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Rockwell Hanford Operations

SUPPORTING DOCUMENT	Number	Rev. No.	Page A of 146 Total Pages
PROGRAM: Waste Management	SD- WM-SAR-016	Rev 1	

Document Title:

Double-Shell Tank Farm Facility (241-AN, AW, AP, and SY) Safety Analysis Report

Baseline Document ☐ Yes ☒ No

WBS No. or Work Package No.
WB 25

Key Words:

Double-Shell Tanks, Safety Analysis, Existing Waste, Coating Removal Waste

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See reverse side for additional approvals

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Abstract

The operational hazards and risk acceptability of the Double-Shell Tank Farm Facilities have been identified and evaluated. (Non-Aging Waste)

This report identifies the potentially hazardous events and Operational Safety Requirements associated with waste transfers from the process facilities to tanks, between tanks, and between farms. The operation and design for all Double-Shell (DS) Tank Farm Facilities are similar and thus the new AP Tank Farm does not require a separate analysis.

No credible accidents were identified where risk to a maximum individual (onsite or offsite) would exceed the whole body dose or equivalent dose to any organ for the low-to-moderate hazard level category.

The report and its approval is a "Readiness Review" check point requirement for operational testing of the AP Tank Farm.

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Summary of Revision

Complete Revision X Page Change _____

DESCRIPTION OF CHANGE

Revision 1 of this document is the result of informal and formal (1) DOE-RL review comments and their resolution. Revisions to Chapters 1, 2, 5, 6, 7, 9 and 11 have been made. Revision 1 presents a more thorough analysis of the hazards and risk from operating the non-aging waste Double-Shell Tank Farm Facilities including an analysis of the consequence of loss of electrical power, the lack of emergency power, and loss of vacuum.

(1) Reference Letter, May 8, 1986, J. D. White to General Manager, Rockwell Hanford Operations, "Double-Shell Tank Farm Safety Analysis Report."

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1.0 INTRODUCTION

This Safety Analysis Report (SAR) fulfills requirements covered in DOE 5480.1A[1] and chapter V of DOE-RL 5480.1.[2] It assesses the risk of operating the 241-AP Tank Farm facility and replaces the previously issued SAR[3-6] for existing double-shell (DS) tanks in the AW, AN, and SY Tank Farms, thus providing a single SAR and Operational Safety Requirement (OSR) for non-aging DS Tank Farm facilities.

This single-SAR coverage will not apply to the AY and AZ aging-waste tanks.[7]

The analysis addresses relevant aspects of radiation and industrial safety related to the structures, equipment, systems, and operations. The format follows that provided in RHO-HS-MA-1 (REV 1).[8]

Previous environmental[9,10] and safety reports[3-7] concluded that the existing DS waste storage tank facilities operate without undue risk to the health and safety of employees and the general public, also with minimum impact to the environment.

1.1 GENERAL

Double-shell tanks have been used to store liquid radioactive wastes (transuranic, high-level, low-level, and Hanford-facility waste) since 1971. Double-shell tanks have been used exclusively for receiving liquid waste since 1981, when single-shell tanks were retired from waste-receiving service. Currently about 15 million gallons of liquid waste are stored in 20 existing DS tanks located in the 200 East and 200 West Areas at the Hanford Site.

Construction of eight additional DS tanks in the 241-AP Tank Farm facility is nearly complete and operations are planned for July 1986. Four additional tanks (241-AQ Tank Farm) are planned to be constructed and operational for aging waste by fiscal year (FY) 1993.

Yearly planning concerning the requirements for and usage of DS tanks is based on annual reports on tank farm "Waste Volume Projections."[11] The reports are issued by the Waste Management Process Group of the Waste Management System Engineering Department of Rockwell Hanford Operations. The System Engineering reports are based on the annual report of "Waste Generation and Volume Reduction Factors."[12] Waste volume projections are estimated from several different operating scenarios, summarized in table 1-1.[12] Double-shell tank storage requirements as a function of time for Scenario I, the "reference plan,"[11] is shown in figure 1-1. Planned usage for the eight 241-AP tanks is also included in figure 1-1. Inflow, outflow, and accumulation volumes projected for DS tanks for Scenario I are shown in figure 1-2. Projections as of the first quarter of 1986[13,14] which are based on plant and farm operations have resulted in a revision of

Table 1-1. Facility Assumptions Used in Each Scenario.

	Scenario I	Scenario II	Scenario III	Scenario IV
PUREX Projections	o 2,528 MTU processed by 10/86 o 11,488 MTU N-Reactor fuel processed by 10/96 o 200 MTU shippingport and Al clad fuel processed in 1994 o 1,238 MTU fuel processing starting in FY 1992	Same as Scenario I except PUREX will perform TRU removal of CRW starting in FY 1986 Shear/Leach of N-Reactor fuel will occur starting in FY 1992 PUREX will process 802 MTU/yr NPR fuel from FY 2000-2014	Same as Scenario I	Same as Scenario I
Salt Well	Criteria: o Select tanks based on 50,000 gal of drainable liquor o Pump to 0.5 gpm or a major mechanical failure	Same as Scenario I	Same as Scenario I	Same as Scenario I
PFP Projections	o PFP operates through 1997 o RMC operates 1985 through 1997 o Laboratories operate through 2015	Same as Scenario I except TRUEX will be implemented in FY 1991 SIS will become operational starting in FY 1992	Same as Scenario I	Same as Scenario I
B Plant Projections	o Current processing mission o Process PUREX CRW starting in FY 1987 o Process retrieved NCAW when PUREX becomes current o CC/PFP solids in FY 2002	o Current processing mission o Process retrieved NCAW starting in FY 1988	Same as Scenario I except Process PUREX CRW starting in FY 1988 Process NCAW one year after PUREX currency CC/PFP solids in FY 2003	No B Plant operations beyond current mission
Hanford Waste Vitrification Plant Projections	Startup 9/94 to process: o CRW/TRU solids o 100-N HFW starting in FY 1987 o PUREX CRW starting in FY 1988 (after TRU removal) o Non-TRU inventory starting in FY 1990	Same as Scenario I	Same as Scenario I except Startup 9/96, same processing Scenario as I	No Hanford Waste Vitrification Plant
Other Facilities	o AP Farm operational 4/01/86 o AQ Farm operational in 2/1/93 o 242-A Evaporator operations through 2015	Same as Scenario I	Same as Scenario I except AQ Farm operational 2/1/94	Same as Scenario I

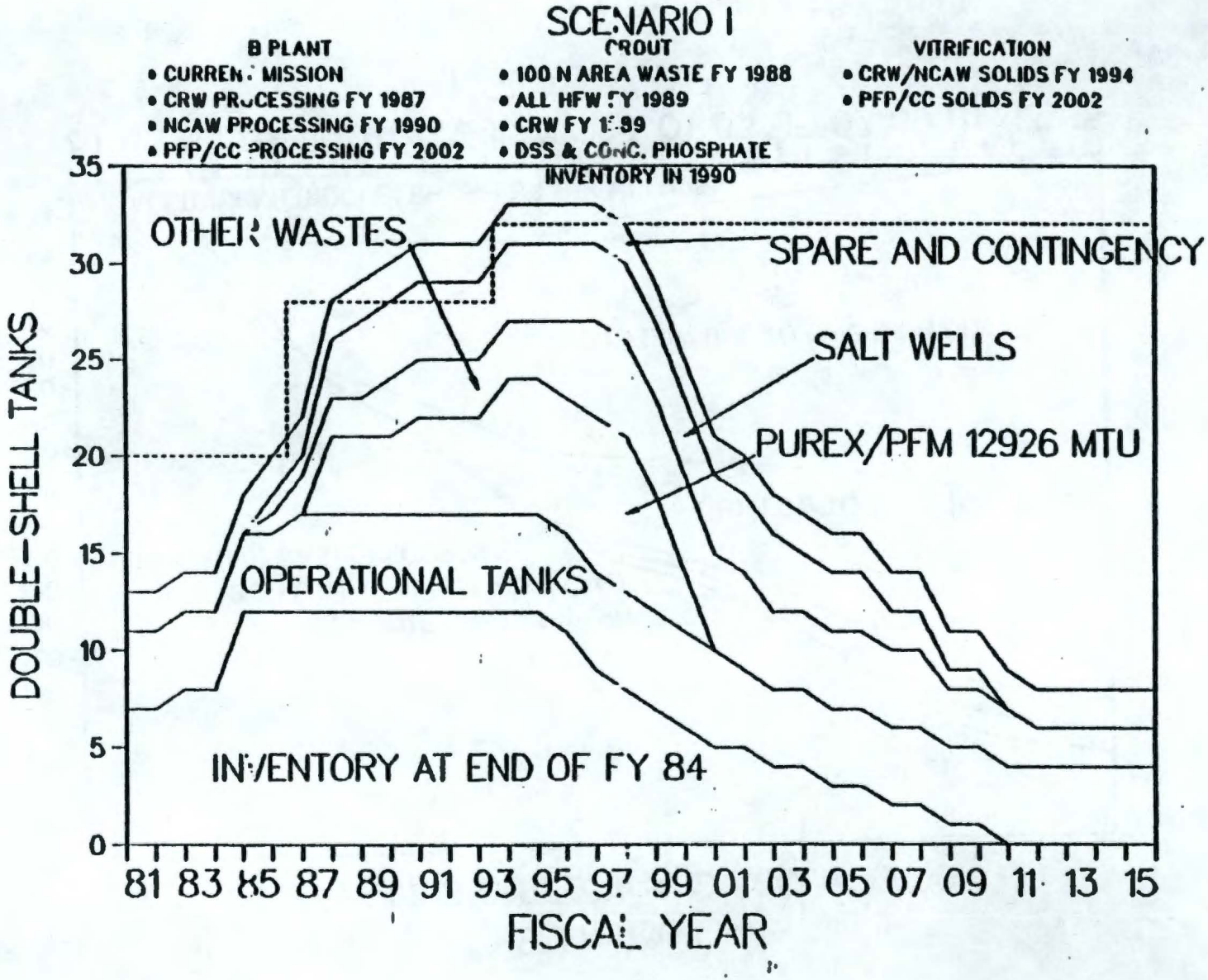

Figure 1-1. Double-Shell Tank Requirements for Scenario I.

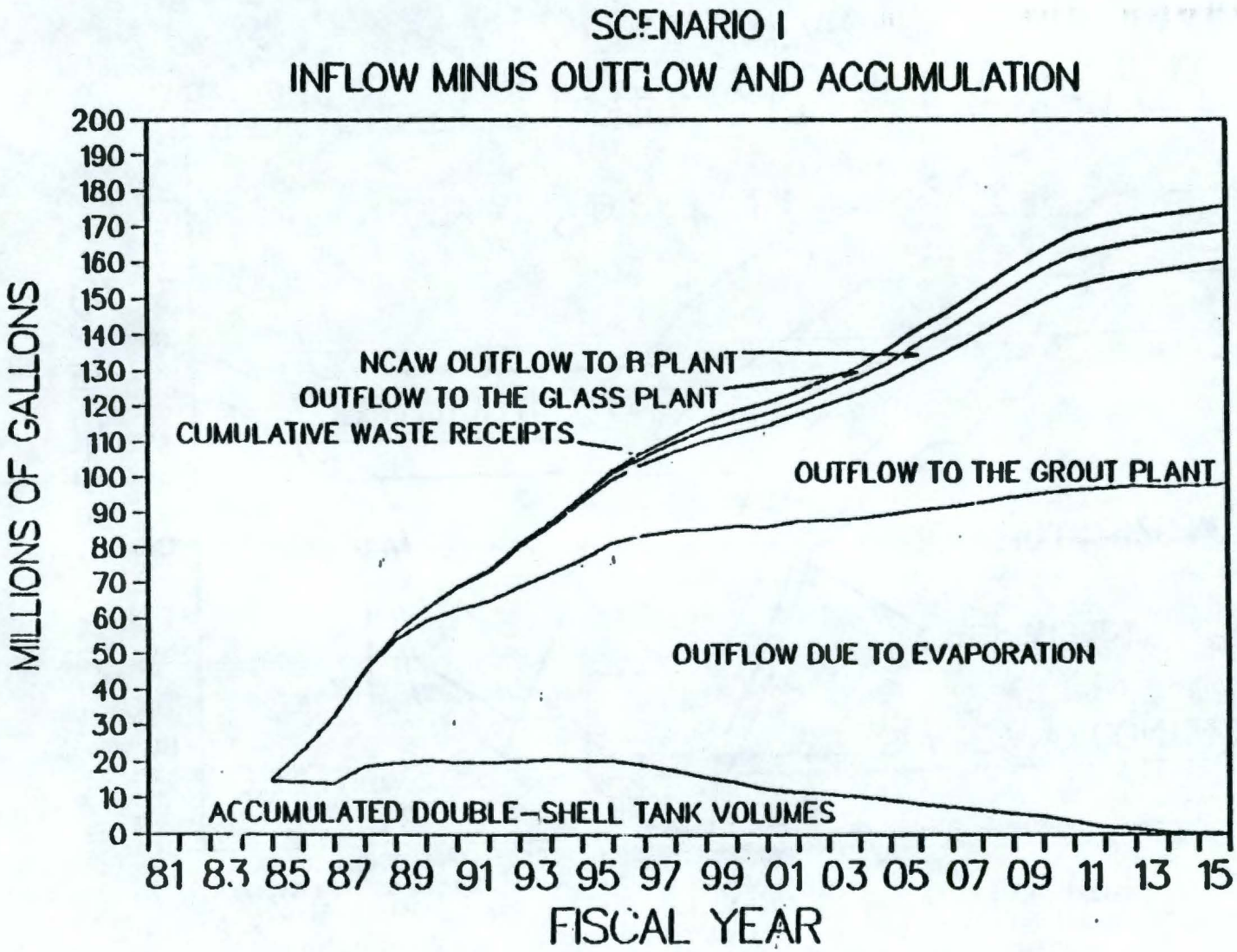

Figure 1-2. Inflow, Outflow, and Accumulative Volumes for Scenario I.

the reference scenario. These new projections resulted in a need of four additional non-aging waste tanks (241-AT Tank Farm) and the conversion of tank 107-AN to aging-waste service by FY 1990.

