subsystems of the VTA include an instrumentation/control system and a condensate drain system. A simplified system diagram for the AN Tank Farm VTA system is shown in Figure 1. System boundaries are identified on Figure 2 in Chapter 4.0.
Figure 1. System Diagram for the AN Tank Farm Ventilation Tank Annulus System.
3.0 REQUIREMENTS AND BASES

In this section, all the requirements on the VTA system are identified, as well as the bases for those requirements and a brief summary of how the requirements are met. Engineering design requirements, functional and operability requirements, programmatic requirements, and testing and maintenance requirements are included. Basis information is provided from the source documentation, when available. The source documentation for the bases for many of the requirements is incomplete or unavailable. The intent of this document is not to recreate these bases where they are incomplete, but to compile existing information on the bases.

The requirements in this section are assigned classifications with regard to their importance according to the hierarchy defined in this section.

3.1 REQUIREMENTS

System requirements in this section build on and logically support the system functions. The requirements in this section are assigned classifications with regard to their importance according to the following hierarchy.

Safety Requirements

Safety classifications for SSCs are defined in DOE-STD-3009-94, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses. These safety classifications are then assigned to the requirements imposed on the SSCs as described in this SDD.

- **SC – Safety Class**: SSCs including portions of process systems, whose preventive and mitigative function is necessary to limit radioactive hazardous material exposure to the public, as determined from the safety analysis. No SC SSCs or requirements are identified for the VTA system.

- **SS – Safety Significant**: SSCs which are not designated as SC SSCs, but whose preventive or mitigative function is a major contributor to defense in depth (DID) and/or worker safety as determined from the safety analysis.

- **Other Safety Requirements**
  - **TSR – Technical Safety Requirement**: The TSRs are defined in HNF-SD-WM-TSR-006, Tank Farms Technical Safety Requirements, and identify those criteria that define the envelope within which the facility is to be operated. They define operability criteria and operational limits for SC or SS SSCs to mitigate or prevent postulated accident scenarios or to protect assumptions in the accident analyses.
DID – Defense in Depth: Defense-in-Depth features include safety SSCs, TSRs, and other design and administrative features that provide multiple layers of defense to prevent or mitigate potential hazardous conditions and postulated accidents. The DID features provide layers of defense against a release of hazardous materials so that no one layer by itself, no matter how dependable, is relied upon totally. The DID philosophy in RPP-13033 typically takes credit for programs that may implement hardware requirements, but does not necessarily identify the specific attributes of the hardware that are utilized as DID features. This SDD, therefore, does not identify any DID design features or requirements that are driven by the environmental management program. See RPP-14821, *Technical Basis Document for Defense-in-Depth Features*, and RPP-13033, Section 3.3.2.3.2, for more details.

**Environmental Requirements**

- **ENV – Environmental**: The State of Washington has codified environmental regulations applicable to nuclear facilities; the *Washington Administrative Code* (WAC) is the implementation of those regulations. The VTA system is the main discharge pathway to the environment for all gaseous emissions from the tank annuli and, therefore, is subject to the requirements of WAC 246-247, “Radiation Protection—Air Emissions.” Requirements based on compliance with these regulations are classified as ENV. Requirements from RPP-16922 Environmental Specification Requirements, are also given the ENV classification. The stack currently is a non-designated or minor stack, based on its expected emissions, in accordance with 40 CFR 61, Subpart H. Stack designations are identified in RPP-16922, Section 2.1.1, “Tank Farms Emission Unit Designations”.

**Process Requirements**

- **MC – Mission Critical**: The mission of the tank farm facilities is to safely store mixed radioactive and hazardous waste, to retrieve the waste, and to deliver it to the Waste Treatment Plant. Any requirements of the ventilation system that support this mission other than safety basis or environmental regulatory requirements are classified as MC.

TFC-ENG-STD-07, *Ventilation System Design Standard*, establishes the performance requirements and provides references to the requisite codes and standards to be applied during the design of the DST ventilation subsystem that supports the first phase of waste feed delivery to the treatment facility and may identify MC requirements applicable to this new mission. However, TFC-ENG-STD-07 is intended to be the basis for new projects/installations. It is not intended to retroactively affect previously established project design criteria without specific direction by the program.
• **OSD – Operating Specification Document:** OSDs are comprised of the specifications that maintain processes/operations within acceptable limits to protect equipment from damage, ensure product/service quality, increase efficiency, and prevent mission interruption. (TFC-ENG-CHEM-P-14, Operating Specification Documents).

• **GEN – General:** This classification includes all other requirements for this system including contractual requirements between the DOE and the operations contractor and codes and standards that are required not by regulation but at the option of the DOE or its contractor. This classification includes requirements from project documents for the original design and installation of the tank farm. The initial requirements were specified in the baseline document, ARH-CD-304, Functional Design Criteria — Additional High-Level Waste Storage and Handling Facilities.

Table 1. Summary of AN Tank Farm Ventilation Tank Annulus System Safety, Environmental, and Operating Specification Document Requirements. (2 sheets)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Class</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion Mitigation Program,</td>
<td>OSD</td>
<td>3.4.1.1</td>
</tr>
<tr>
<td>VTA System Operation Surveillance</td>
<td>OSD</td>
<td>3.7.3.1.1</td>
</tr>
<tr>
<td>VTA System Annual Evaluation</td>
<td>TSR</td>
<td>3.4.3.1.2</td>
</tr>
<tr>
<td>Provide for Continuous Air Monitoring (CAM)</td>
<td>ENV</td>
<td>3.4.1.2</td>
</tr>
<tr>
<td>Inlet HEPA Filters</td>
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<td>Demister</td>
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<td>Exhaust Heater</td>
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<tr>
<td>ALARACT 16.1</td>
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<td>3.5.2.2</td>
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<tr>
<td>Exhaust HEPA Filter dP Gauges Calibration</td>
<td>ENV</td>
<td>3.7.4.1</td>
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<tr>
<td>Emission Measurement System Flow-Rate Adjustments and Calibration</td>
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<tr>
<td>Stack Flow Rate Measurement</td>
<td>ENV</td>
<td>3.7.3.3</td>
</tr>
<tr>
<td>HEPA Filter In-Place Leak Testing</td>
<td>ENV</td>
<td>3.7.3.2</td>
</tr>
</tbody>
</table>
Table 1. Summary of AN Tank Farm Ventilation Tank Annulus System Safety, Environmental, and Operating Specification Document Requirements. (2 sheets)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Class</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annulus Pressure Operating Specification Limit</td>
<td>OSD</td>
<td>3.4.1.3</td>
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<td>HEPA Filter dP Operating Specification Limits</td>
<td>OSD</td>
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</tr>
<tr>
<td>HEPA Filter Temperature Operating Specification Limit</td>
<td>ENV</td>
<td>3.4.2.6</td>
</tr>
</tbody>
</table>

Notes:

ALARACT = As low as reasonably achievable control technology.
CAM = Continuous air monitor.
DST = Double-shell tank.
DID = Defense in depth.
dP = Differential pressure.
ENV = Environmental (requirement).
HEPA = High-efficiency particulate air (filter).
MC = Mission critical.
OSD = Operating specification document.
TSR = Technical safety requirement.
VTA = Ventilation tank annulus.

3.2 BASES

Bases explain why requirements exist and why they have been specified in a particular manner or at a particular value during the engineering design process. Basis information is delineated in design input information, design constraints, and intermediate outputs, such as design studies, analyses, and calculations. The basis encompasses consideration of such factors as facility mission, facility availability, facility efficiency, costs, schedule, maintainability, and safety. (10 CFR 830).

3.3 REFERENCES

Specific references are essential to understanding and using the SDD. Reference to source documents from which requirements and basis information have been extracted adds traceability to the SDD and improves its credibility. To the extent that such reference documents are available, the source documents that contain the cited requirements or the bases information are referenced in the SDD. If the requirement or basis information is not recorded in a separate document, the documentation no longer exists, or retrieval of such a document is not feasible, the basis notes that a documented reference is not available.
3.4 GENERAL REQUIREMENTS

The functional and operability requirements are identified in this section, along with the bases that are necessary for the VTA system to fulfill the system function statements of Section 2.1. Interface requirements with adjacent systems and applicable codes and standards are also identified in this section.

3.4.1 System Functional Requirements

The system functional requirements identified in this section directly support the system functions identified in Section 2.1. Table 1 summarizes the safety, environmental and OSD requirements imposed on the Ventilation Tank Annulus VTA system that are identified in this section.

3.4.1.1 Corrosion Mitigation Program,

**Requirement:** Annulus tank ventilation systems shall be operating except for outages not to exceed 30 days. The system shall provide sufficient ventilation to minimize the potential for condensation in the DST annulus and remove water accumulated from intrusion.

**Class:** OSD

**Basis:** The basis for requiring operation of the annulus ventilation is that corrosion is a cumulative phenomenon that is minimized by operating the annulus ventilation system as much as possible to remove moisture and prevent condensation from collecting on the tank walls. The effectiveness of the annulus ventilation systems was evaluated in RPP-7695, Double-Shell Tank Annulus Ventilation Engineering Study. RPP-7695 concluded that operation of the annulus ventilation systems may significantly reduce the amount of moisture in the annulus and thereby reduce the potential for corrosion. (OSD-T-151-00007, Section 1.5.2, “Annulus Tank Ventilation System and Annulus Inspection.”)

**How Requirement is Met:** The surveillance activities that ensure that the above operability criteria are met include, verification that at least one fan is operating and that the tank annulus inlet dampers are not closed. These verifications are documented as part of TF-OR-DR-AN, AN Daily Rounds.

The 30-day duration was based on engineering judgment and operational experience that indicate that routine maintenance and most repairs can be accomplished within 30 days and those outages of longer than 30 days require special attention. The requirement for a corrosion mitigation program is not derived from the accident analyses in RPP-13033 the DSA. This program is intended to support the tank farms programmatic mission for extended use of the DSTs.
If the annulus tank ventilation system is out of service for longer than 30 days, a plan and schedule for restoring the system is required to be submitted to DOE. The surveillance activities that ensure that the above operability criteria are met are verification that at least one fan is operating, that the tank annulus inlet dampers are not closed.

### 3.4.1.2 Provide for Continuous Air Monitoring (CAM)

**Requirement:** The system shall accommodate monitoring by the annulus leak-detector CAM.

**Class:** ENV

**Basis:** The annulus leak detector CAM supplements the operation of the DST leak detection systems. Detection of airborne releases into the annulus could give an indication of a leak from the primary tank structure into the annulus. VTA system operation is necessary for the leak detector CAMs to perform their function. See Section 3.2.7.2 and OSD-T-151-00031, Operating Specifications for Tank Farm Leak Detection and Single Shell Tank Intrusion Detection, for additional basis information. (OSD-T-151-00031)

**How Requirement is Met:** Operation of the VTA system, with reasonable downtime for maintenance, draws air through the annulus of each tank and delivers it to the leak-detector CAMs. A CAM is connected to the VTA system at the exhaust duct of each tank. A vacuum pump extracts an air sample from the exhaust flow stream, and the CAM scans the sample for radioactive particulate. If a leak from the primary tank were to occur, the CAM would detect an increase in radioactive-particulate activity and an alarm would actuate upon exceeding the set point of 2,000 cpm.

The required flow rate specified in the round sheets (1 cfm) is based on the optimum counting efficiency of the CAM over the entire operating range of 0 to 4 cfm. This value is based on the results from testing conducted by PNNL and documented in PNNL-10938, Evaluation of Eberline, AMS-3A and AMS-4, Beta Continuous Air Monitors, and PNNL-11701, UC-702, Generic Effluent Monitoring System certification for Salt Well Portable Exhauster.

### 3.4.1.3 Heat Removal

**Requirement:** The quantity of air supplied to the annulus shall be sufficient in combination with the primary tank ventilation for heat removal of at least 100,000 Btu/hr per tank.

**Class:** GEN

**Basis:** Radioactive decay heat generation could cause waste temperatures to rise resulting in tank and auxiliary equipment damage due to excessive temperatures.
Although the basis for the heat removal rate of 100,000 Btu/hr is not documented for the AN Tank Farm, the same heat removal rate of 100,000 Btu/hr is specified for the AP Tank Farm and is based on the concentration of 6.0 Ci/gal of cesium-137, as specified in SD-340-FDC-001, Table 1. This is also likely to be the basis for the AN Tank Farm heat removal rate. RPP-13033 evaluated the potential of waste tanks to experience the tank bump accident resulting from rising waste temperatures. This evaluation concluded that, under current waste conditions, tank bump consequences that are less than the guidelines for the onsite worker and do not pose significant facility worker hazards (RPP13033, Section 3.3.2.3.1).