The Tank Farm facilities are operated by the Tank Farm Surveillance and Operations (TFS&O) Group supported by the Tank Farm and Evaporator Process Engineering (TF&EPE) Group. The latter group is responsible for operating specifications, operating procedures, training assistance, and technical support for tank farms. The TF&EPE Group has designated cognizant process engineers for each facility which generates or stores waste.

Operations for the AW, AN, SY, and AP double-shell Tank Farm facilities are all similar and thus no major specification or procedure change is required for the AP Tank Farm. Grout processing will use tank 102-AP as the designated feed storage tank. However, grout processing will be discussed in a separate SAR prepared for the grout facilities.

It is not the intent of this report to require upgrade or changes in design, construction, or equipment already in operation.

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2.0 SUMMARY

Safety-related incidents pertaining to construction features and operations of the SY, AW, AN, and AP Tank Farm facilities were identified. Possible causes and potential consequences were also identified. Safety-related features are cited which are incorporated in the design and operating procedures to prevent, call attention to, or to mitigate the consequences of the event.

2.1 DISCUSSION

A large fraction of safety-related incidents in DS Tank Farms result directly from human error; little automation is applied. Thus the need for rigorous procedures, administrative controls, and Quality Assurance must be stressed.

The frequency of incidents resulting in a small loss of radioactivity from the primary containment is high in DS tanks because of the mobility of the material and the continued movement of material between facilities, farms, and tanks.

The radioactivity and thermal energy in the DS tank waste is much less than that in the aging waste tanks and significant penetration of the protective barrier per event is therefore less ($>10^6$ Btu/h versus $<10^8$ Btu/h).

The consequence of worst case events are lower for DS tank waste than for aging waste because the release of radioactivity is low, even under severe conditions (loss of annulus and primary tank ventilation).

The inventory of radioisotopes in DS tanks on a tank-by-tank basis is significantly less than in aging waste tanks and thus the consequence of the same event is less.

2.2 WORST CASE INVENTORIES

Three waste types are discussed in the SAR: (1) Hypothetical existing Inventory--consisting of DS slurry and complexant concentrate, accumulated until the end of FY 84. The radioisotopes consist essentially of ^{137}Cs and ^{90}Sr. (2) Current Waste--consisting of cladding removal waste divided into supernatant (eventually DS slurry) and sludge. This waste inventory is based on 6% ^{240}Pu fuel and cladding decayed for 1 yr since discharge. (3) Other waste--consisting of streams such as Plutonium Finishing Plant (PFP) waste that have high TRU content in sludge but are non-TRU in the supernate. Partitioning of the activity from the liquid to the primary tank vapor space is much less for insoluble components (sludge) than it is for soluble material in feed, slurry, or supernatant.

2.3 MAXIMUM CREDIBLE ACCIDENT

Failure of a HEPA filter and/or de-entrainer could result in a maximum release to the environs of the contamination contained in them. The filter contamination is limited because the prefilters are changed when the dose rate exceeds 100 mR/h at the monitored point. Some fraction of the released activity would be from the de-entrainer.

The maximum contamination is assumed to be equivalent to that contained in .06 gallon of existing DS slurry (0.1 Ci, ^{90}Sr and ^{137}Cs). The calculated dose commitment (summation of external radiation, inhalation, for onsite and offsite individuals) are presented in table 2-1. For tanks that contain high TRU in sludge (PFP waste) the postulated vapor space concentrations and resultant filter loading is low.

Table 2-1. Calculated 1st Year Dose Commitment to an Individual Following a Filter Rupture (rem).[a]

	Total Body	Bone	Lung
Onsite	0.2	2.4	0.14
Offsite	0.0005	0.002	0.00015

[a]Assuming a 30-min exposure.

Based on the onsite individuals 1st year bone dose commitment,(1) a low-hazard level is assigned to this accident.

The analysis of a tank leak shows that the radionuclide concentrations and dose commitments are insignificant over a long period. There are, however, environmental impacts associated with the release of toxic chemicals and economic impacts associated with the loss of a DS tank.

The operation of the DS waste tank farms is bounded by the hazard associated with the maximum credible accident. The hazard of operating these farms is therefore classified as low, and the risk is acceptable.

2.4 REFERENCES

1. Christensen, G. M. and R. Jacobs, Safety Analysis and Report Preparation Guide, RHO-HS-MA-1 Rev. 1 Rockwell Hanford Operations, Richland, Washington (January 1984).

3.0 SITE CHARACTERISTICS

3.1 GEOGRAPHY AND DEMOGRAPHY

The U.S. Department of Energy's (DOE) Hanford Site occupies 1,500 km^2 (570 mi^2) of the semiarid Pasco Basin in southcentral Washington State (fig. 3-1). The Rockwell-managed DS tanks are located in the tank farm complex of the 200 East and West Areas on the Hanford Site (fig. 5-1). Detailed geographic characteristics of the site are presented in references 1, 2, and 3.

The 1980 population living within an 80-km (50-mi) radius of the Hanford Meteorological Station (HMS), west of the 200 East Area, was 341,000 and the 1990 population of this area is projected to be 417,000.(4) The onsite employee population of the Hanford Site is 15,000.(5) Land use in the area surrounding the Hanford Site includes urban, suburban, recreational, commercial, and industrial operations, plus irrigated and dry-land farming.

3.2 NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES

The Hanford Site is primarily a location for DOE-controlled facilities. Public transportation facilities nearest the 200 Areas are State Highways 24 and 240. Nuclear facilities within 40 km (25 mi) of the 200 Areas include the Exxon Nuclear Fuel Fabrication Plant located just north of Richland, Washington. Located within the boundaries of the Hanford Site are the Public Power Supply System reactor, the U.S. Ecology Company, Inc. waste disposal facility, and the numerous DOE facilities. The eastern boundary of the nearest military facility, the Yakima Firing Center, is 40 km (25 mi) west-northwest of the HMS.

3.3 CLIMATOLOGY AND METEOROLOGY

The climate in the vicinity of Hanford has been recorded since 1912 and is characterized as mild and dry with occasional periods of high wind.(1) A peak gust wind (straight) of 130 km/h (80 mi/h) was measured on January 11, 1972 at the 15-m (50-ft) level of the HMS tower. The average annual precipitation is 16 cm (6.3 in.). Tornadoes are very rare in this region, tending to be small, and causing only minor damage.(1) The probability for winds which exceed 125 mi/h is 10^{-6}/yr.(6) On June 16, 1948, a tornado was observed near the east end of Rattlesnake Mountain, 16 km (10 mi) south of Hanford's waste management facilities; no damage resulted. Water erosion associated with facilities located on the 200 Areas plateau is minor because of the minimal precipitation, high soil porosity, and minimal ground slope.

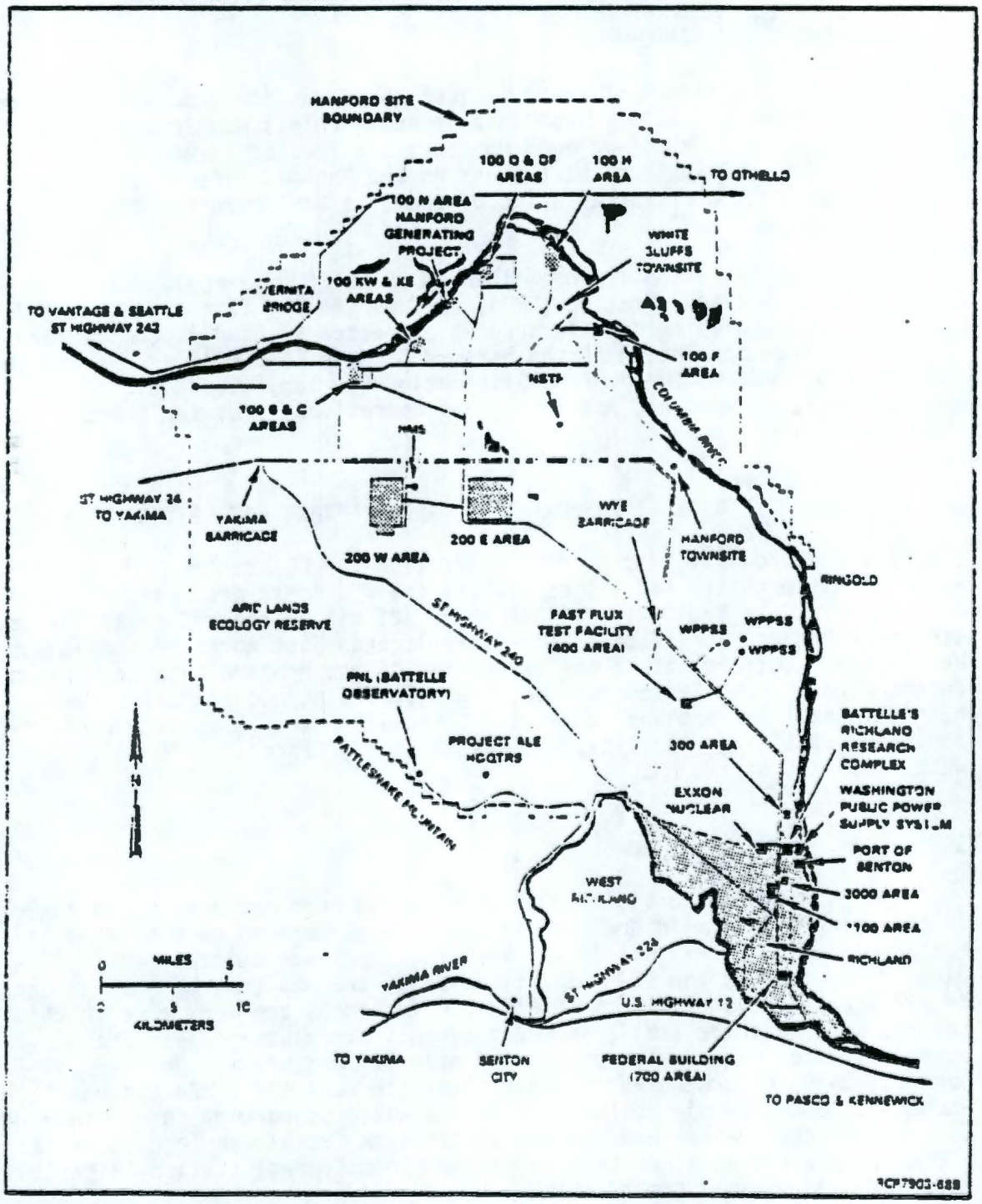

Figure 3-1. Hanford Site.

3.4 GEOLOGY AND HYDROLOGY

The Hanford Site lies within the geologic formation known as the Columbia Plateau Physiographic Province. It is part of a smaller subdivision called the Pasco Basin, which is composed of large quantities of basalt interspersed with thick layers of sedimentary material. These sedimentary layers are water bearing, and collectively constitute a vertically stratified series of confined aquifers beneath the Hanford Site. Above the uppermost layer of basalt lies the unconsolidated sand and gravel of the Ringold Formation, which ranges up to 300 m (1,000 ft) in depth. Above this, and extending to the surface, is the Hanford Formation, covered by a thin layer of windblown silts and sands.

The water table in this unconfined region lies 46 to 90 m (150 to 300 ft) below the surface in the 200 Areas. The maximum 24-h precipitation that can be expected to occur once in 1 million years is 28 cm (11 in.).[3] Even this amount of rainfall would not cause appreciable flood damage to facilities at Hanford.[6] The maximum amount of precipitation recorded in a 12-h period was 4.8 cm (1.9 in.).[3] The natural recharge under the present climate conditions is estimated to result in an infiltration rate between 0 and 0.5 cm/yr maximum.[7]

3.5 SEISMOLOGY

Hanford facilities are exposed to the possibility of moderate earthquake damage (zone 2) from both active seismic zones of western Washington and closer shocks originating in the seismic zone that includes Walla Walla.

The safe shutdown earthquake (SSE) of 0.25-g horizontal ground acceleration allows for an earthquake intensity of MM VIII on the Modified Mercalli scale (magnitude 6.8 on the Richter scale) epicentered at the Hanford Site. This is considered conservative, since no earthquake of this magnitude has ever been recorded in eastern Washington or Oregon.[1] The largest recorded earthquakes were one of magnitude 5.7 at Milton-Freewater, Oregon, July 15, 1936 and one of magnitude 4.0 which occurred south of College Place, Washington, April 7, 1979.[3] The return period (lower limit) for the SSE at the Hanford Site is 5,500 yr (1.8×10^{-4}/yr).[8]

The December 14, 1872 earthquake in the North Cascades is estimated to have resulted in an intensity of MM VIII. The resulting ground acceleration at Hanford was estimated to have been about 0.05 g. In 1976 a panel of experts concluded that this earthquake was of magnitude 7.0. Because this earthquake occurred in a distinct tectonic province separate from the Columbia Plateau, it is considered unlikely that an event of the magnitude of the 1872 earthquake could take place in the Columbia Plateau.[3,9]

The largest local earthquake of historical record occurred at Corfu, a few kilometers north of the site, in 1918. Various damage estimates have been reported resulting in a classification of MM IV or V. Estimates of the peak ground acceleration made for the Corfu event range from 0.01 to 0.03 g. Data indicates that no events larger than MM V to VI have occurred in the vicinity of the 200 Areas.

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4.0 PRINCIPAL DESIGN CRITERIA

The purpose of the DS tanks is to provide intermediate (up to 50 yr) storage for the nonaging, high-level radioactive waste: Hanford facility waste, evaporator feed, grout feed, and DS slurry. The waste material will be stored in DS tanks prior to further processing or transfer to a permanent storage facility; the heat generated by radioactive decay will be <70,000 Btu/h per tank.

Criteria for the design and construction of the DS tanks and associated support systems were developed according to the codes and standards in effect at the time of design and construction. Criteria that were developed specifically for the storage of high-level radioactive waste in the DS tanks may be found in references 1 through 8 and chapter 5 of this document. The considerations used to analyze the safety aspects of the DS Tank Farm are presented in this chapter. These considerations are described in three general categories: structural, control, and administrative.

4.1 STRUCTURAL

Safety considerations are used in the evaluation of the physical structures, systems, and components. The general components of the facility design, for purposes of high-level contamination confinement, shall be: (1) process enclosures, (2) operating area compartments, and (3) structure containment, (including the associated ventilation).[9]

The degree of confinement in the design shall depend on the potential hazards inherent in the material being confined. The principle means for assuring the safe confinement of large quantities of radioactive material within the tank farm facility shall be the provision of confinement system between the tank (normal location of the radioactive material) and the environment.[10]

Structures, confinement systems, and related components important to safe operations will be designed and located to minimize the probability and effects of fires and explosions. Recognized industrial fire and chemical safety standards will be applied in the evaluation of plant structures, confinement systems, and equipment.[10,11]

Facilities and systems will be designed to withstand wind forces in accordance with the "Uniform Building Code" (UBC), section 2311.[12] Underground waste storage tanks will be designed to meet the criteria in "ASME Boiler and Pressure Vessel Code," section VIII,[13] and seismic criteria defined in "Hanford Plant Standard Design Criteria" 4.1, Category I.[14] Other systems (support facilities) will be in compliance with the UBC, section 2312, for seismic Zone 2.[15]

There will be no bypasses or drains in the radioactive liquid-waste-treatment system by which waste may inadvertently circumvent treatment equipment or be released directly into the environment.(16)

Exposure rates in work areas shall be as low as reasonably achievable (ALARA) by using proper facility design and equipment layout. Design factors to consider include: occupancy time, source terms, spacing, processes, and equipment selection and shielding. Primary means of assuring protection will be through physical safeguards (e.g., remote handling, equipment, and shielding). Administrative controls will be regarded as secondary means of exposure control.(9)

The wastes in the intermediate storage facilities will be contained so as to be retrievable for removal and transfer without compromising personnel safety.(16)

Process and waste storage vessels and piping serving as primary confinement barriers will have a secondary barrier provision so that failure of the primary barrier does not result in the release of radioactive material in excess of DOE Guidelines.(4,9)

Provisions will be made for cleanout and decontamination of liquid waste piping, as necessary, to clear potential blockages, perform maintenance and/or repair, or to maintain occupational doses ALARA.(17)

Tanks and transfer systems will be designed to resist credible internal and external forces, including natural phenomena.(17) Pressure-retaining tank and transfer systems will be of welded construction to the extent practicable.(16)

At least two independent safety features will be provided to prevent excessive releases of radioactivity to the environment. The functioning of safety-related systems will be analyzed with reference to other systems to ensure that their proper functioning does not lead to any additional safety problems.(10)

Gravity flow will be utilized to the maximum extent possible to reduce the potential for contamination associated with pumping and pressurization.(16)

Systems will be provided for the removal of radioactive decay heat, as required, to protect the integrity of confinement systems.

Adequate heat transfer will be provided for all stored waste. The structure surrounding the storage tank will be designed to withstand the expected operating temperatures. Nonuniform heat distribution caused by solids in the waste will be considered in the design of the tank and of the heat transfer systems.(10)

4.2 CONTROL

Control considerations were used for evaluating parameters or locations having significant importance to safety. DOE Order RL 5820.2[18] states that: "Radioactive liquid discharges to the ground shall be as low as technically and economically practical and for new facilities shall be below Table II concentration guides." In addition, this order states that: "Facilities discharging liquid which could, as a consequence of an accident or process upset, become contaminated above nondischargeable levels, shall be equipped with automatic detection, and appropriate handling capabilities."

Measurement capability will be provided to determine the volume, concentration, and radioactivity of wastes fed into storage tanks. To the extent practical, more than one method will be used in making the determination of fluid volume and concentration.[16]

Protection will be provided to control exposure to direct radiation and to control inhalation of, ingestion of, and external contamination by radioactive materials. This protection shall be provided by installing radiation shielding and ventilation systems, controlling the access to plant areas, limiting quantities of radioactive materials to specified areas, monitoring plant areas and plant personnel for radioactivity, and providing appropriate administrative controls and protective devices. The measures will be provided either singly or in combination, depending on the level or type of radioactivity present and on the work being performed.[10]

The facility will be provided with control room(s) and/or control location(s) for instrument readout and for the control of actions to maintain safe operational status of the facility. The design will provide safe access under accident conditions to equipment controls that may be necessary to shut down and maintain safe control of the facility without unnecessary radiation exposure of plant personnel.[10]

Instrumentation will be provided for the early detection of leakage from the primary confinement system.

Process and waste storage vessels will be vented through appropriate treatment systems for the confinement of airborne radioactive materials.

Instrumentation and controls will be provided, as required, to fully monitor safety-related variables and to maintain them within operating ranges. Safety-related instrument systems will be designed to a fail-safe mode and will alert operators to a failure condition.[10]

Instrumentation will be provided for periodically or continuously monitoring the potentially radioactive airborne and liquid effluents and contamination levels. Monitoring for nonradioactive contaminants will be in accordance with appropriate regulations.[10] RHO-MA-139[19] Environmental Protection Manual, provides criteria for effluent sampling and monitoring,

and RHO-MA-220,[20] Radiological Standards and Operational Controls, provides criteria for radiation monitoring, allowable exposure, posting, etc.

Radioactive discharge to the atmosphere will be as low as technically and economically practical, with the objective of not exceeding DOE Order 5480.1A, Table II concentration guides[21] at the points of discharge. DOE Order 5480.1A, p. XI-6 defines "point of discharge" as the place where the effluent passes beyond the site boundary. Reference 19 restricts the concentration at the point of release to Table I or Table II limits which assure ALARA and compliance to DOE Orders at the point of discharge.

Provisions will be made to prevent the reversal of air flow (normally maintained from areas of low contamination potential toward areas of high contamination potential) either by adequate pressure drops to produce the desired air flow direction or by back-flow air adequate to provide required contamination control.[10]

Concentrations of radionuclides in liquids discharged to the soil will be ALARA. Discharges from old facilities will be maintained below the concentration guides in Table I of chapter XI of DOE Order 5480.1A,[9] while new facilities will be maintained below the concentration guides of Table II of the DOE Order. Liquid containing transuranic wastes with concentrations greater than these concentration guides will not be discharged to the environment.[18]

4.3 ADMINISTRATIVE

Considerations that do not lend themselves to structural design or automatic control, but that promote safety by means of actions suggested and/or required are termed administrative controls.

DOE Order 5480.1A, chapter V[21] establishes safety procedures and requirements for nuclear facilities. The following administrative considerations are included:

- A contractor safety review and appraisal system that requires independent safety review and approval of all changes to components, equipment, procedures, and systems required for facility safety
- Development and implementation of quality assurance programs
- Implementation of notification, investigation, and reporting of occurrences and the followup system to assure remedial action

- o A formal documented system for the control and traceability of records and documentation

- o A documented training program for personnel involved in operating nuclear facilities.

The radioactivity and the chemical and physical characteristics of all high-level wastes in intermediate storage will be determined. Influents to radioactive liquid waste systems will be controlled to prevent the introduction of material that may adversely affect system performance. Such materials may include, but are not necessarily limited to, oils, certain types of organics, insoluble solids, and solvents.(15)

Sampling frequency and type will be determined by considering the purpose for which the data are being obtained, (e.g., evaluation of the effectiveness of waste treatment and control, compliance with operating limits of applicable effluent or performance standards, compilation of release data, etc.). Continuous sampling is desirable and may be necessary where there is wide variation in the concentration or mixture of potential pollutants in the effluent stream. However, periodic sampling may suffice when the concentrations and mixtures are reasonably constant and there is little likelihood of unusual variations. Similarly, proportional sampling may be necessary when effluent flow rates fluctuate; whereas, a representative grab-sample may suffice for batch discharges.

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5.0 FACILITY DESIGN

5.1 INTRODUCTION

The DS tanks are located in the 200 East and 200 West Areas at the Hanford Site. The 241-SY (three tanks) Tank Farm is located in the 200 West Area while the 241-AN (seven tanks), -AW (six tanks) and -AP (eight tanks) Tank Farms are located in the 200 East Area. Double-shell tanks are designed and constructed to minimize the potential for leakage of radioactive liquids to the environment.

The DS tanks constitute a significant part of the overall waste management operations at Hanford and provide for safe, interim storage of the wastes until permanent waste storage is implemented.

This chapter contains a brief physical description of the tank farm facilities including: (1) the basic tank configuration, (2) pits, (3) tank ventilation systems, (4) process piping, (5) instrumentation systems, and (6) utilities. A summary of the design criteria for each of the DS tank farm facilities may be located in appendix A. The location of the various tank farms is shown in figure 5-1 with respect to the nearby facilities.

The AN, AP, AW, and SY Double-Shell Tank Farms are similar to one another in design, with minor differences for operability considerations.

5.2 TANK CONFIGURATION

Each tank consists of three concentric structures as shown in figure 5-2. The outer tank structure is a reinforced concrete tank designed to sustain soil loadings, dead loads, live loads, and temperature gradients generated by the radioactive wastes contained within the primary tank. The reinforced concrete tank is lined with a carbon-steel liner referred to as the secondary steel tank. The inner, freestanding, completely enclosed carbon-steel tank, is referred to as the primary tank. An annular space separates the steel tanks. The primary tank is designed to contain the radioactive waste materials. The secondary steel tank would contain any liquid leakage from the primary tank until the tank contents can be transferred to available storage space.

The freestanding primary tank is ~75 ft in diameter and ~46 ft high at the dome crown. The maximum content height is ~35 ft. The carbon steel in the bottom of the tank ranges from 1/2 to 1 in. in thickness. The knuckle (the transition from the tank floor to tank wall) is 7/8 in.-steel plate. The primary tank wall thickness ranges from 1/2 to 3/4 in. and the dome is 3/8-in.-thick steel.