How Requirement is Met: Operation of the VTA system, with reasonable downtime for maintenance, removes heat through convection at the primary tank outer surface. Convection is enhanced by air distribution beneath the tank and flow around all sides of the tank. Verification of the heat removal rate of 100,000 Btu/hr is not documented.

3.4.1.4 Annulus Pressure Operating Specification Limit

Requirement: The system shall maintain the annulus pressure within the limits of \( \geq -20 \text{ in. wg} \) and \( \leq 0 \text{ in. wg} \).

Class: ENV/OSD

Basis: The low pressure limit is the structural design value and is established to prevent buckling of the primary tank wall, jeopardizing tank integrity. Minimum Annulus Vacuum is set to avoid a pressurization event and to maintain confinement ventilation. (OSD-T-151-00007, Table 1.3.2, “Secondary Tank Annulus Vacuum”)

How Requirement is Met: The ventilation system operates in conjunction with physical barriers to form a confinement system. The fan maintains a negative pressure on the receiver tank with respect to the outside atmosphere. Annulus pressures are monitored daily in accordance with TF-OR-DR-AN AN Daily Rounds.

Under current drive sheave arrangement and maximum achievable fan speed, the exhaust fans are not capable of providing a vacuum within the AN annulus spaces that would exceed the -20 in. wg limit. The AN Tank Farm VTA system has two exhaust units, the A Train and the B Train. The A Train unit normally ventilates the annuli of Tanks 241-AN-101, 241-AN-102, and 241-AN-103. The B Train unit normally ventilates only the annuli of Tanks 241-AN-104, 241-AN-105, 241-AN-106, and 241-AN-107. The A-Train fan maximum achievable static pressure is approximately 16.7 in. wg, and the B-Train fan maximum achievable static pressure is approximately 15.5 in. wg (see Appendix F, AN Tank Farm Ventilation Tank Annulus System Fan Curves). When only one fan is operating,
the system is configured by procedure to open an isolation valve on a crossover duct so that the single fan ventilates all seven tanks.

Should the system be inadvertently configured to ventilate all seven tanks with both fans (e.g., crossover duct valve open), the maximum static pressure achievable will still not be capable of providing a vacuum within the AN annulus spaces that would exceed the -20 in. wg limit, as the two parallel exhaust fans share a common exhaust plenum and stack. In this parallel configuration with common exhaust duct, the individual fan static pressures are not additive (Jorgensen, Robert, 1999, *Fan Engineering, An Engineer’s Handbook on Fans and Their Applications*, Ninth Edition, pages 14-14 through 14-17).

### 3.4.2 Subsystems and Major Components

The VTA system is divided into a number of subsystems and major components with unique functional requirements that directly support the system functions identified in Section 2.1. The safety, environmental, and OSD requirements that apply to subsystems or major components of the VTA system are summarized in Table 1.

The AN Tank Farm VTA system consists of the following subsystems:

- Annulus inlet station subsystem
- Tank exhaust ductwork and header subsystem
- Exhaust train subsystem
- Exhaust stack sampling subsystem
- Condensate collection subsystem.

Major components of the above subsystems are as follows:

- Isolation valves
- Prefilters
- HEPA filters
- Filter housings
- Demisters
- Heating coils
- Exhaust fan assemblies
- Stack and process monitoring instrumentation
- Heater controllers and interlocks.

#### 3.4.2.1 Inlet High-Efficiency Particulate Air Filters (HEPA)

**Requirement:** Radioactive particulate shall be confined at the inlet air control stations.

**Class:** ENV

**Basis:** This requirement is derived from the need to maintain radioactive air emissions as low as reasonably acceptable (ALARA) (see Section 3.5.2). The
inlet HEPA filters reduce the potential for the unfiltered release of radioactive particles to the environment from unexpected annulus pressurization, especially during ventilation system downtime. (WAC 246-247-130 and DOE-HDBK-1132-99, *Design Considerations*, Section 1.1.6, “Confinement Ventilation Systems”) **How Requirement is Met:** HEPA filters are installed in the annulus inlet air station for all seven waste tanks. These filters have a factory rated particulate removal efficiency of 99.97% for particles as small as 0.3 μm. HEPA filter life-cycle activities from design and procurement to removal and disposal are managed at tank farms in accordance with TFC-ENG-STD-07, *Ventilation System Design Standard.*

### 3.4.2.2 Demister

**Requirement:** Moisture particles shall be removed from the air stream prior to the HEPA filters.

**Class:** ENV

**Basis:** Moisture particles within the tank annuli and entrained in the exhaust air stream must be removed to protect downstream components. Moisture on the HEPA filters can cause degradation of the filter media as well as premature failure from high differential pressure (dP). Removal of this moisture limits the amount of moisture collecting on the filters and protects the filters from premature failure, thus increasing the reliability of the filters to perform their function. The demisters are required abatement technology as specified in the Hanford Air Operating Permit (AOP). (Hanford AOP)

**How Requirement is Met:** A Demister with 99% removal efficiency for particles >10 μm are installed upstream of the heater on each exhaust train. A 4-in.-thick, 9-lb/ft³, wire-mesh demister is provided for both the VTA system A Train and B Train. The demisters are sized for the design flow rates and have greater than 99% efficiency for removal of clean liquids of 10 μm and larger droplet size. The demister is identified on Hanford Site Drawing H-2-71937. An analysis that documents the selection of the demister is *Information not readily available*, but may be recreated as resources allow.

### 3.4.2.3 Exhaust Heater

**Requirement:** The relative humidity of the exhaust air shall be maintained below the dew-point along the entire filter train.

**Class:** ENV

**Basis:** Condensation on the cooler surfaces of the exhaust train caused by moisture in the exhaust air stream must be mitigated to protect exhaust train
components. The heater raises the temperature and thus reduces the relative humidity of the air exhausted from the storage tank annulus. This prevents condensed moisture from plugging the downstream HEPA filters. Condensation occurring on the HEPA filters can cause degradation of the filter media as well as premature failure from high dP. The heater limits the amount of condensation collecting on the filters and protects the filters from premature failure, thus increasing the reliability of the filters to perform their function. The heaters are required abatement technology as specified in the Hanford AOP. (Hanford AOP, SD-340-FDC-001 and RPP-16922, Table 2-2, “Required Abatement Technology Equipment,” lists heaters for each AN annulus stack.) The heating coil is identified in Vendor Information File 20586 (see Appendix CE) and Hanford Site Drawing H-2-71397. An analysis that documents the selection of the heating coil is Information not readily available, but may be recreated as resources allow.

How Requirement is Met: Heaters are located upstream of the HEPA filters in each of the exhaust trains. The A Train heater is rated at 9 kW, 460 V, 3 phase, 60 Hz, and the B Train heater is rated at 12 kW, 460 V, 3 phase, 60 Hz. Temperature controllers modulate heater output to maintain the heater differential temperature at the selected control setpoint. Heater inlet and outlet temperatures are monitored to verify system operation.

3.4.2.4 Exhaust HEPA Filters

Requirement: Radioactive particulates shall be removed from the exhaust air stream to meet ALARA principles and the emission standards defined in the regulations identified in Section 3.4.4.

Class: ENV

Basis: The combined emissions of radionuclides to ambient air from all facilities on the Hanford Site are limited to a total effective dose equivalent of 10 mrem/yr to any member of the public. The two exhaust HEPA filter banks in series are required abatement technology, in accordance with the Hanford AOP, to maintain emissions below this limit. (DOE-HDBK-1132-99, Design Considerations, Section 1.1.6, “Confinement Ventilation Systems,” and Hanford AOP)

How Requirement is Met: Two HEPA filter banks in series are installed on each exhaust train. Each bank is two filters wide and two filters high for a total of four filters per bank. The individual filters have a factory rated particulate removal efficiency of 99.97% for particles as small as 0.3 μm. HEPA filter life-cycle activities from design and procurement to removal and disposal are managed at tank farms in accordance with TFC-ENG-STD-07. Each HEPA is 24-in.–by 24-in. –by 11.5-in.-thick and rated at 1,000 ft³/min at 1 in. w.g. HEPA filters are identified on Hanford Site Drawing H-2-71937.
3.4.2.5 HEPA Filter Differential Pressure Operating Specification Limits

Requirement: The filter dP shall be maintained within the following limits:

- Inlet HEPA filter \( \leq 5.9 \text{ in. w.g.} \)
- First exhaust HEPA filter \( \leq 5.9 \text{ in. w.g.} \)
- Second exhaust HEPA filter \( \leq 4.0 \text{ in. w.g.} \)

Class: OSD

Basis: RPP-11413, *Ventilation System In-Service Requirements*, Section 4.1, “Differential Pressure Limits,” provides the operating requirements for the various HEPA filters on the annulus exhaust systems and provides a basis for these limits in chapter 5.

The maximum operating limit of 5.9 in. w.g. applies to the first exhaust HEPA filter because it is the first confinement barrier for radioactive and other particulates, it will trap most of the material in the air stream, and it will load much faster than the downstream filters. The established limit is 40% below the manufacturer’s HEPA filter design test limit of 10 in. w.g. for an additional margin of safety to prevent filter failure due to excessive dP. This limit is also 20% less than the maximum used HEPA filter dP limit of 8.0 in. w.g. suggested by ERDA 76-21, *Nuclear Air Cleaning Handbook: Design, Construction, and Testing of High-Efficiency Air Cleaning Systems for Nuclear Application*, to allow for decreased filter strength due to aging and deterioration.

The maximum operating limit of 4.0 in. w.g. applies to downstream HEPA filters with less loading potential. A fast or high loading of a secondary HEPA filter indicates failure or unusual particulate loading in the first HEPA filter and the lower dP limit provides earlier warning to detect such problems with the first HEPA filter.

How Requirement is Met: HEPA filter dP readings are monitored and recorded daily in accordance with TF-OR-DR-AN, *AN Daily Rounds*.

3.4.2.6 HEPA Filter Temperature Operating Specification Limit

Requirement: The air stream temperature at all HEPA filters in the system shall be maintained \( \leq 230^\circ\text{F} \).

Class: OSD

Basis: Excessive temperatures in the air stream will cause weakening of the filter gaskets and sealant and lead to filter failure. Manufacturer literature from Flanders Filters, Inc. indicates the maximum safe operating limit is 250 \( ^\circ\text{F} \) based
on periodic operation. This OSD limit of 230 °F protects this maximum temperature limit of 250 °F. A limit of 200°F is recommended by both Flanders Filters, Inc. and the neoprene gasket sealing material provider and is also recommended. RPP-11413, Section 4.3, “Temperature Limits,” provides the temperature limits for the various HEPA filters on the annulus exhaust systems and provides a basis for the limits in chapter 5. RPP-11413 requires a temperature ≤ 200°F for continuous operation and ≤ 230°F for periodic operation.

How Requirement is Met: Temperature controls located at the heater of the VTA system prevent excessive air temperatures. The HEPA filter inlet temperature is monitored daily during operator rounds in accordance with TF-OR-DR-AN, AN Daily Rounds.

3.4.2.7 Condensate Collection System Seal Pot

Requirement: HEPA filter bypass of ventilation air through the drain lines shall be prevented.

Class: ENV

Basis: This requirement is derived from the need to prevent emission through the untreated pathway of the drain lines to maintain radioactive air emissions ALARA.

How Requirement is Met: The seal pots act as an engineered confinement barrier to ensure that no ventilation air is allowed to bypass any of the system components. The drain lines return back to the waste tank and could provide a potential air flow path that bypasses some of the exhaust train components. The seal pot allows drainage while sealing this path to air passage.

3.4.2.8 Radioactive Emission Measurement

Requirement: The stack effluent shall have periodic emission measurements providing a minimum of one 4 week sample per year.

Class: ENV

Basis: The stack for the annulus exhaust system for the AN tank farm are designated as “Minor Stacks”. Because of this designation, emissions measurements are required on a periodic basis. A radioactive air emissions report is required by WAC 246-247-080. Specific sampling requirements for this system are identified in the Hanford AOP. See RPP-16922, Table 2-1, “Radioactive Emission Unit Description,” and Hanford AOP emission unit description for unit EU228 for further basis information.

How Requirement is Met: The record sampler draws a representative sample stream from the exhaust stack and passes it through a filter. The filter is
periodically removed and analyzed for radioactive material in accordance with TF-OPS-006, *Air Sample Filter Exchange for Record Samplers, Stack and Annulus CAMs*.

### 3.4.3 Boundaries and Interfaces

The VTA system interfaces with the following systems:

- Waste transfer system
- Electrical distribution system (EDS)
- Raw water system
- WSTA system including the CAM primary tank leak-detection system
- Ventilation tank primary system.

The specific boundary definitions for these systems and the boundary drawing are included in Section 4.1.2. The functional requirement to accommodate sampling by the CAM primary leak-detection system is described in Section 3.4.1.2. Electrical power requirements are identified in Section 3.6.4. No other interfacing requirements are imposed on the VTA system.

### 3.4.4 Codes, Standards, and Regulations

This section identifies codes, standards, and regulations that currently apply to the VTA system, or that were in effect at the time of construction. TFC-ENG-STD-07 establishes the performance requirements and provides references to the requisite codes and standards to be applied during the design of the DST ventilation subsystem that support the first phase of waste feed delivery to the Waste Treatment Plant.

#### 3.4.4.1 Hanford Air Operating Permit

**Requirement:** The system shall meet the regulatory requirements and emission limits contained in the Hanford AOP.

**Class:** ENV

**Basis:** The AOP contains all regulatory requirements from all involved governmental agencies including the U.S. Environmental Protection Agency, the Washington Department of Ecology (Ecology), the Washington Department of Health, and the Benton Clean Air Authority. Attachment 2 of the AOP identifies applicable requirements from the WAC and from applicable Notices of Construction specific to the AN Tank Farm VTA system, including required
abatement technology and all conditions on system operation. The AOP is owned by the Washington Department of Ecology and can be accessed at URL http://www.ecy.wa.gov/programs/nwp/piarchive.htm.

How Requirement is Met: The required abatement technology is installed in the AN Tank Farm VTA system exhaust trains. This includes one fan, two HEPA filter banks in series, one heater, and one demister for each exhaust train. An assessment of compliance with the administrative, recording, and reporting requirements of the Hanford AOP is beyond the scope of this SDD.

3.4.4.2 ALARACT Technology Standards

Requirement: All existing emission units (including the AN Tank Farm VTA system) and non-significant modifications shall utilize as low as reasonably achievable control technology (ALARACT) (WAC 246-247-040). The ALARACT technology standards required by WAC 246-247-130 are identified in Table 2.

Class: ENV

Basis: Provides greater assurance that the system is capable of meeting the emission standards set forth in WAC 246-247-040. See Table 2.

How Requirement is Met: Table 2 identifies the codes, standards, and regulations that currently apply to the AN Tank Farm VTA system. New construction and modifications to the existing system shall meet these standards. However, the existing ventilation components may or may not comply with these standards because they were designed, built, and installed before many of the standards were in effect.

The technology standards to which the original system was built are identified, when available, in this SDD. A complete list of the standards required at the time of construction can be found in the construction specifications B-130-C7, Construction Specification for the 241-AN Tank Farm Completion Project B-130, and B-130-C7-A, Construction Specification Addendum for the 241-AN Tank Farm. The intent of Table 2 is to provide a baseline that the current system can be measured against.

The VTA components were designed and installed in accordance with the applicable standards that were in effect at the time the tank farm was constructed. These codes and standards are identified in Table 3, for information only. Table 4 identifies the specifications that existed for the piping (ductwork) that was installed for the original VTA system.
3.4.4.3 U.S. Department of Energy Orders

Requirement: The system shall comply with the DOE Orders identified in Table 2, as applicable.

Class: GEN

Basis: Compliance with DOE Orders is a contractual obligation for the tank farm contractor.

How Requirement is Met: The existing ventilation components may or may not comply with these DOE Orders because they were designed, built, and installed before many of the orders were in effect. A detailed compliance assessment is beyond the scope of this SDD. However, although the system may not directly comply with these DOE Orders, it is considered acceptable for continued use based on current maintenance and other routine activities performed on the system, along with the successful past operating history of the system.
Table 2. Codes, Standards, and Regulations Applicable to the AN Tank Farm Ventilation Tank Annulus System. (3 sheets)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Class</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAC 246-247 Radiation Protection – Air Emissions</td>
<td>ENV</td>
<td>Washington State has codified environmental regulations applicable to nuclear facilities, and the Washington Administrative Code is the implementation of those regulations. The Washington State Department of Health is the regulatory agency with the responsibility to enforce these requirements. The U.S. Environmental Protection Agency (codified in 40 CFR, “Protection of Environment”) also has requirements for radioactive emissions, but the Washington State Department of Health has primary jurisdiction.</td>
</tr>
<tr>
<td>WAC 173-480 Ambient Air Quality Standards And Emission Limits For Radionuclides</td>
<td>ENV</td>
<td>Defines the maximum allowable levels for radionuclides in the ambient air. It contains standards for radioactive air emissions in the state of Washington as required by WAC 246-247-040.</td>
</tr>
<tr>
<td>ASME AG-1 Code on Nuclear Air and Gas Treatment</td>
<td>ENV</td>
<td>Required ALARACT technology standard in accordance with WAC 246-247-130. This code provides minimum requirements for the performance, design, construction, acceptance testing, and quality assurance of equipment used as components in nuclear safety-related air and gas treatment systems in nuclear facilities.</td>
</tr>
<tr>
<td>ANSI/ASME N509 Nuclear Power Plant Air-Cleaning Units and Components</td>
<td>ENV</td>
<td>Required ALARACT technology standard in accordance with WAC 246-247-130. This standard covers requirements for the design, construction, and qualification and acceptance testing of the air-cleaning units and components that make up the engineered safety feature and other high-efficiency air and gas treatment systems used in nuclear facilities.</td>
</tr>
<tr>
<td>ANSI/ASME N510 Testing of Nuclear Air Treatment Systems</td>
<td>ENV</td>
<td>Required ALARACT technology standard in accordance with WAC 246-247-130. This standard covers field testing of high-efficiency air treatment systems for nuclear facilities.</td>
</tr>
<tr>
<td>ANSI/ASME NQA-1 Quality Assurance Program Requirements for Nuclear Facilities</td>
<td>ENV</td>
<td>Required ALARACT technology standard in accordance with WAC 246-247-130. This standard sets forth requirements for the establishment and execution of quality assurance programs for the siting, design, construction, operation, and decommissioning of nuclear facilities.</td>
</tr>
<tr>
<td>Requirement</td>
<td>Class</td>
<td>Basis</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
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<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ANSI N13.1</td>
<td>ENV</td>
<td>Required ALARACT technology standard in accordance with WAC 246-247-130 and WAC 246-247-075. This standard sets forth guidelines and performance-based criteria for the design and use of systems for sampling the releases of airborne radioactive substances from the ducts and stacks of nuclear facilities.</td>
</tr>
<tr>
<td>ANSI/ANS N42.18</td>
<td>ENV</td>
<td>Required by WAC 246-247-075. This standard provides recommendations for the selection of instrumentation specific to the continuous monitoring and quantification of radioactivity in effluents released to the environment. This standard specifies detection capabilities, physical and operating limits, reliability, and calibration requirements, and sets forth minimum performance requirements for effluent monitoring instrumentation.</td>
</tr>
<tr>
<td>DOE-HDBK-1132-99 Design Considerations</td>
<td>GEN</td>
<td>Provides general design criteria for use in the acquisition of U.S. Department of Energy facilities and for establishing responsibilities and authorities for the development and maintenance of these criteria.</td>
</tr>
</tbody>
</table>
Table 2. Codes, Standards, and Regulations Applicable to the AN Tank Farm Ventilation Tank Annulus System. (3 sheets)

<table>
<thead>
<tr>
<th>Requirement</th>
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</tr>
</thead>
<tbody>
<tr>
<td>DOE/EH-0173T</td>
<td>GEN</td>
<td>Establishes elements of a radiological monitoring program (HNF 5183, Tank Farm Radiological Control Manual).</td>
</tr>
</tbody>
</table>

Notes:
The following codes and standards are recommended for guidance only in WAC 246-247 and are included here for information.
- PNL-6577, *Health Physics Manual of Good Practice for Reducing Radiation Exposure to Levels that are As Low As Reasonably Achievable (ALARA)*.

ALARACT = As low as reasonably achievable control technology.
ENV = Environmental (requirement).
GEN = General (requirement).
VTA = Ventilation tank annulus.
Table 3. Codes, Standards, and Regulations For the Ventilation Tank Annulus System Ductwork That Were in Effect at the Time that the AN Tank Farm Ventilation Tank Annulus System Was Installed. (2 sheets)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Class</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>The design of the facilities will be consistent with applicable guides and</td>
<td>IPR</td>
<td>The VTA system is the main discharge pathway to the environment for all gaseous emissions from the waste tank annuli. Construction Specification B-130-C7, <em>Construction Specification for the 241-AN Tank Farm Completion Project B-130</em>, identifies codes and standards that were used for fabrication and installation of the VTA system ductwork.</td>
</tr>
<tr>
<td>standards that invoke concentration limits for radioactive materials at the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Code/Standard</td>
<td></td>
<td>How the Code/Standard is Met</td>
</tr>
<tr>
<td>ANSI/ASME B31.1, <em>Power Piping</em>.</td>
<td></td>
<td>VTA system pipe (ductwork) located below grade, from the connection to the DST to the flanged riser located above grade, is fabricated and installed in accordance with ANSI/ASME B31.1, and the materials shall be as noted in Table 4. VTA system pipe (ductwork) located below grade, from the connection to the DST to the flanged riser located above grade, was hydrostatic tested in accordance with ANSI/ASME B31.1 at a test pressure of 5 lbf/in² (gauge).</td>
</tr>
<tr>
<td>Hanford Plant Standard HPS-220-W, <em>Standard Specification for Welding Carbon Steel</em>.</td>
<td></td>
<td>Welding of carbon steels was in accordance with Hanford Plant Standard HPS-220-W. Weld inspection was in accordance with HPS-220-W using Type I acceptance criteria. Annulus ventilation pipe (ductwork) was welded in accordance with HPS-220-W. Inspection was performed in accordance with HPS-220-W using Type II acceptance criteria.</td>
</tr>
</tbody>
</table>
Table 3. Codes, Standards, and Regulations For the Ventilation Tank Annulus System Ductwork That Were in Effect at the Time that the AN Tank Farm Ventilation Tank Annulus System Was Installed. (2 sheets)

<table>
<thead>
<tr>
<th>Code/Standard</th>
<th>How the Code/Standard is Met</th>
</tr>
</thead>
</table>
| SMACNA, 1975, *Industrial Duct Construction Standards* (1st edition). | Except for annulus intake station ductwork upstream of HEPA filters, ventilation tank primary and VTA system ductwork located above grade was fabricated in accordance with SMACNA, 1975, *Industrial Duct Construction Standards* (1st Edition), welded construction. Ducts and ductwork shall be understood to include all items of sheet metal construction including plenums and stacks. Materials for the VTA system ductwork included the following:  
  - Galvanized steel sheets in accordance with ASTM A527-71 (1975), *Steel Sheet, Zinc-Coated (Galvanized) by Hot Dip Process, Lock Forming Quality*, 1.25 oz coating class  
  - Carbon steel shapes, plates, and bars in accordance with ASTM A36-75, *Structural Steel*, hot dipped galvanized.  
  - Fasteners in accordance with ASTM A307-76b, *Carbon Steel Externally and Internally Threaded Fasteners*, Grade A or B, with heavy hex nuts and unified national coarse threads cadmium plated or electro galvanized. |

Notes:

- DST = Double-shell tank.
- HEPA = High-efficiency particulate air (filter).
- IPR = Initial project requirement.
- VTA = Ventilation tank annulus.
Table 4. AN Ventilation Tank Annulus System
Ductwork Materials Specifications

<table>
<thead>
<tr>
<th>Size</th>
<th>Material</th>
<th>Nominal Wall Thickness</th>
<th>Fittings</th>
<th>Flanges</th>
<th>Gaskets</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 in. through</td>
<td>Black steel ASTM A135, Grade A</td>
<td>0.133 in</td>
<td>Butt-welded per ANSI B16.9 and ASTM A234, Grade WPB, Schedule 20</td>
<td>150-lb steel per ANSI/ASME B16.5, slip-on, per ASTM A181, Grade 2</td>
<td>Neoprene, 1/8 in. thick, 55/65 durometer</td>
</tr>
<tr>
<td>12 in.</td>
<td>Black steel ASTM A53, Type S, Grade A or B, or ASTM A106, Grade B</td>
<td>Schedule 10</td>
<td>Butt-welded per ANSI B16.9 and ASTM A234, Grade WPB, Schedule 20</td>
<td>150-lb steel per ANSI/ASME B16.5, slip-on, per ASTM A181, Grade 1, or ASTM A105</td>
<td>Neoprene, 1/8 in. thick, 55/65 durometer</td>
</tr>
<tr>
<td>12 in.</td>
<td>Black steel ASTM A53, Type S, Grade A or B, or ASTM A106, Grade B</td>
<td>Schedule 20</td>
<td>Butt-welded per ANSI B16.9 and ASTM A234, Grade WPB, Schedule 20</td>
<td>150-lb steel per ANSI/ASME B16.5, slip-on, per ASTM A181, Grade 1, or ASTM A105</td>
<td>Neoprene, 1/8 in. thick, 55/65 durometer</td>
</tr>
</tbody>
</table>

Notes:
- ANSI/ASME B16.5, Steel Pipe Flanges, Flanged Valves, and Fittings
- ANSI B16.9, Factory-Made Wrought Steel Butt-welding Fittings
- ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- ASTM A105-76a, Standard Specification for Carbon Steel Forgings for Piping Applications
- ASTM A106-76a, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
- ASTM A181-68, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
- ASTM A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
3.4.5 Operability

The intent of this section is to identify operability requirements as defined in TSR Limiting Conditions for Operation (LCO) in accordance with DOE-STD-3024-2011. No LCOs are specified for the VTA system. Section 3.4.1.1, “Corrosion Mitigation Program”, delineates operation requirements for this VTA.