The secondary steel tank lines the reinforced concrete tank and extends to the primary tank dome. The secondary steel tank is 80 ft in diameter and varies in thickness from 3/8-in. to 1/2-in. steel plate. A 2 1/2-ft-annular space between the primary and secondary steel tanks allows for installation

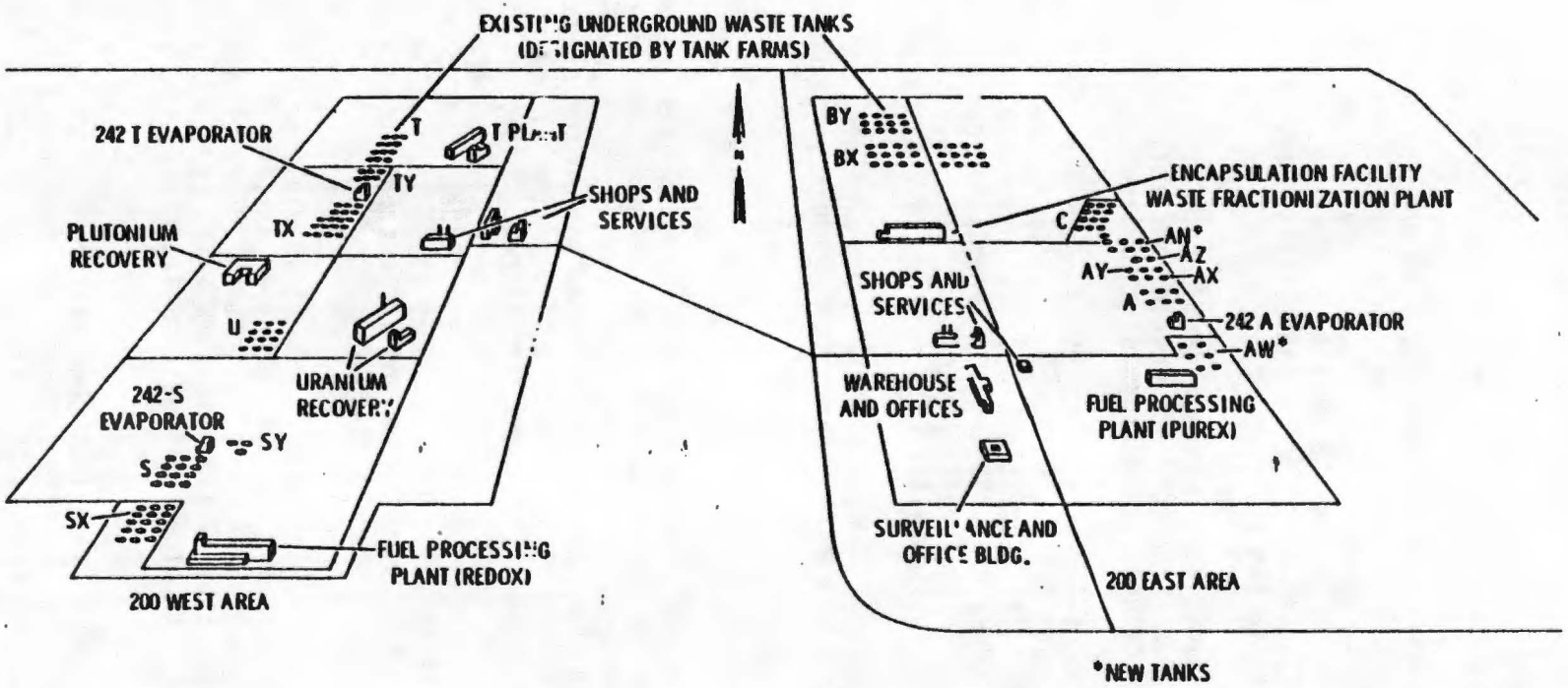


Figure 5-1. 200 East Area Tank Farm Location and Location of New Tanks.

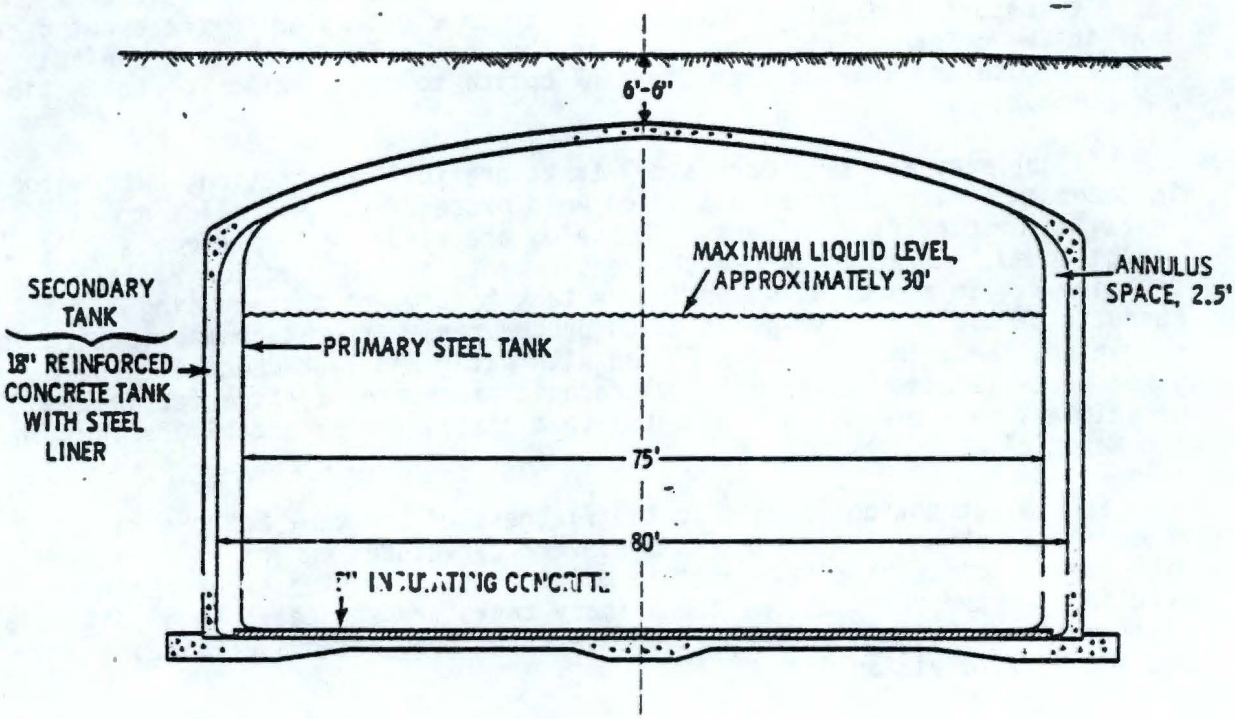


Figure 5-2. Schematic Drawing of Double-Shell Tank at Hanford.

of leak detection devices, inspection equipment (e.g., periscopes, television cameras, and photographic cameras, ventilation air supply and exhaust piping, and equipment for pumping liquid from the annular space).

An 8-in. slab of insulating concrete (a castable refractory made with an aluminate cement and a slate aggregate) is sandwiched between the primary and the secondary tank bottoms (see fig. 5-2). This slab provides protection for the reinforced concrete foundation from the excessive temperatures experienced during stress relief of the primary tank. The annulus ventilation system routes air through slots in the insulating concrete to the annulus. This air flow removes heat from the waste tank and would transport radioactive particulates to an air sampler in the event of a leak in the primary tank. The slots in the insulating concrete are also used to route any leakage from the tank bottom to the annulus for collection and pumpout.

All primary and secondary steel tanks are full penetration, butt-welded in accordance with approved qualified weld procedures. All welds are installed by certified welders. The welds are visually inspected, radiographed, and accepted per the requirements of ASME section VIII, division 2. In addition, welds in the tank bottom are tested using magnetic-particle and dye-penetration procedures. After tank fabrication is completed, the primary tank is filled with water and leak checked. The steel plate is also tested using ultrasonic procedures (before fabrication or shipment to the construction site) to minimize the potential of flaws in the material.

Special attention is paid to the flatness of the tank bottoms since research has shown that uneveness or severe curvatures can cause localized high-stress points that may initiate or contribute to stress-corrosion cracking. After fabrication, the primary tanks are subjected to a post-weld heat treatment (stress relief) which meets the requirements of ASME, section VIII, division 2.

The reinforced concrete tank is comprised of two independent components: (1) foundation and (2) walls/dome. The foundation transmits the bearing forces from the tank and concrete walls to the load bearing backfill beneath the foundation. The concrete wall rests on a steel slide plate mounted in the foundation footing. The top of the concrete tank foundation contains sloped slots which will collect and route any leakage from the secondary steel tank to a leak detection well.

The reinforced concrete structure is designed to withstand the most severe combination of operating and natural forces, including a breach of the primary tank with the resulting loads on the secondary steel tank and reinforced concrete structure.

Design analysis of the concrete structures indicates it will experience a nonlinear creep and cracking due to elevated temperature conditions induced by the contents of the primary tank, but it reaches an equilibrium point with a margin of safety.

There are ~60-65 tank dome penetrations (called risers) in the primary tank and annulus for monitoring and processing activities. A typical dome penetration arrangement is shown in figure 5-3, with a description of the number and sizes of penetrations. The primary tank risers are required for liquid level, sludge level, temperature and pressure measurements, and an observation port. Penetrations for the primary tank processing operation include vessel ventilation, slurry distribution, supernatant pumpout, drainage collection from various pits, encasements, and spares.

Penetrations through the tank dome into the annulus area are required for annulus pumpout, ventilation air inlets and outlets, instrument leads, leak detection, annulus inspection, and construction access. All risers terminating above grade are located to permit crane access to pits.

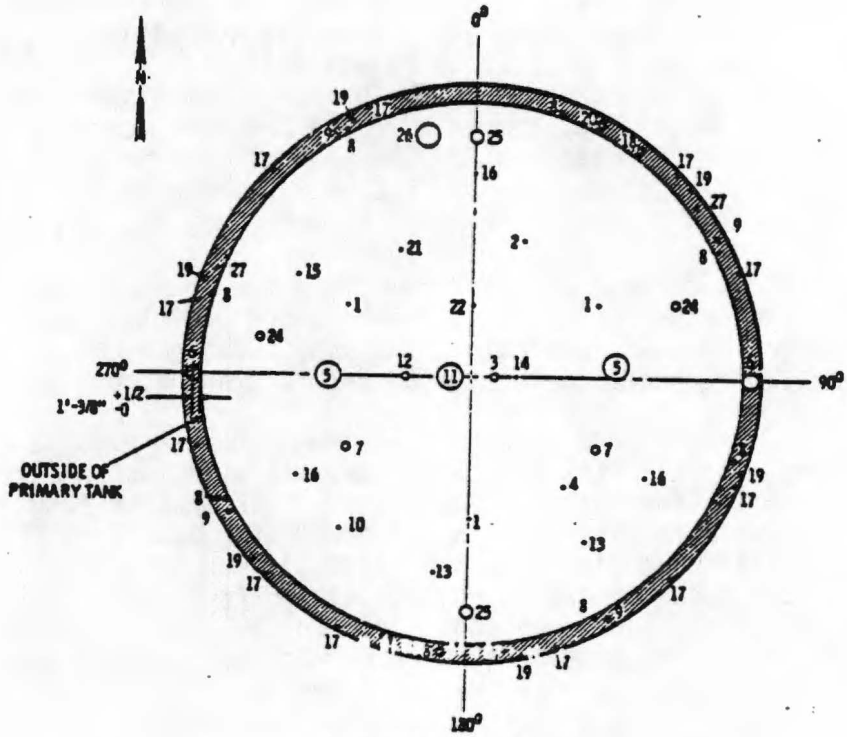
Each tank is equipped with at least two concrete pits to be utilized in tank contents removal: (1) a central pump pit over the primary tank and the pump and the fill line for each tank, and (2) an annulus pump pit for waste removal from the secondary tank in the event of a leak from the primary tank. Additional pump pits have been installed on specific tanks as required. Leak detection wells collect liquid from slots in the concrete foundation below the secondary tank liner for pumping back through the central pump pit. The pits consist of reinforced concrete boxes set in the ground above the risers on leak detection wells. The top of each pit has removable concrete cover blocks which allow equipment access when removed and provide shielding when installed.

5.3 PROCESS PIPING

Process piping is used for two purposes: (1) transporting product from the 242-A Evaporator or other processing facility to the tanks; and (2) transferring material between tanks. The pipelines from the evaporator or other processing facilities are called slurry lines (see fig. 5-4 for typical slurry layout). The lines for moving waste between tanks are called supernatant lines (see fig. 5-5 for typical supernatant piping layout). Slurry piping is smaller in diameter than that for the supernatant in order to increase the fluid velocity and minimize settling of solids in the line.

One slurry line and one supernatant line are typically connected to each tank. These lines connect the central pump pits on each tank to the tank farm valve pit(s) containing valved jumpers used to make transfers to and from the desired tanks. Process waste lines are also provided to connect the central pump pit(s) with both the leak detection pit and annulus pump pit.

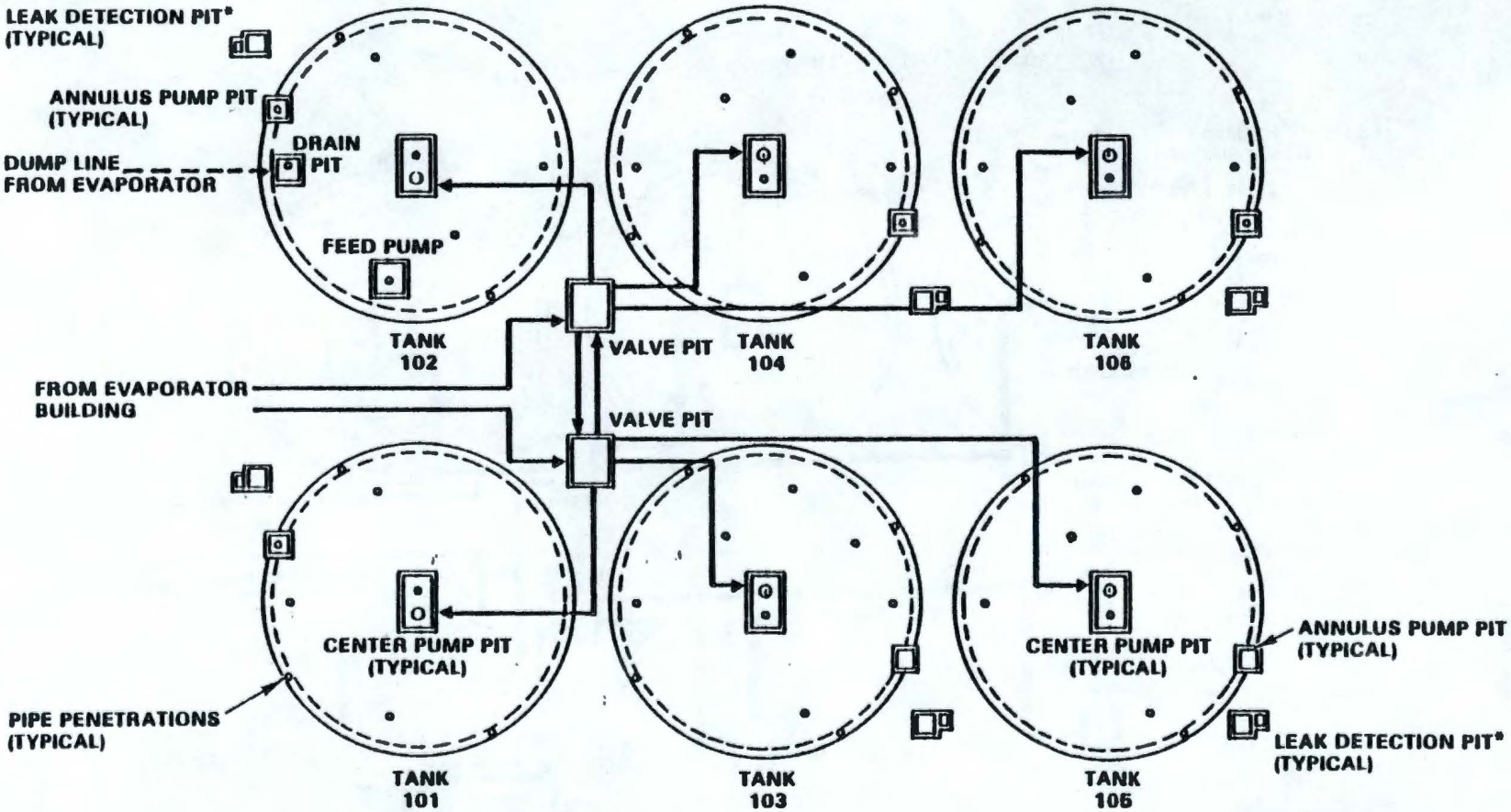
All process lines are designed with a minimum average slope of 0.25% to assure proper drainage. The primary lines are encased with a secondary pipe (encasement) to collect leakage in the event of a primary line failure. All piping is designed to accommodate thermal expansion and contraction and void spaces are provided in the insulation around the piping.



PLAN FOR DOME PENETRATIONS

NOZZLE NO.	QTY	SIZE	FUNCTION (REFERENCE ONLY)
1	3	4" SCHED 40	SLUDGE MEASUREMENT
2	1	4" SCHED 40	LIQUID LEVEL (LIT)
3	1	12" SCHED 40	SUPERNATANT PUMP, PUMP PIT DRAIN OR SPARE
4	1	4" SCHED 40	THERMOCOUPLE PROBE
5	2	42" I.D. x 1/2" WALL	CONSTRUCTION OPENING
6	2	20" SCHED 20	ANNULUS ACCESS
7	2	12" SCHED 40	TANK VENT, SPECIFIC GRAVITY & SPARE
8	8	4" SCHED 40	AIR INLET TO TANK INSULATION
9	4	8" SCHED 10	PUMP PIT AIR OUTLETS
10	1	4" SCHED 40	FLUSH PIT DRAIN OR SPARE
11	1	42" I.D. x 1/2" WALL	SUPERNATANT ADD AND SLURRY DISTRIBUTOR
12	1	12" SCHED 40	OBSERVATION PORT
13	2	4" SCHED 40	TANK PRESSURE AND SPARE
14	1	4" SCHED 40	SUPERNATANT RETURN
15	1	4" SCHED 40	SPARE
16	3	4" SCHED 40	SLUDGE MEASUREMENT
17	11	4" SCHED 40	ANNULUS INSPECTION
18	2	12" SCHED 40	ANNULUS ACCESS
19	6	4" SCHED 40	ANNULUS INSTRUMENT LEADS
20	1	12" SCHED 40	ANNULUS PUMP OUT AND ANNULUS PUMP PIT DRAIN
21	1	4" SCHED 40	LIQUID LEVEL (HIGH LE)
22	1	4" SCHED 40	SLUDGE MEASUREMENT
23			
24	2	12" SCHED 40	SUPERNATANT PUMP AND FEED PUMP PIT DRAIN & SPARE
25	2	20" SCHED 40	CLEANOUT BOX AND VALVE
26	1	30" I.D. x 1/2" WALL	SLDG DRAIN
27	3	4" SCHED 40	ANNULUS LEAK DETECTION

Figure 5-3. Tank Penetrations Schematic.



NOTE:
PIPING IN SLURRY SYSTEM TO BE UNDERGROUND, DOUBLE ENCASED.

*AP TANK FARM HAS ONE LEAK DETECTION PIT FOR FOUR TANKS.

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Figure 5-4. Slurry Piping in the 241-AW Farm.

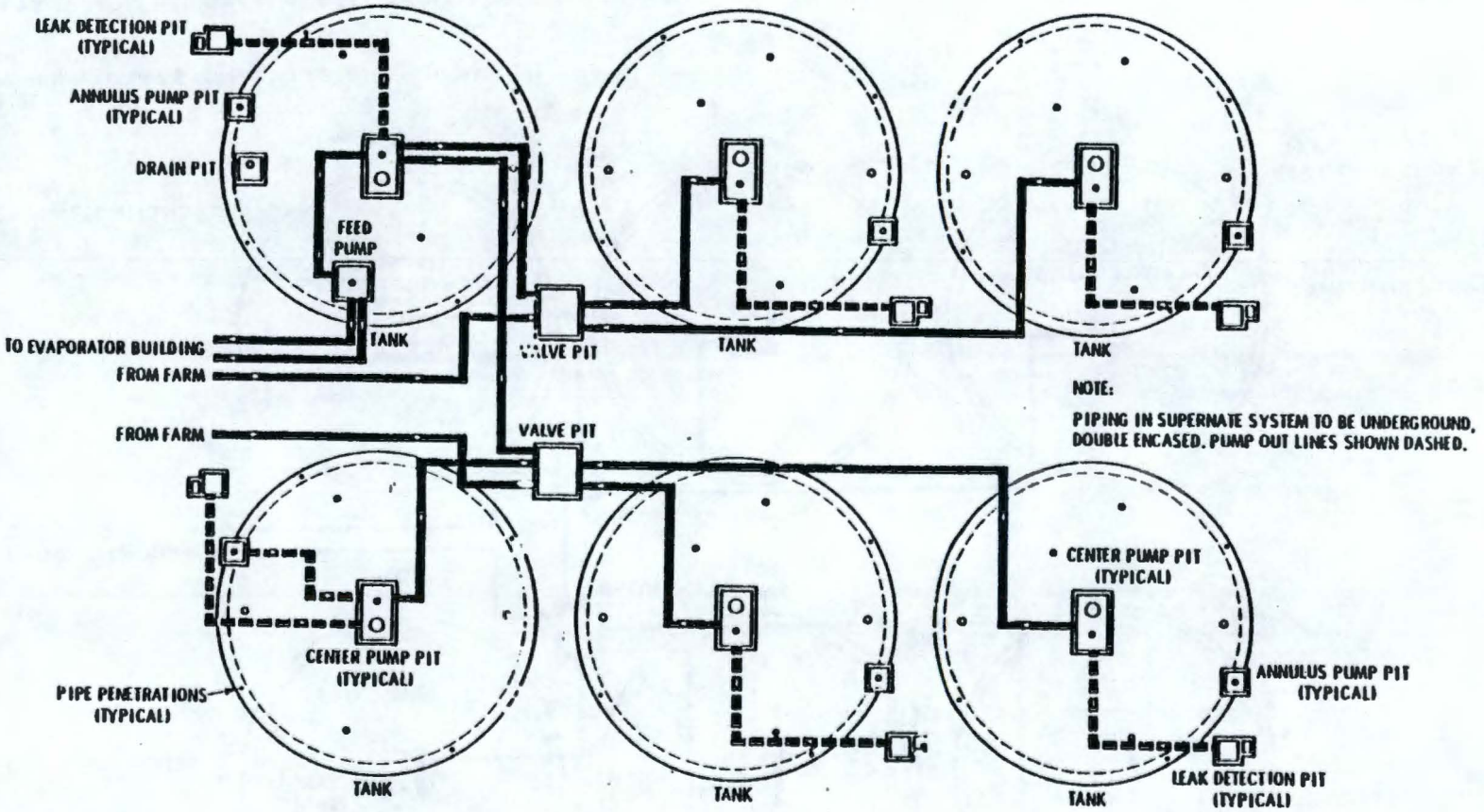


Figure 5-5. Supernatant Piping.

All process piping is full-penetration butt-welded using qualified procedures and certified welders. After fabrication, all welds are visually, dye-penetrant, and radiographically inspected by qualified personnel. Additionally, all piping is hydrostatically tested to 150% of the design pressure.

After pipe fabrication is completed and accepted, the piping is covered with a minimum of 2 1/2 ft of earth to provide radiation shielding.

5.4 TANK VENTILATION SYSTEMS

The ventilation system for each tank farm (see fig. 5-6, 5-7, and 5-8 for typical installations) consists of two completely separate systems: (1) the primary tank ventilation system and (2) the annulus ventilation system.

The primary or K1 ventilation system removes vapors from the primary tank and maintains a negative internal tank pressure relative to atmospheric pressure. Below ground piping in AN, AP, and AW Tank Farms, and above ground piping in SY Tank Farm connects one primary riser from each tank to the tank farms primary exhaust system.

Each primary exhaust system typically consists of a de-entrainment pad to remove contained moisture; a heater to prevent condensation on the filters; a prefilter; two high-efficiency particulate air (HEPA) filters in series; a fan; and an exhaust stack with a flow measuring device, record sampler, and CAM. The primary exhaust system in SY Tank Farm has one moisture separator, heater, filter bank and fan. The primary exhaust systems in AN, AP, and AW Tank Farms each have two de-entrainers (one in service, the other in standby), and two heater, filter bank, and fan subsystems (one in service, the other in standby).

The annulus or K2 ventilation system is used to cool the tanks, minimize moisture condensation in the annular space, and serve as a sensitive method of detecting leakage of radioactive materials from the primary tank. An air inlet unit to each tank annulus has a prefilter, a HEPA-filter, and manual butterfly valve. Outside air is supplied through pipes located inside the tank annulus and embedded in the insulating concrete layer beneath the primary tank bottom. The SY Tank Farm has four air supply lines per tank while AN, AP, and AW Tank Farms each have eight air supply lines per tank. From the center of the insulating concrete, the air flows radially outward to the annulus through slots provided in the insulating concrete against the bottom of the primary tank.