3.4.6 Performance Criteria

Performance criteria for the design of new waste tank ventilation systems or significant modifications of existing waste tank ventilation systems can be found in TFC- ENG-STD-07, Ventilation System Design Standard. Specific criteria for this system can be found in the body of this SDD.

3.5 SPECIFIC REQUIREMENTS

Requirements that do not directly support the system functions, but that provides for worker safety, protect the system from environmental conditions and natural events, and enhance the ease of system operation are identified in this section.

3.5.1 Radiation and Other Hazards

RPP-13033 and environmental regulations identify the specific radiological safety and environmental requirements that must be met to comply with radiation exposure limits. The specific requirements for radiation protection are identified in other sections and are summarized below. See Table 1 for a summary of the safety and environmental requirements. Additional safety features provided that go above and beyond the radiation protection specified in RPP-13033 and the environmental emission limits generally are referred to as ALARA and are described in the next section.

The VTA system is the primary discharge pathway for gaseous effluents from the waste tank annuli. The potential for radioactive particulate in the exhaust air stream is mitigated by the HEPA filters. HEPA filter efficiency testing, housing and ductwork pressure testing, and welded ductwork are all features that ensure radiation confinement. The exhaust stack is monitored to detect any abnormal release of radiation. The confinement ventilation function of the VTA system prevents the uncontrolled release of radioactive contaminants through fugitive emission pathways.
3.5.2 As Low As Reasonably Achievable (ALARA) Standards

Specific radiation exposure levels are established, and system requirements designed to meet those exposure levels are established by safety analysis and environmental regulations. Additional requirements are imposed on the VTA system to ensure that worker exposure to radiation is kept ALARA. TFC-ESHQ-RP-RWP-C-03, ALARA Work Planning, establishes ALARA program details for maintenance work planning.

3.5.2.1 Radioactive Air Emissions

Requirement: Radioactive air emissions to the environment shall be kept ALARA.

Class: ENV

Basis: Protects facility workers and the environment from undue exposure to radiation. (RPP 13033, Section 7.4,”ALARA Policy and Programs and HNF-5183, Tank Farm Radiological Control Manual)

How Requirement is Met: This requirement is met through system design features that are in addition to required abatement controls and are described in the following sections:

- Section 3.4.1.3, Annulus Pressure Operating Specification Limit
- Section 3.4.2.1, Inlet HEPA Filters
- Section 3.4.2.7, Condensate Collection System Seal Pot

3.5.2.2 ALARACT 16.1

Requirement: System operation shall comply with the provisions of “ALARACT 16.1, Tank Farm ALARACT Demonstration For Work on Potentially Contaminated Ventilation System Components” in TFC-ESHQ-ENV-STD-06 Environmental Requirements Standard.

Class: ENV

Basis: The ALARACT demonstrations were agreed to among the Washington State Department of Health, DOE, and the Tank Farm Contractor to document environmental regulatory requirements for frequently performed work activities conducted by DOE contractors within the Tank Farm facility. The applicable sections of an ALARACT are the methods of radiological control, monitoring, and records/documentation that will be followed when conducting an activity. ALARACT 16.1 applies to work on potentially contaminated ventilation system components, including repair or replacement of ductwork, dampers, valves, recirculation fans, flexible boots, heaters, instrumentation, or other ventilation system components.
How the Requirement is Met: ALARACT 16.1 references other administrative documents to be complied with during the work planning process.

3.5.2.3 Access and Working Space

Requirement: Access and working space around the VTA system exhauster skid shall be in accordance with supplier recommendations.

Class: GEN

Basis: Quick and efficient performance of operation and maintenance activities within the radiation area around the exhaust train maintains exposure to personnel ALARA.

How Requirement is Met: The VTA system exhaust trains are located with adequate clearance on all sides to operate and maintain the equipment. The filter unit and fan are located to accommodate the equipment footprint, personnel egress, and required maintenance.

3.5.3 Nuclear Criticality Safety

No requirements for nuclear criticality safety are imposed on the VTA system. Under current operating conditions, a nuclear criticality accident is not credible in any of the DSTs at the Hanford Site. RPP-13033, Chapter 6.0, provides a summary of the criticality safety program and the technical basis for criticality safety at the tank farms.

3.5.4 Industrial Hazards

Requirement: Guards shall be installed on reciprocating; rotating, or moving parts that are exposed to contact by employees or that may otherwise create a hazard.

Class: GEN

Basis: The fans of the Ventilation Tank Primary system units have rotating parts that are exposed to contact by employees (TFC-ESHQ-S-STD-21, Machine Guarding).

How Requirement is Met: The fans are equipped with belt guards and shaft guards, which protect employees from the moving parts.

3.5.5 Operating Environment and Natural Phenomena

Requirement: The VTA system shall be designed to withstand the operating environment in which it is located. A summary of conditions for the AN Tank Farm site is presented in Table 5. This table summarizes the operating environment and natural phenomena conditions in the AN Tank Farm as described in RPP-13033, Chapter 1.

Class: GEN
Basis: The VTA system is located outside and above ground. It is expected to operate continuously under all environmental conditions.

How Requirement is Met: No document has been found that provides evidence that the VTA system was designed to withstand the stated environmental conditions. The VTA system has been operational for over 20 years. This fact suggests that the system is capable of withstanding the described environment. The operating environment and natural phenomena design requirements that apply to future modifications and construction designs are found in TFC-ENG-STD-02, *Environmental/Seasonal Requirements for TOC Systems, Structures and Components*; and TFC-ENG-STD-06, *Design Loads for Tank Farm Facilities*.

3.5.6 Human Interface Requirements

It is Tank Operations Contractor (TOC) policy to conduct human-machine interface activities in a way that ensures the health and safety of employees, subcontractors, and the public, and the protection of the environment (RPP-13033, Section 13.0, “Human Factors”). The process for the systematic evaluation of human factors for the TOC is described in TFC-PLN-09, Human Factors Program.

The TOC personnel assigned to tank farm facilities shall be qualified, competent, and adequately staffed to support safe and effective operations. Management and technical personnel meet the education and experience requirements of DOE O 5480.20A, “Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities”. The TOC “Procedures and Training” safety management programs ensures that procedures and training processes have been developed to enhance personnel safety performance, and that work is performed by trained employees operating in accordance with approved procedures. (RPP-13033, Section 17.4.5.3,”Procedures and Training.”)

3.5.7 Specific Commitments

3.5.7.1 ALARACT Demonstrations

The ALARACT demonstrations were agreed to among the Washington State Department of Health, DOE, and the Tank Farm Contractor to document environmental regulatory requirements for frequently performed work activities conducted by DOE contractors within the Tank Farm facility. See Section 3.5.2.2 for more details.

3.5.7.2 DST Leak Detection

The Washington State Department of Ecology’s *Administrative Order 98NW-009* (Ecology 1998b), the *Notice of Penalty Incurred 98NW-007* (Ecology 1998a), and two subsequent appeals (Pollution Control Hearings Board *Department of Energy et al. v Ecology 98-249* and *Department of Energy et al. v Ecology 98-250* [Ecology 1998c, 1998d]) concerned, among other things, the inadequacies of the leak-detection system in the tank farms. This

In accordance with this settlement, each DST on the Hanford Site will be equipped and operated with a complete continuous leak-detection system by December 31, 1999. [NOTE: This commitment has been incorporated into OSD-T-151-00031.] The leak-detection system on each DST may not be replaced by, but may be supplemented by, the operation of an annulus ventilation system CAM. See Section 3.4.1.2 for a description of how this requirement affects the VTA system.

Table 5. Summary of Environmental Conditions for the AN Tank Farm Site.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient air temperature</td>
<td>-33 °C to 46 °C (-27 °F to 115 °F) (extreme limits)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>0% to 100%</td>
</tr>
<tr>
<td>Rain</td>
<td>2.921 in. per month</td>
</tr>
<tr>
<td>Snow (The site is subject to blowing and drifting snow.)</td>
<td>10.2 in. max. in 24 hours 36 cm (14 in.) max. accumulation</td>
</tr>
<tr>
<td>Sleet/hail and glaze</td>
<td>Sleet and hail account for less than 1% of frozen precipitation. Maximum hailstone diameter is 1 cm (3/8 in.). Glaze occurs approximately 6 days a year.</td>
</tr>
<tr>
<td>Blowing dust</td>
<td>Visibility is restricted to 6 mi or less.</td>
</tr>
<tr>
<td>Solar radiation</td>
<td>838 Langley (from TEFC-ENG-STD-02)</td>
</tr>
<tr>
<td>Wind</td>
<td>129 km/h (80 mi/h) gusts</td>
</tr>
<tr>
<td>Latitude</td>
<td>46° 34’ N</td>
</tr>
<tr>
<td>Longitude</td>
<td>119° 36’ W</td>
</tr>
<tr>
<td>Altitude</td>
<td>733 ft</td>
</tr>
</tbody>
</table>

Note: Compiled from information in RPP-13033, Tank Farms Documented Safety Analysis, Chapter 1.0.

### 3.6 ENGINEERING DISCIPLINARY REQUIREMENTS

This section identifies design requirements that typically are related to particular disciplines of engineering.
3.6.1 Civil and Structural

**Requirement:** The VTA system and components shall be designed and constructed in accordance with the *Uniform Building Code* for both seismic and wind loads. Any major modifications to the existing system or new installations shall be designed in accordance with the latest adopted version of the governing building codes.

**Class:** GEN

**Basis:** The VTA system is located in an area that occasionally experiences seismic activity and strong winds. Design and construction of the system to the requirements provides assurance the system can perform its intended functions under the loads from natural forces. (ARH-CD-304)

**How Requirement is Met:** The system has survived sustained high winds and numerous seismic events of varying degrees. An analysis that documents whether the design is compliant is *Information not readily available*, but may be recreated as resources allow.

3.6.2 Mechanical and Materials

3.6.2.1 Exhaust Fans

**Requirement:** The exhaust fans shall provide continuous ventilation through the annulus space.

**Class:** GEN

**Basis:** An exhaust fan is required to provide the motive force for airflow through the annulus.

**How Requirement is Met:** Centrifugal fans are provided based on the following specifications:

- The VTA system A Train Fan is sized to provide a nominal air flow capacity of 2625 ft³/min with entrance air conditions of 120°F and 77 grains moisture per pound of dry air. The fan specification is for an operating point of 13.13 in. wg fan static pressure at standard conditions.

- The VTA system B Train Fan is sized to provide a nominal air flow capacity of 3500 ft³/min with entrance air conditions of 120°F and 77 grains moisture per pound of dry air. The fan specification is for an operating point of 13.13 in. wg fan static pressure at standard conditions.

The fans and specifications are identified in Vendor Information (VI) File 20589 (see Appendix E) and on Hanford Site Drawing H-2-71937, *HVAC Equipment Schedules, Details and General Notes*. The selection of the fans is based upon the specification available in the VI File 20589.
3.6.2.2 Heating Coil

See Section 3.4.2.3 for requirements regarding the exhaust heater.

3.6.2.3 Valves

**Requirement:** Valves/dampers shall be installed for isolation purposes and for flow and pressure control.

**Class:** GEN

**Basis:** VTA systems require valves/dampers to balance the airflows through the system and to isolate a part of the system when required for repairs and maintenance.

**How Requirement is Met:** A 12-in. manual-operated butterfly valves rated at 150 lbf/in$^2$ (gauge) is installed in the duct leading from the intake station to the underground duct supply to the annulus, and in the annulus exhaust duct from each tank. Valves are identified on Hanford Site Drawing H-2-71937 and in Vendor Information File 20618 (see Appendix E).

3.6.2.4 Demister

See Section 3.4.2.2 for requirements associated with the Demister.

3.6.2.5 HEPA Filters

See Section 3.4.2.4 for requirements associated with the HEPA Filters.

3.6.3 Chemical and Process

No unique chemical or process requirements are related to the VTA system.

3.6.4 Electrical

**Requirement:** Electrical power shall be supplied to the VTA system to meet the load requirements. The components of the VTA system that require 480 V, 3-phase electrical power are as follows:

- Fan AN241-VTA-EF-003; 10 hp motor (M-003)
- Fan AN241-VTA-EF-004; 15 hp motor (M-004)
- Heater AN241-VTA-HTR-001, 9 kW
- Heater AN241-VTA-HTR-004, 12 kW.

The components of the VTA system that require 120 V, single-phase electrical power are as follows:
Motor-operated dampers
Stack sampling and monitoring equipment
Environmental control devices (e.g., fans, heaters, lights, heat trace)
Heater controllers.

Class: GEN

Basis: This requirement is derived from the supporting function of electrical power to enable systems and components to meet functional requirements.

How Requirement is Met: Documentation specifying the electrical power loads, and subsequent selection justification and sizing of electrical power components is unavailable. The system meets the electrical power requirements specified above based on the successful passed operating history of the system. Power is provided by the EDS as identified on Figure 2.

3.6.5 Instrumentation and Control

Requirement: The VTA system A Train and B Train shall have a control system that maintains system airflow through the annuli of tanks in the AN Tank Farm.

Class: GEN

Basis: The annulus A Train system normally ventilates only the annuli of Tanks 241-AN-101, 241-AN-102, and 241-AN-103. The annulus B Train system normally ventilates only the annuli of Tanks 241-AN-104, 241-AN-105, 241-AN-106, and 241-AN-107.

How Requirement is Met: Pressure switches are located in each of the outlet ducts from 241-AN-101, 241-AN-102, and 241-AN-103. These switches sense pressure and signal damper M-701 to open if any one of the duct pressure readings reaches (-)3.7 in. w.g. or greater. The switches also signal damper M-701 to close if all of the duct pressure readings reach (-)4.0 in. w.g. or less. Pressure switches are located in each of the outlet ducts from Tanks 241-AN-104, 241-AN-105, 241-AN-106, and 241-AN-107. These switches sense pressure and signal damper M-801 to open if any one of the duct pressure readings reaches (-)3.7 in. w.g. or greater. The switches also signal damper M-801 to close if all of the duct pressure readings reach (-)4.0 in. w.g. or less.

Requirement: The VTA system A Train and B Train heating coils shall have a control system to maintain air-stream temperatures through the train above the dew point temperature of the gas.

Class: GEN

Basis: Moisture on HEPA filters can cause degradation of the filter medium, as well as premature failure. Maintaining air-stream temperature above dew-point limits the amount of condensation that can collect on the HEPA filters.
How Requirement is Met: Temperature controllers on both trains modulate heater output to maintain the differential temperature across the heater. Calculations demonstrating the required temperature differential to maintain the relative humidity are information not readily available, but may be recreated as resources allow.

3.6.6 Computer Hardware and Software

No computer hardware and software requirements relate to the controls of the VTA system.

3.6.7 Fire Protection

No fixed fire protection features are identified in the DSTs. The hazards in these tanks are such that no fire protection system exists that can reasonably be expected to mitigate the event once initiated. No fire protection requirements are related specifically to the DST VTA systems. Fire protection is supplied by the overall site fire-protection systems. These systems include tank farm fire detection systems, fire hydrants connected to potable and raw water, and portable fire extinguishers. See RPP 13033, Section 2.7.3, "Fire Protection Systems” for additional information.

3.7 TESTING AND MAINTENANCE REQUIREMENTS

3.7.1 Testability

HEPA filters require in-place leak testing which is described in Section 3.7.3.2. Exhaust stack flow rates are required to be periodically measured which is described in Section 3.7.3.3.

3.7.1.1 High-Efficiency Particulate Air Filter In-place Leak Test Ports


Class: ENV, OSD

Basis: HEPA filter test sections with aerosol injection and sampling ports, qualified in accordance with ASME AG-1, ASME N509, and ASME N510, ensure that aerosol mixing, flow characteristics, and sampling methods allow for accurate determination of installed HEPA filter leak tightness and efficiency. This also allows for HEPA filter in-place leak testing to be performed from outside the system using apparatus and devices, which are supplied as integral parts of the test sections. This requirement is derived from the requirement for HEPA filter in-place leak testing described in Section 3.4.3.1. (also see DOE Order 6430.1A, Section 1300-3.6)
How Requirement is Met: Both A and B exhaust trains and the air inlet stations have flow test ports or test sections before and after all HEPA filters that allow access into the air stream for filter testing. Hanford Site Drawing H-14-020201, Ventilation Tank Annulus System (VTA) O&M System P&ID, illustrates these test ports. The installed test apparatus may not comply with the specified ASME codes and standards because the system was installed before these standards existed. See Section 3.1.4 for details on code compliance.

3.7.1.2 Stack Flow-Rate Measurement Ports

Requirement: Test ports shall be located on the exhaust stack to allow insertion of test probes for flow-rate measurement.

Class: ENV

Basis: This requirement is derived from the stack flow rate measurement requirement (see Section 3.4.3.2. Also see DOE Order 6430.1A, Section 1300-3.6)

How Requirement is Met: Hanford Site Drawing H-14-020201 illustrates these ports. See also the test procedure data sheets in 3-VB-155AD for specific test ports used for stack flow rate measurement.

3.7.2 Technical Safety Requirement-Required Surveillances

The intent of this section is to identify surveillance requirements relating to safety SSCs as defined in HNF-SD-WM-TSR-006 and in accordance with DOE-STD-3024-2011. The VTA system is not a safety SSC and no LCOs are specified for the VTA system.

3.7.3 Non-Technical Safety Requirement Inspections and Testing

3.7.3.1 VTA System Operation Surveillance - Corrosion Mitigation Program,

VTA System Operation Surveillance for corrosion mitigation is described in section 3.4.1.1.

3.7.3.1.1 Ventilation Tank Annulus System Annual Evaluation

Requirement: Evaluations of the annulus tank ventilation system shall be performed every 365 days not to exceed 456 days.

Class: TSR

Basis: Ensures that annulus ventilation system flow rates remain adequate to prevent condensation on the tank walls over a long period (assuming that water ingress may occur), and to provide detection of water ingress. The 365-day frequency for the
evaluations is considered adequate based on engineering judgment that degradation of ventilation system performance will typically occur over a long time. (HNF-SD-WM- TSR-006)

**How Requirement is Met:** This annual evaluation has two objectives. The first objective is to update the calculated dew point temperature that would result from a postulated water pool on the annulus floor, as a function of waste temperature and estimated annulus ventilation flow rate, and to identify problematic tanks where the tank surface temperature in the upper region of the annulus is below the predicted dew point. The second objective is to obtain actual stack flow rates from which to verify the estimated annulus flow rate for each DST, and to compare actual annulus inlet and outlet measured dew point temperatures for evidence of water intrusion.

### 3.7.3.2 HEPA Filter In-Place Leak Testing

**Requirement:** All HEPA filters shall be aerosol tested upon installation, after each filter change, if the system has been off for over 60 days, and at least annually. The penetration shall be within the operating specification limit of \( \leq 0.05\% \) by a DOE-approved challenge aerosol.

**Class:** ENV

**Basis:** The HEPA filters function as abatement technology for effluent releases. The in-place leak test ensures that the HEPA filters are capable of limiting radioactive releases to the environment by verifying that the nominal particulate removal efficiency is \( >99.95\% \) for polydisperse particles as small as 0.3 \( \mu \)m. (RPP-11413, Section 5.5, "HEPA Filter In-Place Leak Test Requirements” and RPP16922, Section 2.3.4.3, "In-Place Challenge Test”.)

**Class:** OSD

**Basis:** Maintaining the specified efficiency enables the ventilation system to meet federal, state, and DOE regulatory requirements for releases. See ENV basis above. (OSD-T-151-00007, RPP-11413, and RPP-11866, Technical Basis for the Operating Specifications for Miscellaneous Facilities)

**How Requirement is Met:** The filters are entered in the Preventive Maintenance/Surveillance (PM/S) system with recall frequencies for in-place leak testing to meet the stated requirement. The concentration of challenge aerosol that is injected upstream of the filter is compared to the measured concentration downstream of the filter to determine the penetration of aerosol particles. Verification of the HEPA filter performance criteria is conducted using maintenance procedure 3-VBP-156, *HEPA Filter In-Place Leak Test (Aerosol Test)*, in conjunction with location-specific datasheets. The test is designed to be in accordance with the guidance in ANSI/ASME N510 and Energy Research and Development Administration (ERDA) document ERDA 76-21. The system may not meet the test qualification requirements of ASME N509 and ASME
N510, but the test meets the intent of ASME N510 to the maximum extent practical. The test demonstrates filter particulate removal efficiency to be >99.95% for polydisperse particles as small as 0.3 \( \mu \)m at the design airflow rate.

### 3.7.3.3 Stack Flow Rate Measurement

**Requirement:** The stack volumetric flow rate shall be measured at least annually using methods specified in Reference Method 2 of 40 CFR 60, “Standards of Performance for New Stationary Sources,” Appendix A.

**Class:** ENV

**Basis:** In combination with emissions measurement data, stack volumetric flow-rate measurements provide a measurement of gross radioactive emissions. Stack flow and sampling data, including flow-rate calculations, are required by WAC 246-247-080. (RPP-16922, Section 2.3.3, “Stack Air Flow,” AOP, and WAC 246-247-080)

**How Requirement is Met:** Stack flow measurements are performed using procedure 3-VBP-155, *Air Flow Test for Tank Farm Stacks and Ducts*, in conjunction with location specific data sheets.

### 3.7.4 Maintenance

#### 3.7.4.1 Exhaust HEPA Filter Differential Pressure Gauges Calibration

**Requirement:** The dP gauges for the exhaust HEPA filters shall be calibrated at least annually.

**Class:** ENV

**Basis:** Ensures accurate dP monitoring for an indication of filter loading and trending of changing conditions. (RPP-16922, Section 2.3.3, “Stack Air Flow,”)

**How Requirement is Met:** The exhaust HEPA filter dP gauges are calibrated at least every 330 days in accordance with 6-PCD-511, *Dwyer Magnahelic Differential Pressure Series 2000 and Capsuhelic Differential Pressure Series 4000.*

#### 3.7.4.2 Emission Measurement System Flow-Rate Adjustments and Calibration

**Requirement:** Tank farm emissions units with a Potential To Emit (PTE) <=5 mrem/year are required to have CAM systems and must be maintained, calibrated, and field checked in accordance with ANSI N13.1-1999.

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Class: ENV

Basis: Achieves optimum sampling conditions for the measurement of radioactive emissions. Equipment calibration records are required by WAC 246-247-080 RPP-16922, Section 2.3.2, “CAM System”, and Hanford AOP.

How Requirement is Met: Daily inspections of the record sampler are performed with the procedure TF-OPS-005, Daily CAM and Record Sampler Inspections. Instructions for calibration of the CAM and record sampler vacuum gauges and flow switches and the functional testing of the rotameter, totalizer, and timer are contained in 6-FCD-077, Stack Sampling, Monitoring and Annulus CAM Enclosure Systems.

3.7.4.3 Reliability-Centered Maintenance Requirements

RPP-14698, Reliability Centered Maintenance Double Shell Tanks Annulus Ventilation Systems, identifies specific and detailed maintenance requirements for all components in the VTA system based on a reliability-centered maintenance analysis.