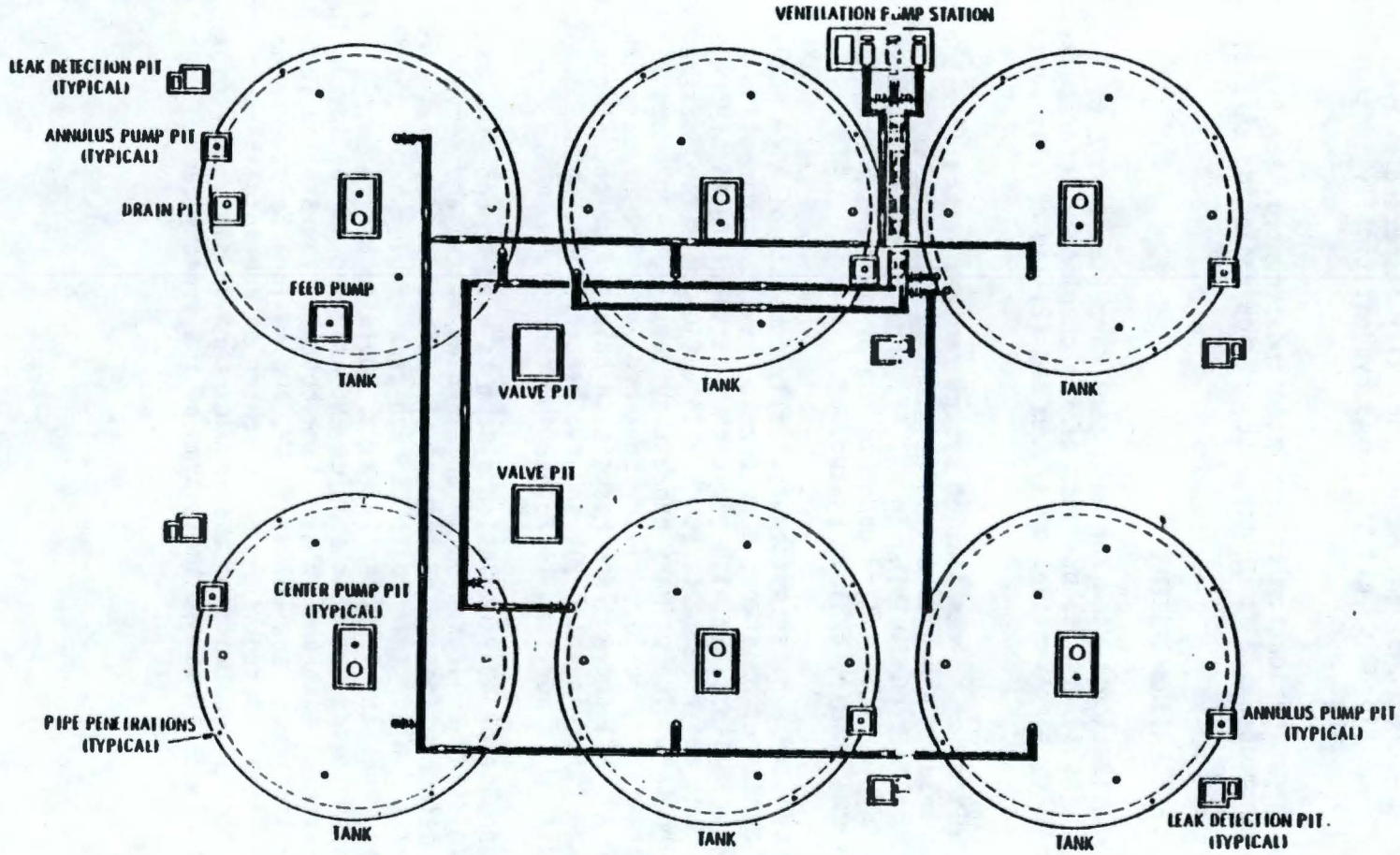
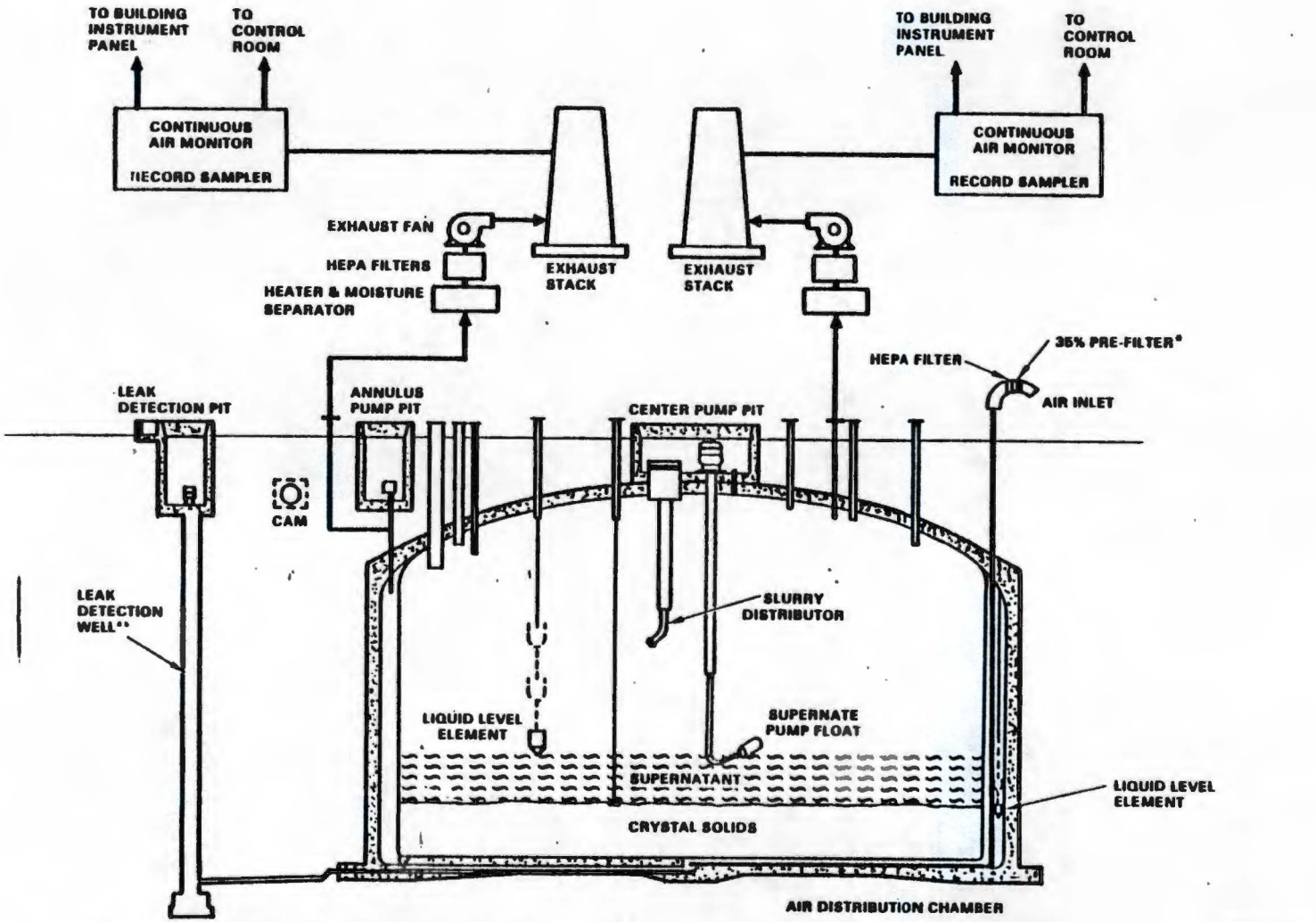


Figure 5-6. Tank Farm Ventilation System.



*AP TANK FARM HAS HEATERS ON INTAKE, FOUR INLET STATIONS FOR EIGHT TANKS
**AP HAS TWO LEAK DETECTION WELLS, ONE WELL FOR FOUR TANKS

Figure 5-7. Tank Ventilation Details.

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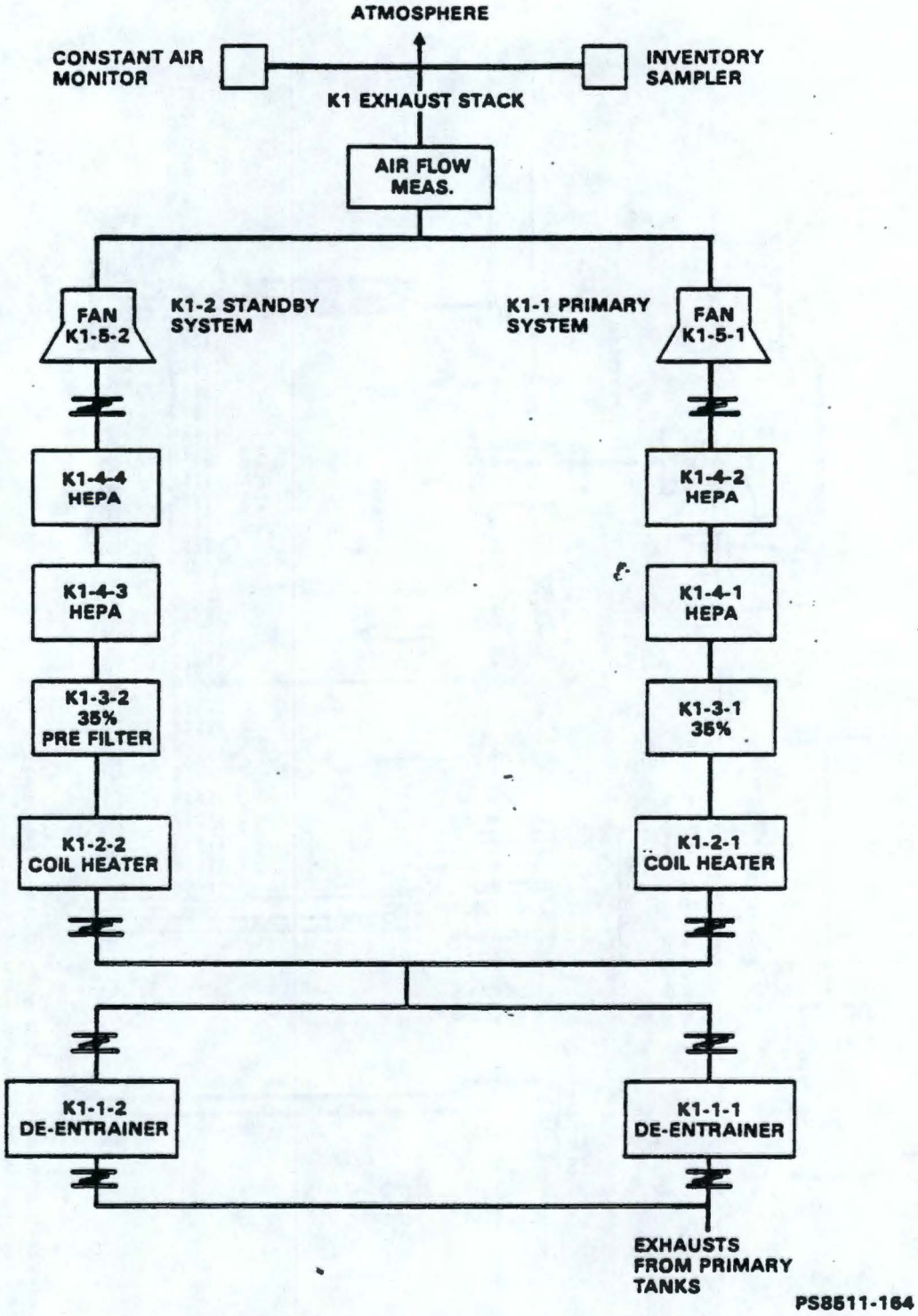

Figure 5-8. Typical Primary Tank Exhaust System.

The annulus exhaust piping in AN, AP, and AW Tank Farms is below ground and four risers from each tank are piped to a single header from that tank. The annulus exhaust piping in SY Tank Farm is above ground and one riser from each tank is piped to one header from that tank. One continuous air monitor is installed on the annulus exhaust header from each DS tank to detect airborne radioactive particles. A butterfly valve is installed in the annulus exhaust header from each DS tank for flow balancing.

The annulus exhaust system in each of the DS tank farms typically consists of a moisture separator (except AP Tank Farm), heater, prefilter (SY Tank Farm only), two HEPA filters in series, fan and an exhaust stack with a flow measuring device, record sampler, and CAM. In SY Tank Farm, there is one annulus exhaust system for all three tanks. In AN and AW Tank Farms, there are two annulus exhaust moisture separator, heater, filter bank, and fan systems that operate simultaneously and are connected to three or four tanks each. A butterfly valve in the AN and AW annulus exhaust piping permits the flow from all tanks in the farm to be routed to either of that farm's annulus exhaust systems.

In AP Tank Farm, there are two annulus exhaust heater, filter bank and fan systems that alternate in operation and are each connected to all eight AP tanks. The annulus exhaust fan for all DS tank farms is shutdown if leakage occurs to prevent moisture release into the system.

5.5 INSTRUMENTATION AND ALARM SYSTEMS

Instrumentation and alarm systems for each tank are provided to monitor operating parameters such as liquid level, temperature, leak detection, pressure, and area radiation levels (fig. 5-8 and 5-9). All readouts are at a local instrument building in each tank farm, and/or a nearby continuously manned facility.