3.8 OTHER REQUIREMENTS

3.8.1 Security and Special Nuclear Material Protection

No special nuclear material is located in or associated with the VTA system. The VTA system has no security features.

3.8.2 Special Installation Requirements

No special installation requirements are related to the VTA system. The VTA system was installed in accordance with standard construction practices.

3.8.3 Reliability, Availability, and Preferred Failure Modes

No specific requirements for availability, and preferred failure modes are documented for the AN Tank Farm VTA system. See Section section 4.1.4 for a description of reliability features.

3.8.4 Quality Assurance

This SDD does not detail the quality assurance requirements enforced during past ventilation projects, but modifications, additions, and operations of the existing VTA systems fall under the current quality assurance program, TFC-PLN-02, Quality Assurance Program Description. A
graded approach is used to determine the level of quality control placed on changes and additions to the VTA system.

3.8.5 Miscellaneous Requirements

No miscellaneous requirements are related to the VTA system.
4.0 SYSTEM DESCRIPTION

4.1 CONFIGURATION

This section describes the overall system and components. The VTA system is divided into the subsystems and major components listed below. The system diagram is shown in Figure 1 in Section 2.3.

The AN Tank Farm VTA system consists of the following subsystems:

- Annulus inlet station subsystem
- Tank exhaust ductwork and header subsystem
- Exhaust train subsystem
- Exhaust stack sampling subsystem
- Condensate collection subsystem.

Major components of the above subsystems are as follows:

- Isolation valves
- Prefilters
- HEPA filters
- Demister
- Heating coils
- Exhaust fan assemblies
- Stack and process monitoring instrumentation
- Heater controllers and interlocks.

4.1.1 Description of System, Subsystems, and Major Components

4.1.1.1 Annulus Inlet Station/Tank Exhaust Ductwork and Header

Each DST located in the AN Tank Farm is equipped with an annulus inlet station. Negative pressure created by the VTA system exhaust fan pulls outside air into the DST annulus through the inlet station. The inlet control stations consist of a prefilter, a HEPA filter, and an isolation valve. The inlet stations are connected to the tank risers by below-grade ductwork. The underground duct splits into eight air-delivery ducts that terminate in an air-distribution chamber (under the center of the primary tank) in the insulating concrete pad. When the air reaches the distribution chamber, it flows into slots cut in the insulating concrete pad to the annulus. Air is drawn out of the annulus through four 8-in. risers located 90 degrees apart. These four ducts merge into one 12-in. header. The header passes through a ventilation pit before reaching the exhaust train equipment pad. At the ventilation pit, connections are provided on the header for a sample probe for the CAM, a pressure gauge, a pressure switch, and a test port. A balancing valve also is located in the pit.
4.1.1.2 Annulus Exhaust Trains

The AN Tank Farm VTA system has two exhaust units, the A Train and the B Train. The A Train unit normally ventilates the annuli of Tanks 241-AN-101, 241-AN-102, and 241-AN-103. The B Train unit normally ventilates only the annuli of Tanks 241-AN-104, 241-AN-105, 241-AN-106, and 241-AN-107. Airflow through the annulus of each tank is 800 ft³/min. Each exhaust train consists of a demister, heating coil, two banks of HEPA filters in series, and an exhaust fan.

The demisters are located upstream of the heating coil in each of the VTA system exhaust trains. The demisters are the wire mesh type that removes liquid particles from the gas stream by impingement on the surface of the pad material. The pad size is 18 in. by 36 in. by 4 in. thick. The density of the pad is 9 lb/ft³. The demister removal efficiency is greater than 99% for clean liquids of 10 μm and larger droplet size.

Heating coils are located upstream of the HEPA filters in each of the exhaust trains. The heating coils maintain the air-stream temperature through the exhaust train above the dew-point temperature of the gas. The heating coil for the A Train exhaust unit is rated at 9 kW, 460 V, 3-phase, 60 Hz. The heating coil for the B Train exhaust unit is rated at 12 kW, 460 V, 3-phase, 60 Hz.

Downstream of the heating coil are two banks of HEPA filters in series. The HEPA filters provide primary control of radiation-particle emission to the outside air. Each bank is two filters wide and two filters high for a total of four filters. Each individual HEPA filter is rated to remove particles as small as 0.3 μm with a rated efficiency of no less than 99.97%. The filters used in the AN Tank Farm VTA systems have face dimensions of 24 in. x 24 in., and are 11.5 in. in depth. The individual filters are rated for maximum clean pressure drop of 1.0 in. w.g. at 1000 ft³/min and a maximum pressure drop of 10 in. w.g. at 1000 ft³/min.

To ensure proper operability, the filters are in-place leak tested on an annual basis. Between the banks of HEPA filters is a test port that is used to detect downstream penetration of the first filter, and a port used to inject aerosol for challenging the second filter.

The allowable leakage for the in-place leak test is different than that of a new filter. A new filter is rated at 99.97% efficiency, which is based on a penetration test performed at the factory. In the field, a leak test is performed that determines whether there is leakage around or through the filter. The acceptance criterion used for the in-place leak testing is 99.95% efficiency and is based on criteria from ASME AG-1.

Downstream of the HEPA filters is the exhaust fan. The A Train fan has a capacity of 2625 ft³/min at 13.13 in. w.g. The B Train fan has a capacity of 3500 ft³/min at 13.13 in. w.g. The configuration is arranged so that the fans are not interchangeable with the exhaust trains. Each fan is unique to its own particular exhaust train. The discharge of each fan connects to the stack. An isolation damper is located after the fan and before the connection at the stack. The damper closes when the fan is shut down to prevent backflow from the operating fan.
4.1.1.3 Exhaust Stack

The air exits the VTA system through a stack. The stack contains a flow-measuring device, a record sampler, a CAM, and flow measurement test ports.

4.1.1.4 Condensate Collection System

Condensate and moisture removed from the air passing through the VTA system is routed to seal pots by a network of 1-in., 1.5-in., and 3-in. drain lines.

Each demister has a 3-in. drain line. The heater plenum and the HEPA filter housing have 1-in. drain lines. These drain lines route the water collected to seal pot AN241-VTA-SP-102. The seal pot has a 1.5-in. line that connects to a drain line that returns the moisture to Tank 241-AN-101.

4.1.2 Boundaries and Interfaces

4.1.2.1 WSTA System and Primary Tank Leak-Detection Continuous Air Monitor

The VTA system interfaces with risers located in each of the DSTs in the AN Tank Farm. Air is supplied to the tanks via the inlet control stations through inlet risers, and exits the tank by outlet risers. The connection occurs at different configurations for each tank. The riser numbers are as shown on Figure 2. The WSTA system divides the VTA system into an inlet portion and an outlet portion, although the annulus air space is shared between the two systems. The tank risers for the inlet and outlet ductwork are the boundaries.

The CAM system (primary tank leak detection) samples the exhaust air from the tank annuli for radioactivity, to monitor for leakage from the primary tank confinement boundary. The point where the sample line connects to the sample probe in the ventilation duct is the boundary between the CAM system and the VTA system.

4.1.2.2 Electrical Distribution System

Electrical power to the ventilation system is supplied by the AN Tank Farm EDS. Various AN Tank Farm EDS panels and circuits are used to supply the power required by the ventilation system. The electrical connections and interfaces are outlined in Figure 2. The boundary is at the power terminals for the heaters and fan motors. The boundary is at the load side of the breaker for the valve motors. Instrumentation and monitoring systems are considered part of the VTA system, and their boundaries with the EDS are at the load side of their breakers.

4.1.2.3 Waste Transfer System

Moisture removed from the air by the demisters is collected in seal pot AN241-VTA-SP-102. The boundary for the VTA system is defined as the interface of the seal pots with the line to Tank 241-AN-101.
4.1.2.4 Raw Water System

Each demister has a hose connection for raw water. Raw water is supplied to the demisters by the AN Tank Farm auxiliary raw water system. Raw water is used to flush the demister, reducing solids buildup. The boundary for the VTA system is defined as the hose connections for each demister.

4.1.2.5 Ventilation Tank Primary System

The condensate drain lines from upstream and downstream of the heaters in the ventilation tank primary exhausters drain to the VTA system seal pot, AN241-VTA-SP-102. The boundary between the ventilation tank primary system and the VTA system is the point where the drain lines enter the seal pot.

4.1.3 Physical Location and Layout

The U.S. Department of Energy Hanford Site is located northwest of Richland, Washington. The DSTs are located on the Hanford Site in areas identified as the 200 East and the 200 West Areas. The AN Tank Farm is located in the 200 East Area. See Figure 3 for the tank farm layout. See Figure 4 for the VTA system location.

4.1.4 Principles of Operation

Each DST located in the AN Tank Farm is equipped with an annulus inlet station. Negative pressure created by the VTA system exhaust fan pulls outside air into the DST annulus through the inlet station. Airflow through the annulus of each tank is 800 ft$^3$/min. The AN Tank Farm VTA system has two exhaust units, identified as the A Train and B Train. The A Train unit normally ventilates the annuli of Tanks 241-AN-101, 241-AN-102, and 241-AN-103. The capacity of the A Train unit is 2625 ft$^3$/min at 120 °F. The B Train unit normally ventilates only the annuli of Tanks 241-AN-104, 241-AN-105, 241-AN-106, and 241-AN-107. The capacity of the B Train unit is 3500 ft$^3$/min at 120 °F. Both fans are normally operated continuously.

To control pressure in the annulus, pressure switches are located in each of the outlet ducts from Tanks 241-AN-101, 241-AN-102, and 241-AN-103. These switches sense pressure and signal damper M-701, which is located upstream of the exhaust fan for the A Train, to open if any one of the duct pressure readings reaches (-)3.7 in. w.g. or greater. The switches also signal damper M-701 to close if all of the duct pressure readings reach (-)4.0 in. w.g. or less. Pressure switches also are located in each of the outlet ducts from Tanks 241-AN-104, 241-AN-105, 241-AN-106, and 241-AN-107. These switches sense pressure and signal damper M-801, which is located upstream of the exhaust fan for the B Train, to open if any one of the duct pressure readings reaches (-)3.7 in. w.g. or greater. The switches also signal damper M-801 to close if all of the duct pressure readings reach (-)4.0 in. w.g. or less.

Dampers M-701 and M-801 will fail in the position they are in upon loss of power or shutdown of the exhaust fans. Outlet dampers M-702 and M-802 on the downstream side of exhaust fans
for the A and B Trains are drive open and spring shut. The dampers will fail close on loss of power or shutdown of the exhaust fans. Exhaust fans for the A and B Trains will shut down upon high-radiation signal from the annulus exhaust stack CAM.

If necessary, a single exhaust unit can ventilate the annulus of all seven DSTs. The valve in the crossover duct is opened, and an isolation valve at the inlet of either the A Train or B Train is closed. Adjustments are then made to provide reduced airflow through the annulus of each of the DSTs. This is not the preferred operating mode because it is has not been determined if one exhaust train can ventilate the entire tank farm and still maintain adequate flow to ensure operability of the CAM leak detectors and to remove moisture to prevent corrosion. Further evaluation is needed to support continuous operation with only one exhaust train operating.

4.1.5 System Reliability Features

As described in previous sections, the A Train unit normally ventilates the annuli of Tanks 241-AN-101, 241-AN-102, and 241-AN-103, and the B Train unit normally ventilates only the annuli of Tanks 241-AN-104, 241-AN-105, 241-AN-106, and 241-AN-107. The design of the system does not enhance the reliability of the system via redundancy.

4.1.6 System Control Features

The VTA system is manually controlled except for the automatic pressure control, as described in Section 4.1.4. Interlocks and alarm features of the system components are shown on Hanford Site Drawing H-14-020201 and described in Section 4.1.4.
4.1.6.1 System Monitoring

The VTA system alarms are identified in Table 6. See H-14-020201 for specific instrumentation types and location.

Table 6. AN Tank Farm Ventilation Tank Annulus System Alarms.