Each tank is equipped with an automatic liquid-level gauge. The gauge is located on a primary riser and consists of a plummet suspended on a tape, reel tape, sight glass, control box, air purge, and water-flush sprays. In automatic operation, the plummet position is periodically adjusted until electrical continuity between the plummet and the liquid surface is achieved. The tape reading is automatically converted to an electrical signal for remote readout.

Sludge level detectors are installed to monitor the height of the solids level in the tanks. The device consists of a weight suspended by a predetermined length of cable from a capped riser. Readings are taken manually by removing the riser cap, attaching a calibrated tape to the sludge weight cable and lowering the weight to the solids surface.

Each tank is equipped with ~100 chromel-constantan thermocouples for monitoring temperatures throughout the tank structure (fig. 5-8). A single probe containing 18 thermocouples is used to monitor waste temperatures at various levels in the primary tank. The concrete dome and walls contain 24 thermocouples located at the outer surfaces. Twenty-four additional

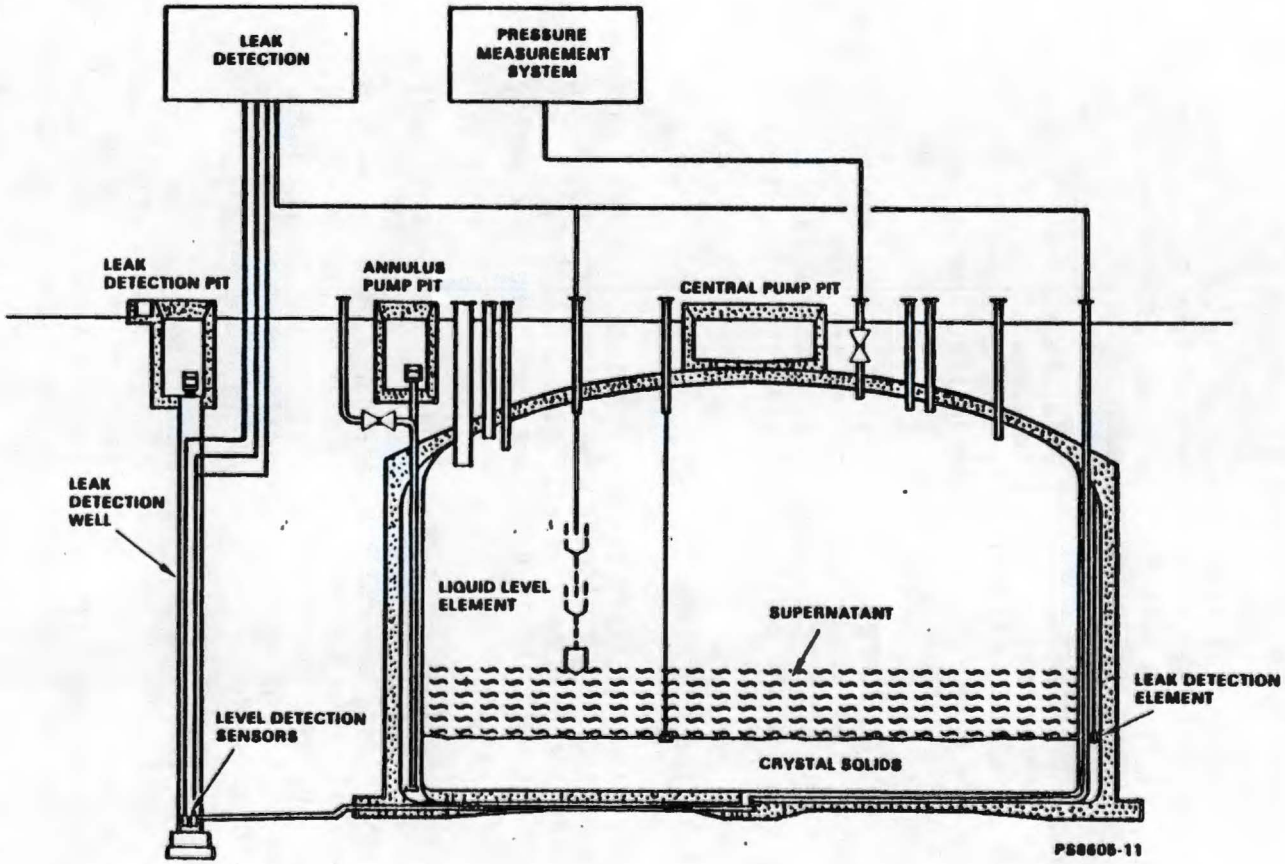

Figure 5-9. Tank Leak Detection System.

thermocouples are located on the interior next to the steel in the primary tank dome and the steel liner. Nine thermocouples are located in the concrete base slab. Twenty-four thermocouples are located in the insulating concrete layer next to the bottom of the primary tank. Two thermocouples are located near the bottom of the primary tank in the annulus. All thermocouples are strategically distributed, both vertically and radially, to achieve a representative sample of actual temperatures. All thermocouples read out in the instrument buildings and at the Computer Automated Surveillance System (CASS).

Entry to areas that may become contaminated but which are not normally areas of high radiation (such as service pits or leak detection pits) are controlled by Radiation Protection Technologists. Overall surveillance of radiation levels in the tank farms is provided by pole mounted area radiation monitors (ARMs). There are three ARMs in AW Tank Farm, four ARMs in AN Tank Farm, six ARMs in AP Tank Farm, and three ARMs in SY Tank Farm.

In addition to the leak detection provided by continuous air monitors, conductivity probes are installed in the annulus, process pits, and encasements. These areas are normally dry; the presence of any liquid would activate the probe to indicate a leak and sound an alarm in the instrument building.

Leak detection wells collect leakage from secondary tanks. The liquid level in each leak detection well is monitored using specific gravity and weight-factor detectors and associated instrumentation. A radiation detection element is installed adjacent to each leak detection well to monitor radiation levels in the wells, and a thermocouple is installed near the bottom of each well to monitor the temperature of the liquid in the well.

All alarms in each DS tank farm are annunicated locally and/or in the tank farm instrument building, and as an individual or common alarm at the continuously manned 242-A or 242-S facilities. Some DS tank farm alarms are annunciated at the CASS.

Specific leak detection and radiation alarms are tied into shutdown circuits. The 200-E master pump shutdown circuit is a general interlock for all supernatant pumps in AN, AW, AP, AY, AZ Tank Farms, and slurry pump PB-2. The slurry pump shutdown is an interlock to shutdown the 242-A slurry pump PB-2 only. Table 5-1, which shows the shutdown interlocks for AP Farm, is an example of the shutdown logic.

Table 5-1 also shows which AP Farm alarms are tied into the 200 East Area System Loop (known as Gamewell). Gamewell is a redundant alarm system for pit leak detectors and ARMs. Gamewell alarms at 242-A and 242-S for 200 East and 200 West Areas, respectively, and on CASS.

The AP Tank Farm has a valve position monitoring and display system (VPMDS) that provides a continuous verification system of the position of process valves in AP valve pit and AW-02A central pump pit. The

Table 5-1. 241-AP Interlock Alarms and Shutdown.

	200E Complex tank farms master shutdown[b]	200E Area alarm system loop (Gamewell)	Slurry out pump PB-2 only shutdown
Annulus Pump Pit Leak		X	
Leak Detection Pump Pit Leak		X	
Central Pump Pit Leak	X	X	
AP Valve Pit Leak	X	X	
Flush Pit Leak	X	X	
Area Radiation Monitor High[a]	X	X	
Area Radiation Monitor Failure[a]	X	X	
Service Pit High Radiation	X		
SN-609/SN-610 Encasement Leak	X		
SL-509/SL-510 Encasement Leak			X
FP-1 Valve Open	X		
FL-1 Valve Open	X		
DR-1 Valve Open	X		
2 in. FL High Pressure in Flush Pit	X		
2 in. FL High Pressure in Valve Pit	X		
2 in. DR-712 Flow	X		
Master Shutdown Switch[b]	X		
Pump Pit 241-AP-02D Leak	X	X	

[a]Has time delay override in 242-A for preventative maintenance.
[b]200E Master Shutdown (shuts down all supernate pumps in 241-AN, AW, AY, AZ, and AP Tank Farms as well as slurry out pump PB-2).

microprocessor-based digital VPMDS uses limit switches on valve bodies and pressure switches between valves in jumpers to detect valve position, line pressurizations, misroutings and leaking valves. The VPMDS readouts are on graphic cathode ray tubes (CRTs) located in the 242-A Control Room and in 272-AW.

Many tank farm sensors are continuously monitored by the CASS system; a few are monitored on an hourly basis. Continuous monitors are maintained for the following variables:

- o CASS equipment (substation failures)
- o Leak detection pits (high radiation, high liquid level)
- o Tank pressure indicators (high and low pressure)
- o Annulus leak detectors
- o Exhaust systems
- o Radiation detection units (annulus exhaust, exhaust stacks, raw water line in service pit, area radiation monitors, and instrument building interior)
- o Process line encasement leak detectors, process pit leak detectors, clean out box leak detectors (if applicable)
- o Process line heat trace overtemperature.

5.6 PITS

The typical tank farm has two types of pits: process and non-process pits. The process pits include: valve pits, central pump pits, annulus pump pits, leak detection pump pits, and special purpose pits. The non-process pits include: flush pit, ventilation pits, and service pit. Process pits are constructed of reinforced concrete and have concrete coverblocks for shielding. The floors of process pits drain to tanks.

A central pump pit is located on top of three risers in the center of each tank. Central pump pits have two purposes: supernatant filling and removal, and slurry distribution. For supernatant removal, central pump pits are designed to house a deep-well turbine pump. These pits also have a slurry distributor which is used to direct slurry evenly in the tank.

An annulus pump pit is located over an annulus riser on each tank. Annulus pump pits are used for installing deep-well turbine pumps in the annulus in the event of a primary tank leak.

Leak detection wells are piped to a drainage grid in concrete foundation of each tank. In AN, AW, and SY Tank Farms there is one leak detection well for each tank. In AP Tank Farm, there are two leak detection wells, one each for four tanks.

Leak detection wells collect, and are monitored to detect, drainage from a secondary tank leak. A leak detection pump pit located over the well provides the capability for installation of a pump and recovering this drainage.

The leak-detection well may be ventilated through a vent line connected to the annulus ventilation system. An in-line ball valve may be opened should a leak detection well become contaminated and ventilation become necessary.

Valve pits contain the valved jumpers that connect the process pipelines from central pump pits in the farm to each other and to other facilities. In AN, AW, and SY Tank Farms, there are two valve pits each, and in AP Tank Farm there is one valve pit. The routing of waste between tanks and/or other facilities is determined by the positioning of these valves.

5.7 UTILITIES

5.7.1 General Systems

Electrical power, steam, water, and compressed air are supplied to tank farm facilities as needed for specific equipment or operations.

Electrical power is supplied via existing lines which serve tank farm facilities. Compressed air is provided to specific facilities by either a local compressor or by piping instrument air from the nearest existing source in the tank farms. Steam and water are obtained from existing supply lines in the tank farms.

Descriptions of utility systems for specific facilities are contained in manuals and supporting documents issued for the facility. Operating procedures may contain information related to utility systems. Also, the drawing index should be referred to for a specific tank farm or tank farm facility.

A description of emergency actions related to loss of utility systems is contained in RHO-MA-111.5, Emergency Plan - Tank Farms. In the event of the loss of power and/or HVAC, there is no detrimental effect from over heating for times[1] (several years) which are large relative to that for recovery.

5.7.2 Electrical: AW, and AN Farms

These farms obtain power from the AZ radial tap on general purpose area feeder C8-16. This feeder originates at the 251-AW substation. Should there be a fault at a point between the 251-W substation and the AZ radial and a point on C8-16, the line may be sectioned and service restored to the

system by backfeeding from one of the remaining three general purpose area feeders in the 200 East Area in a timely manner. Should there be fault at the AZ radial tap, power restoration cannot occur until the fault has been cleared; this can be accomplished in <4 h.

5.7.3 Electrical: SY Tank Farm

Normal power is supplied by the Bonneville system from existing 13.8 kV line C8-L4. Power is fed to the SY Tank Farm through the 242-S substation. There is no second line or emergency power available on an automatic switchover basis for this farm; however, an emergency generator can be hooked up at the substation in <4 h.

5.7.4 Electrical: AP Tank Farm

Electricity is supplied to AP Tank Farm from 13.8 kV line C8-L-6 feeding the 1,000 kVA T-1 transformer in the unit substation in the northwest corner of AP Tank Farm. In the event of a loss of electricity, no emergency backup is currently available, however an emergency generator or radial tap can be hooked up to the substation in <4 h.

5.9 REFERENCE

Allen G. K., Double-Shell Tank Heating Transfer Analysis, RHO-CD-939, Rockwell Hanford Operations (March 1980).