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Source Instrument</th>
<th>Set point</th>
<th>Alarm Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>High annulus exhaust stack CAM radiation alarm</td>
<td>AN296-VTA-CAM-910</td>
<td>3000 counts/min</td>
<td>241-AN-271, ANN-102</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>242-A Evaporator</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TMACS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Local alarm box</td>
</tr>
<tr>
<td>Annulus exhaust stack CAM failure alarm</td>
<td>AN296-VTA-CAM-910</td>
<td>N/A</td>
<td>241-AN-271, ANN-103</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>242-A Evaporator</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TMACS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Local alarm box</td>
</tr>
<tr>
<td>Record sampler pump low-flow alarm</td>
<td>AN296-VTA-FSL-922</td>
<td>1.5 ft³/min</td>
<td>242-A Evaporator</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Local alarm box</td>
</tr>
<tr>
<td>CAM sample pump low-flow alarm</td>
<td>AN296-VTA-FSL-912</td>
<td>1.5 ft³/min</td>
<td>242-A Evaporator</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Local alarm box</td>
</tr>
<tr>
<td>High/low CAM enclosure temperature</td>
<td>AN296-VTA-TSH-901</td>
<td>*</td>
<td>Local alarm box</td>
</tr>
<tr>
<td></td>
<td>AN296-VTA-TSL-901</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low air flow, A Train annulus exhaust</td>
<td>AN241-VTA-PDS-710</td>
<td>*</td>
<td>241-AN-271, ANN-106</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TMACS</td>
</tr>
<tr>
<td>Low air flow, B Train annulus exhaust</td>
<td>AN241-VTA-PDS-810</td>
<td>*</td>
<td>241-AN-271, ANN-106</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TMACS</td>
</tr>
<tr>
<td>Heater failure, A Train annulus exhaust</td>
<td>Control Panel, AN241-VTA-CP-709</td>
<td>N/A</td>
<td>241-AN-271, ANN-105</td>
</tr>
<tr>
<td>Heater failure, B Train annulus exhaust</td>
<td>Control Panel, AN241-VTA-CP-809</td>
<td>N/A</td>
<td>241-AN-271, ANN-105</td>
</tr>
</tbody>
</table>

Notes:

* Information not readily available

CAM = Continuous air monitor.
TMACS = Tank Monitor and Control System.

4.2 OPERATIONS

This section summarizes the operating procedure for the VTA system. The complete operating procedure, TO-060-103, Operate AN-241 Annulus Ventilation Systems (VTA), can be viewed with this link to the CHG Procedures web site (see Tank Farm Operating Procedures under
Technical Procedures). Response procedures for alarms, abnormal operating conditions, and emergencies also are identified in this section.

4.2.1 Initial Configuration (Pre-startup)

Pre-startup verifications ensure that the following requirements are met. For further details, see the VTA system operating procedure, TO-060-103.

- Verify that the HEPA filter banks have not been offline for more than 60 days. If they have been offline for more than 60 days, perform an aerosol test immediately after startup.
- Ensure that all alarms are clear.
- Check that the positions of dampers and openings are secured.

4.2.2 System Startup

This section describes the startup procedure for either of the exhaust trains. For further details, see the VTA system operating procedure, TO-060-103.

The VTA system A Train unit and B Train unit are essentially identical. It is intended that both units be operated at all times. However, one annulus exhaust unit can be operated at a time to ventilate all seven annuli. Throughout the startup procedure, the Shift Manager is to be notified upon completion of major steps or for unexpected occurrences.

Take the following steps to start both annulus ventilation fans.

- Ensure that the crossover valve is closed.
- Open the inlet valves.
- Start the exhaust fan by positioning the electrical breaker to ON, press start button until run lamp illuminates, check outlet damper position, check the fan for excessive vibration or noise, check for alarms, check that the record sampler vacuum pump is operating, and inspect the record sampler.
- Start the second exhaust fan by positioning the electrical breaker to ON, press the start button until the run lamp illuminates, check the outlet damper position, check the fan for excessive vibration or noise, check for alarms, check that the record sampler vacuum pump is operating, inspect the record sampler, record the operating data, and trim the annulus flows by damper adjustments.

Take the following steps to start one annulus fan.
• Open the crossover valve.
• Close the inlet valve for the system that will be off.
• Position the inlet valve for the system that will be started.
• Start the exhaust fan by positioning the electrical breaker to ON, press the start button until the run lamp illuminates, check the outlet damper position, check the fan for excessive vibration or noise, check for alarms, check that the record sampler vacuum pump is operating, inspect the record sampler, record the operating data, and trim the annulus flows by damper adjustments.
Figure 2. System Boundaries for the AN Tank Farm Ventilation Tank Annulus System.
Figure 3. AN Tank Farm Layout.
Figure 4. Location of the AN Tank Farm Ventilation Tank Annulus System.
4.2.3 Normal Operations

The VTA system A Train unit and B Train unit are essentially identical. Normal operating mode has both units operating. However, one annulus exhaust unit can be operated at a time to ventilate all seven annuli. Startup of the exhaust trains in either mode is described in Section 4.2.2.

Daily operations consist primarily of performance of surveillance activities per TF-OR-DR-AN, AN Daily Rounds. In addition to operator rounds, procedure TO-060-103 contains instructions for other data collection. Occasionally, adding water to the seal pot is required.

4.2.4 Off-Normal Operations

The emergency and abnormal operating procedures identified in Appendix C, Table C-3, may contain actions involving the AN Tank Farm VTA system. The alarm response procedures identified in Appendix C, Table C-1, specify automatic actions in the event of an alarm and operator actions necessary to restore normal system operation. See the specific procedures for details.

4.2.5 System Shutdown

This section contains procedure summaries for exhaust train shut-down for maintenance. For further details, see the VTA system operating procedure, TO-060-103.

4.2.5.1 Shut Down Annulus System

The VTA system A Train unit and B Train unit are essentially identical. Throughout the startup procedure, the Shift Manager is to be notified upon completion of major steps or for unexpected occurrences.

Take the following steps to shut down A Train and B Train exhaust fans.

- Ensure that the annulus leak-detection conductivity probes for Tanks 241-AN-101 through 241-AN-107 are set at the proper height and are not in alarm.
- Verify that the annulus conductivity probe functional checks are current.
- Shut down the fan.
- Check the outlet damper positions.
- Shut down the CAM and record sampler.
4.2.6 Safety Management Programs and Administrative Controls

The following Safety Management Programs and ACs specified in HNF-SD-WM-TSR-006 may apply to the equipment described in this SDD:

- AC 5.6, “Safety Management Programs”

4.3 TESTING AND MAINTENANCE

4.3.1 Temporary Configurations

The only temporary configuration that would be used for the VTA system is a location for a portable exhauster to be installed. A flange connection is located upstream of the exhaust trains that is specifically identified as a location for the installation of a portable exhauster. Although it has not been used yet, it would allow for ease of connection and would allow for versatility and flexibility in the event of overall system failure.

4.3.2 Technical Safety Requirement-Required Surveillances

No surveillance requirements as defined in HNF-SD-WM-TSR-006 apply to the VTA system.

4.3.3 Non-Technical Safety Requirement Inspections and Testing

4.3.3.1 HEPA Filter In-Place Leak Test (Aerosol Test)

The in-place leak test is an environmental requirement and an OSD requirement as described in Section 3.7.3.2.

4.3.3.2 Stack Flow-Rate Measurement

The annual stack flow rate measurement is an environmental requirement as described in Section 3.7.3.3.

Stack velocity and volumetric flow-rate measurements are performed at least annually in accordance with 3-VBP-155. A pretest leak test is performed on the measurement equipment. The relative humidity and static pressure of the air stream are measured, and then the temperature and velocity pressure at each point on a pitot tube traverse are measured. The velocity and volumetric flow rate is calculated from these data. The pitot tube performance is verified by demonstrating repeatability of the measurements. A posttest leak test is performed on the measurement equipment.
4.3.3.3 Fan-Vibration Monitoring

Fan vibration data are taken in accordance with 5-VT-237, Supply and Exhaust Fan Inspection and Vibration Monitoring. A shock-pulse monitor is used to gather the data and then upload the data to a computer for review. The fans are inspected for proper operation, unusual noise, and excessive vibration. The ducting and supports are inspected for loose fasteners, poor integrity, and excessive vibration. The drive belt is checked for proper tension, belt slap, slippage, or squealing. The bearings are lubricated.

As required, additional fan vibration testing can be performed in accordance with 4-VT-562, DST Exhaust Fan Full Spectrum Vibration Analysis. This activity is not routinely performed.

4.3.3.4 Fan Motor Inspection

Routine fan motor inspections and vibration analyses are performed at least every 365 days in accordance with 4-EDS-471, DST Fan Motor Predictive Maintenance.

4.3.3.5 Damper Motor Testing

Motor current and timing trending, movement and operability tests, and inspections of the damper motors are performed at least every 365 days in accordance with 4-VT-118, Damper Motor Current and Timing Trending.

4.3.3.6 Continuous Air Monitor and Record Sampler Inspections

CAM and record sampler inspections are performed daily in accordance with TF-OPS-005 and monthly in accordance with TF-OPS-021, Inspections and Source Checks of Primary Tank Exhauster, Annulus Exhauster AMS-4 CAMs and Effluent Record Samplers. The inspection includes checks of set-points and sampler flow rates.

4.3.4 Maintenance

Periodic preventive maintenance specified in the preventive maintenance/surveillance system for the VTA system is summarized in this section. See RPP-14698 for additional information on maintenance activities and procedures.

4.3.4.1 Continuous Air Monitor and Record Sampler Instrument Calibration

Calibration of vacuum gauges and flow switches and functional testing of the flow totalizer is performed at least every 330 days in accordance with 6-FCD-077. In addition to calibration, the flow switches and rotameter are inspected for mechanical integrity.
The record sampler system flow adjustments are an environmental requirement as described in Section 3.7.4.2.

4.3.4.2 Continuous Air Monitor Calibration

The CAM is calibrated at least every 330 days in accordance with 6-RM-168, *Eberline AMS-4 Continuous Air Monitor Calibration.* The installed CAM is replaced with a CAM that was calibrated in the shop, thus minimizing system downtime. The removed CAM then can be calibrated for future installation.

4.3.4.3 Heater-Outlet Temperature-Switch Calibration

The heater-outlet temperature switches are calibrated at least every 182 days in accordance with 6-TCD-181, *Calibrate Temperature Switch.* If the switch configuration does not allow test inputs to be applied with the switch installed, the switch may be removed and calibrated by insertion into a heating oven.

4.3.4.4 Differential-Pressure Instrument Calibration

Fan differential-pressure switches are calibrated at least every 730 days in accordance with 6-PCD-508, *Calibrate Pressure Switches.*

Inlet air control station differential-pressure indicators are calibrated at least every 182 days, exhaust HEPA filter dP gauges are calibrated at least every 330 days, and the demisters and the exhaust stack outlet differential-pressure gauges are calibrated at least every 730 days, in accordance with 6-PCD-511.

The exhaust HEPA filter dP gauge calibration is an environmental requirement as described in Section 3.7.4.1.

4.3.4.5 Filter Replacement

Prefilters and HEPA filters are replaced using preventive maintenance/surveillance datasheets when the dP across the filter exceeds the pre-established recall limit, if a HEPA filter fails the in-place leak test, or if the radioactive material loading on the filter exceeds limits.

4.3.4.6 Post-Maintenance Testing

The post maintenance testing program for tank farms is implemented in TFC-ENG-STD-08, *Post-Maintenance Testing,* and applies to corrective and preventive maintenance and modification work. A graded approach is used to determine the rigor of post-maintenance testing so that the testing is consistent with the equipment’s safety categorization. Post-maintenance testing provides re-verification of a component’s functional capability, verification

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2 *Eberline AMS-4 is a trademark of ThermoEberline, Santa Fe, New Mexico.*
that corrective maintenance has satisfactorily corrected the deficiency, and verification that no new deficiencies or abnormal conditions have been created by the maintenance or testing activities.

Specific post-maintenance testing called out on the preventive maintenance/surveillance datasheets for periodic preventive maintenance on the VTA system requires HEPA filters to undergo aerosol in-place leak testing after filter replacement to verify installed penetration efficiency.

4.3.4.7 Post-Modification Testing

General requirements for testing activities are identified in TFC-ENG-DESIGN-C-18, “Testing Practices,” including development testing, acceptance testing, qualification testing, preoperational testing, and operational testing. The extent and rigor of the test program is based on a graded approach as appropriate to the size, complexity, and risks associated with the project or SSCs involved. ANSI/ASME N510 includes specific testing requirements for newly installed ventilation systems such as duct and housing leak testing and HEPA filter-penetration efficiency testing requirements.

4.4 SUPPLEMENTAL INFORMATION

Waste Feed Delivery Mission includes requirements for waste feed delivery that may or may not be currently met by the AN Annulus ventilation Systems. One such requirement is delineated below.

Life of DST System;

Requirement: The DST system shall be capable of accepting and storing waste until all DSTs are closed in 2052.

Basis: ORP-11242
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5.0 REFERENCES


Hanford Site Drawings

- H-2-71937, HVAC Equipment Schedules, Details and General Notes.
- H-14-020201, Ventilation Tank Annulus System (VTA) O&M System P&ID.


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APPENDIX A

SOURCE DOCUMENTS
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APPENDIX ASOURCE DOCUMENTS

See section 5.0, “References” for the source documents related to this report.
APPENDIX B

SYSTEM DRAWINGS AND LISTS

DRAWINGS AND DOCUMENTS MAY BE ACCESSED VIA THE HANFORD SITE DOCUMENT MANAGEMENT CONTROL SYSTEM (DMCS).
APPENDIX B  SYSTEM DRAWINGS AND LISTS

Table B-1 contains the drawings and documents that comprise the design basis portion of the design baseline (as defined in TFC-PLN-03) for the AN Tank Farm Ventilation Tank Annulus (VTA) system. It includes essential drawings identified in HNF-SD-WM-PC-002. These drawings and documents shall be maintained under configuration control. The Design Authority responsible for the system shall approve any changes to these drawings and documents.

Table B-1. AN Tank Farm Essential Drawings.

<table>
<thead>
<tr>
<th>Drawing Number</th>
<th>Sheet Number</th>
<th>Title</th>
<th>Notes</th>
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<tbody>
<tr>
<td>H-14-020101</td>
<td>1</td>
<td>Ventilation Tank Annulus System (VTA) O&amp;M System P&amp;ID</td>
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<td>H-14-020101</td>
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<td>Ventilation Tank Annulus System (VTA) O&amp;M System P&amp;ID</td>
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<tr>
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<td>Ventilation Tank Annulus System (VTA) Stack Monitor P&amp;ID</td>
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</tr>
<tr>
<td>H-2-71937</td>
<td>1</td>
<td>HVAC Equipment Schedules Details &amp; General Notes</td>
<td></td>
</tr>
</tbody>
</table>
Table B-2 contains drawings that support the design basis portion of the design baseline (as defined in TFC-PLN-03) for the AN Tank Farm VTA system and that are shared with other systems. It includes essential drawings identified in HNF-SD-WM-PC-002. These drawings and documents shall be maintained under configuration control. The Design Authority with primary responsibility for the shared system shall approve any changes to these drawings and documents.

Table B-2. AN Tank Farm Support Drawings.

<table>
<thead>
<tr>
<th>Drawing Number</th>
<th>Sheet Number</th>
<th>Title</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-14-010501</td>
<td>1 thru 7</td>
<td>Dome Penetration Schedules (WST/WSTA) Tank 241-AN-101 thru Tank 241-AN-107</td>
<td></td>
</tr>
<tr>
<td>H-14-020000</td>
<td>1,2</td>
<td>Tank Farm System P&amp;ID Structure Legend</td>
<td></td>
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<tr>
<td>H-14-020000</td>
<td>3</td>
<td>Tank Farm System P&amp;ID Equipment Legend</td>
<td></td>
</tr>
<tr>
<td>H-14-020000</td>
<td>4</td>
<td>Tank Farm System P&amp;ID Symbol Legend</td>
<td></td>
</tr>
<tr>
<td>H-14-030001</td>
<td>3</td>
<td>Electrical (EDS) One Line Diagram</td>
<td></td>
</tr>
<tr>
<td>H-2-71906</td>
<td>1</td>
<td>Structural Insulating Concrete Plan &amp; Details</td>
<td></td>
</tr>
<tr>
<td>H-2-71936</td>
<td>1</td>
<td>HVAC Equipment Plan Elevations &amp; Details</td>
<td></td>
</tr>
<tr>
<td>H-2-71936</td>
<td>2</td>
<td>HVAC Equipment Plan Elevations &amp; Details</td>
<td></td>
</tr>
<tr>
<td>H-2-71936</td>
<td>3</td>
<td>HVAC Equipment Plan Elevations &amp; Details</td>
<td></td>
</tr>
<tr>
<td>H-2-71936</td>
<td>4</td>
<td>HVAC Equipment Plan Elevations &amp; Details</td>
<td></td>
</tr>
<tr>
<td>H-2-71991</td>
<td>1</td>
<td>Piping Plan Tank 101</td>
<td></td>
</tr>
<tr>
<td>H-2-71992</td>
<td>1</td>
<td>Piping Plan Tank 102</td>
<td></td>
</tr>
<tr>
<td>H-2-71993</td>
<td>1</td>
<td>Piping Plan Tank 103</td>
<td></td>
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<tr>
<td>H-2-71994</td>
<td>1</td>
<td>Piping Plan Tank 104</td>
<td></td>
</tr>
<tr>
<td>H-2-71995</td>
<td>1</td>
<td>Piping Plan Tank 105</td>
<td></td>
</tr>
<tr>
<td>H-2-71996</td>
<td>1</td>
<td>Piping Plan Tank 106</td>
<td></td>
</tr>
<tr>
<td>H-2-71997</td>
<td>1</td>
<td>Piping Plan Tank 107</td>
<td></td>
</tr>
</tbody>
</table>
Table B-3 lists documents that are related to the VTA system but that is not active, nor are they maintained under configuration control. These documents are for information only and should be used with caution, as they may not reflect current field configuration.

Table B-3. AN Tank Farm Historical Documents

<table>
<thead>
<tr>
<th>Drawing Number</th>
<th>Sheet Number</th>
<th>Title</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td></td>
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</tr>
<tr>
<td>B-130-C7</td>
<td>-</td>
<td><em>Construction Specification for the 241-AN Tank Farm Completion Project B-130</em>, Vitro Engineering Corporation, Richland, Washington</td>
<td></td>
</tr>
<tr>
<td>1978</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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APPENDIX C

SYSTEM PROCEDURES
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APPENDIX C

SYSTEM PROCEDURES

This appendix contains a list of applicable operating procedures that may provide the reader with technical information regarding the AN Tank Farm Ventilation Tank Annulus System. Operating procedures are available via the RPP Policies and Procedures web site.

<table>
<thead>
<tr>
<th>Procedure Number</th>
<th>Title</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARP-T-221</td>
<td>AN Farm Alarm Response</td>
<td></td>
</tr>
<tr>
<td>TF-OPS-005</td>
<td>Daily CAM and Record Sampler Inspections</td>
<td></td>
</tr>
<tr>
<td>TF-OPS-006</td>
<td>Air Sample Filter Exchange for Record Samplers, Stack and Annulus CAMs</td>
<td></td>
</tr>
<tr>
<td>TF-OPS-021</td>
<td>Inspections and Source Checks of Stack and Annulus CAMs and Effluent Record Samplers</td>
<td></td>
</tr>
<tr>
<td>TF-OR-DR-AN</td>
<td>AN Daily Rounds</td>
<td></td>
</tr>
<tr>
<td>TO-060-103</td>
<td>Operate AN-241 Annulus Ventilation Systems (VTA)</td>
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Table C-2. AN Tank Farm Ventilation Tank Annulus System Maintenance Procedures.

<table>
<thead>
<tr>
<th>Procedure Number</th>
<th>Title</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-VBP-155</td>
<td>Air Flow Test for Tank Farm Stacks and Ducts</td>
<td></td>
</tr>
<tr>
<td>3-VBP-156</td>
<td>HEPA Filter In-Place Leak Test (Aerosol Test)</td>
<td></td>
</tr>
<tr>
<td>4-EDS-471</td>
<td>DST Fan Motor Predictive Maintenance</td>
<td></td>
</tr>
<tr>
<td>4-VT-118</td>
<td>Damper Motor Current and Timing Trending</td>
<td></td>
</tr>
<tr>
<td>4-VT-562</td>
<td>DST Exhaust Fan Full Spectrum Vibration Analysis</td>
<td></td>
</tr>
<tr>
<td>5-VT-237</td>
<td>Supply and Exhaust Fan Inspection and Vibration Monitoring</td>
<td></td>
</tr>
<tr>
<td>6-FCD-077</td>
<td>Stack Sampling, Monitoring and Annulus CAM Enclosure Systems</td>
<td></td>
</tr>
<tr>
<td>6-GENI-131</td>
<td>Calibrate Alarm/Interlock Switches</td>
<td></td>
</tr>
<tr>
<td>6-GENI-135</td>
<td>Generic Calibration of Digital Indicators</td>
<td></td>
</tr>
<tr>
<td>6-PCD-508</td>
<td>Calibrate Pressure Switches</td>
<td></td>
</tr>
<tr>
<td>6-PCD-511</td>
<td>Dwyer Magnehelic Differential Pressure Series 2000 and Capsuhelic Differential Pressure Series 4000</td>
<td></td>
</tr>
<tr>
<td>6-PCD-514</td>
<td>Dwyer Photohelic Series 3000 and Capsu-Photohelic Series 43000 Differential Switches and Gauges</td>
<td></td>
</tr>
<tr>
<td>6-RM-168</td>
<td>Eberline AMS-4 Continuous Air Monitor Calibration</td>
<td></td>
</tr>
<tr>
<td>6-TCD-181</td>
<td>Calibrate Temperature Switch</td>
<td></td>
</tr>
</tbody>
</table>

See RPP-14698, *Reliability Centered Maintenance Double Shell Tanks Annulus Ventilation Systems*, for additional information on maintenance activities and procedures.
Table C-3. Emergency Response Procedures and Abnormal Operating Procedures Involving the AN Tank Farm Ventilation Tank Annulus System.

<table>
<thead>
<tr>
<th>Procedure Number</th>
<th>Title</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TF-AOP-007</td>
<td>Response to Hanford Site Range Fire</td>
<td></td>
</tr>
<tr>
<td>TF-AOP-008</td>
<td>Response to High Winds and Dust Storms</td>
<td></td>
</tr>
<tr>
<td>TF-ERP-006</td>
<td>Facility Fire Response</td>
<td></td>
</tr>
<tr>
<td>TF-ERP-008</td>
<td>Seismic Event Response</td>
<td></td>
</tr>
<tr>
<td>TF-ERP-010</td>
<td>Total Loss of Electrical Power</td>
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</tr>
</tbody>
</table>
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APPENDIX D

SYSTEM HISTORY

*Information not readily available*
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APPENDIX E

VENDOR INFORMATION FILES
APPENDIX E

VENDOR INFORMATION FILES

This appendix contains a list of vendor information that may provide the reader with technical information regarding the design of the AN Tank Farm Ventilation Tank Annulus System. Vendor information records may be searched using the Insight database system, but the information is available only by hardcopy from document control.

Table E-1. Vendor Information.

<table>
<thead>
<tr>
<th>Vendor Information File Number</th>
<th>Title</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>20589 004</td>
<td>Centrifugal Fan</td>
<td></td>
</tr>
<tr>
<td>20618</td>
<td>Valve, Butterfly</td>
<td></td>
</tr>
<tr>
<td>20551</td>
<td>HVAC Equipment (Filter Housings)</td>
<td></td>
</tr>
<tr>
<td>20586</td>
<td>Duct Heater</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX F

AN TANK FARM VENTILATION TANK ANNULUS SYSTEM FAN CURVES
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Fan is Twin City Fan and Blower Model 911 RBO.

Fan characteristic curve is at standard temperature and pressure (STP).

Fan specification is for a nominal air flow of 2625 cfm with entrance air conditions of 120°F and 77 grains moisture per pound of dry air.

Fan specification is for an operating point of 13.13 in. WG fan static pressure at standard conditions.

Maximum and minimum fan speed values (RPM) are based upon a motor speed range of 1700-1800 RPM with motor sheave diameter $D_{MP} = 9.0$ inches and fan sheave diameter $D_{FP} = 5.8$ inches.
Fan is Twin City Fan and Blower Model 913 RBO.

Fan characteristic curve is at standard temperature and pressure (STP).

Fan specification is for a nominal air flow of 3500 cfm with entrance air conditions of 120°F and 77 grains moisture per pound of dry air.

Fan specification is for an operating point of 13.13 in. WG fan static pressure at standard conditions.

Maximum and minimum fan speed values (RPM) are based upon a motor speed range of 1700-1800 RPM with motor sheave diameter $D_{MP} = 7.4$ inches and fan sheave diameter $D_{FP} = 5.8$ inches.
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<table>
<thead>
<tr>
<th>Onsite</th>
<th></th>
</tr>
</thead>
</table>
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Hanford Technical Library | P8-55 |
| 2 | Lockheed Martin Information Technology  
Central Files  
Document Processing Center | B1-07  
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