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6.0 PROCESS SYSTEM

6.1 DOUBLE-SHELL TANK STORAGE SYSTEM

This chapter describes the activities performed in a DS tank farm and addresses the features of the tank farm that allow those activities to be performed safely. For discussion, the activities performed in a double-shell tank farm have been divided into three categories: waste characterization, waste storage, and ventilation.

6.2 WASTE CHARACTERIZATION

The total inventory of waste in non-aging DS tanks as of June 1985 was 51,700 m^3 (table 6-1). This inventory was a mixture of concentrated wastes (that have been processed through the evaporator) and dilute waste. The range of chemical compositions of the waste contained in DS tanks is very wide and depends on the source and the degree to which it has been concentrated. Typical chemical constituents of DS slurry (a final concentration product) and complex concentrate (a final product of concentrating complexed waste) are given in table 6-2. The estimated radionuclide inventory for existing waste in DS tanks including 241-AY and AZ is presented in table 6-3. The estimated radionuclide inventory for the newly generated coating removal waste (supernatant and sludge) and other waste is discussed in the accident analysis of chapter 9.

6.3 STORAGE TANK PROCESS

The tank farm process can be briefly stated as receipt, concentration, and interim storage of radioactive solutions. A number of operations are performed with the ultimate goal of maintaining containment and minimizing the volume required for storage. A list of documents used in administratively controlling the tank farm process is available in the Tank Farm Document Control System Master Index.

6.3.1 Waste Transfer

Waste transfers are routinely made from the process facilities to tank farms, between tanks, and between tanks and other tank farm facilities during operation. The potential adverse conditions that can occur during a waste transfer are a leak from the transfer line or jumper, pressurization of the receiving tank, transfer of steam, and transfer of corrosive solutions.

All transfers within or to DS tanks are made through lines encased with either another pipe or a concrete encasement (exception: SN247 from 241-AX-B valve pit to 101-AN is direct buried and designated for 241-A and

Table 6-1. Non-Aging Waste Double-Shell Tank Inventory (June 1985).[1]

Farm	Volume (m^3)
241AN	25,200
241AP	0
241AW	18,100
241SY	8,400
TOTAL	51,700

Table 6-2. Typical Compositions of Double-Shell Slurry and Complex Concentrates.[2]

Double-shell slurry	
Component	M
$NaAlO_2$	3.44
NaOH	3.56
$NaNO_2$	5.41
$NaNO_3$	5.66
Na_2CO_3	0.13
Na_3PO_4	0.34
TOC[a] (g/L)	12.75
sp. gr.	1.89
Complex concentrates	
$NaAlO_2$	0.35
NaOH	1.1
$NaNO_2$	0.5
$NaNO_3$	4.1
Na_2CO_3	1.0
Na_2SO_4	0.1
Na_3PO_4	0.04
$Fe(OH)_3$	0.125
TOC[a] (g/L)	90.0

[a]Total organic carbon.

Table 6-3. Conservative Inventory Estimate of Existing Wastes to be Stored in Double-Shell Tanks (decayed to the end of 1990).(3)

Radionuclide	Curies
^{241}Am	3 E+04
^{243}Am	3 E+01
^{14}C	4 E+03
^{244}Cm	2 E+02
^{135}Cs	1 E+02
^{137}Cs	2 E+07 (7.4×10^{17} Bq)
^{129}I	4 E+01
^{63}Ni	4 E+04
^{237}Np	6 E+01
^{238}Pu	1 E+01
^{239}Pu	8 E+01
^{240}Pu	2 E+01
^{241}Pu	5 E+02
^{226}Ra	2 E-08
^{106}Ru	1 E+01
^{151}Sm	3 E+05
^{126}Sn	3 E+02
^{90}Sr	2 E+07 (3.4×10^{17} Bq)
^{99}Tc	3 E+04
^{230}Th	1 E-06
^{233}U	5 E-04
^{234}U	4 E-03
^{235}U	2 E+00
^{238}U	4 E+01
^{93}Zr	2 E+02

241-AX jet pumping). Leak detectors are installed so that a leak in the primary line or in pits that the transfer is routed through can be detected. Interlocks and alarm systems are present to shutdown the operation and alert personnel of the condition.

During transfers into DS tanks, there is a potential for the increase in specific volume of the tank vapor space to exceed the capability of the exhaust system when the temperature of the liquid being transferred is significantly higher than the tank temperature. The result is a decrease in vacuum in the tank. The tank vapor space pressure may increase to slightly above atmospheric pressure and create a potential for spread of contamination. Tank pressure is monitored continuously and alarms exist to alert operating personnel of a loss of vacuum. Administrative controls are in place to limit the temperature and rate of addition of waste transferred into DS tanks. Administrative controls are also in place to shut down the transfer if ventilation is lost in the tank farm receiving the transfer.

Many of the transfers made to the tank farms are made by steam jet which, when not operating correctly, can put steam through the transfer line. The piping in AW and AN is designed to withstand temperatures up to 340 °F service.(4,5) The 241-SY piping is designed for 330 °F service.(6) These design temperatures allow the pipeline to be subjected to 100 lb/in^2 saturated steam. In addition, each facility using steam jets has administrative controls to prevent transferring steam through the line.

A pumping system will be used to transfer PUREX decladding waste to the new AP Tank Farm thus eliminating the steam as a source of overpressurization.

6.3.2 Primary Tank Level Measurements

Liquid levels are routinely measured to perform material balances during transfers and for general surveillance. Maximum and minimum levels are established for each tank, based on the design characteristics (chapter 5). When making level measurements there is a potential for spread of contamination to the tank farm or personnel. The mechanisms used in DS tank farms for level measurement are designed to minimize this hazard.

Tank liquid level is routinely measured using an FIC* instrument which automatically senses liquid level using a conductivity probe. The FIC has a local readout in the field and transmits the reading to the CASS. The instrument seals the riser and an air purge to the instrument housing prevents contamination from migrating up to the cabinet.

*Food Instrument Corporation.

In AP, AW, and SY Tank Farms, liquid level may be manually measured using a manual tape. The manual tape is a conductivity probe that is manually lowered from a reel housing located on a riser until the probe touches liquid. Completion of the circuit is indicated by a portable ohmmeter. Manual tape housings, used in AP and AW farms, are enclosed to contain contamination; air purges to the instrument housing prevent contamination from migrating up to the enclosure. The AN Tank Farm does not have manual tapes.

Sludge levels are generally measured in the Sludge Measurement Port (SMP) risers. The SMP riser equipment consists of a screw cap with a fixed length of cable with a sludge weight hanging from it. The riser is opened, and the cable is disconnected from the cap and hooked onto a 50-ft reel tape. The sludge weight is then lowered for a slack tape measurement. After the measurement, the cable is reconnected to the riser cap and the cap is replaced on the riser. The tank vacuum provides the driving force to inhibit contamination from escaping from the riser while it is open. Procedural steps for this operation are designed to minimize the risk of contamination spread and personnel exposure.

6.3.3 Tank Sampling

Samples of a tank's contents are periodically required to prepare for, or determine the results of processing activities such as inter-tank transfers or concentration. The potential adverse conditions that can result from sampling are a spread of contamination and an excessive amount of personnel exposure. Sampling is performed by opening a riser and obtaining a sample using a weighted bottle on a string. The tank vacuum inhibits the spread of contamination. Procedural steps for this operation are designed to minimize the risk of contamination spread and personnel exposure.

6.3.4 Equipment Replacement

Failed equipment such as pumps or airlift circulators must be removed and replaced. During equipment removal, contamination spread and excessive personnel exposure are potential adverse conditions. Failed equipment is removed by removing the pit cover blocks and lifting the equipment from the tank using a crane. Contamination spread is controlled by spraying the equipment with a fixative and/or wrapping it in plastic as it is removed. The equipment is then packaged and transported in accordance with the applicable Safety Analysis Report for Packaging (SARP). Again, the tank vacuum inhibits contamination spread from the tank during this operation. The procedures used for removing equipment minimize personnel exposure and the risk of contamination spread.

6.3.5 Mixing

Tanks 102-AW, 102-AP, and 102-SY have unique systems for mixing their contents because they are the feed tanks for the 242-A evaporator, the Transportable Grout Facility (TGF), and the 242-S evaporator, respectively. Currently, there is no mixing capability in other DS tanks. Tank 107-AN has 22 non-operating airlift circulators.

Tank 102-AW and 102-SY each have two airlift circulators (one 24-in. and one 16-in. dia.) for mixing. The airlift circulators provide a potential for tank pressurization if the primary tank exhauster should shutdown. Shutdown of the airlift circulators, when the primary exhauster is down, is controlled administratively. The airlift circulators also provide a potential for contamination spread from the tank to a clean utility, namely the process air. To mitigate the potential of backflow, check valves are installed in the process-air line to the airlift circulators.

Tank 102-AP has a 150 hp mixing pump installed in the central 42-in. riser. It consists of a submersible multi-stage turbine pump with two 2.5-in.-dia. nozzles located ~1 ft above the tank bottom. Total flow through the pump is 2,700 gal/min. The pump assembly is held in place by a support column that extends up to the 42-in. riser. The entire assembly is rotated to generate a sweeping action to suspend solids. The design of the pump is inherently safe; no potential mode of failure would cause a breach of containment.

6.3.6 Interim Storage

During storage of waste in DS tanks the potential adverse condition is loss of containment. The tanks are designed (chapter 5) to rigorous dome load, temperature, and pressure specifications to provide a significant margin of safety in preventing loss of containment during the 50-yr design life. A number of systems continuously monitor the tank farm for loss of containment.

Area radiation probes located above ground in the tank farms are designed to detect an increase in dose rates above background level. The alarm setpoints are set at 5 mR/h above background at the probe. A remote alarm system to notify personnel and interlocks to shutdown equipment are in place.

Continuous Air Monitors located in the annulus exhaust header from each tank are designed to detect contamination from a leak in the primary tank. In addition, three sets of conductivity-probe leak detectors are located in the annulus to detect a leak. The annulus has pumping capability to remove liquid that would drain there during a leak. If the secondary tank leaks also, it will drain to the leak-detection well via the drainage grid on the tank's concrete foundation. The leak detection well has a radiation monitor and liquid-level instrumentation to indicate if such a leak occurs. The

liquid level in the leak detection well is maintained in such a range that the proper operation of the equipment can be verified and the occurrence of a leak from the secondary tank can be quickly seen through an increase in liquid level.

The chemical composition of the tank's contents is kept essentially non-corrosive with sodium hydroxide and sodium nitrite additions. These chemical additions are made to waste batches at the generating facility before they are transferred to the tank farm. During waste concentration through the evaporator there is a potential that the resulting slurry will not meet the operating specification composition requirements for the DS tanks. When this is of concern, waste streams to the evaporator are mixed so that the concentrated product will meet composition requirements. Another potential problem for concentrated waste is that a reaction may occur that would consume hydroxide or nitrite to the point that the corrosion rate may increase.

The AN, AW, AP, and SY Tank Farms are designed to handle non-boiling waste. Various boiling (or aging) waste problems such as elevated temperatures, high vapor production, and bumping cannot be adequately handled in these tank farms. Transfer of aging waste from the PUREX process tanks to the above tank farms is not possible since there are no direct transfer lines to these tanks. The heat content of waste which is designated for these tanks is determined, and administrative controls are utilized to prevent the transfer if it exceeds the heat specification for the tanks.

6.4 VENTILATION

The ventilation systems for AW, AN, AP, and SY Tank Farms consist of separate primary (K1) and annulus (K2) ventilation systems. The potential adverse conditions for the K1 system are of more consequence than for the K2 system because the K2 system does not ventilate a normally contaminated area. However, if the annulus should become contaminated due to a leak or other mechanism, uncontrolled releases to the environment will be prevented because the K2 system is similar in design to the K1 system.

During normal operation, the K1 vent system maintains a vacuum in the primary tank and prevents contamination spread. The adverse conditions that can occur during operation of the vent system are a breach of HEPA filtration, high differential pressure across the HEPA filters, excessive dose rate from the filters, moisture buildup on the filters, high differential pressure across the de-entrainer, and failure of the exhaust fan or stack monitoring equipment.

HEPA filters are required to have an efficiency of 99.97% of 0.3 micron diameter particles.(7) Once installed, a HEPA filter package must pass a leak test to remove 99.95% of the particles with a mean particle size of 0.5 microns.(8)

High differential pressure on HEPA filters is caused by a buildup of particles or moisture. Each DS tank farm primary vent system has a moisture de-entrainer and an air heater are installed upstream of the HEPA filters to prevent moisture from plugging the filters. The de-entrainer removes water droplets from the exhaust air stream. Backup de-entrainers are available in AW, AN, and AP if the one in use becomes plugged or fails. The result of de-entrainer failure or inefficient operation is usually not critical to maintaining containment. The HEPA filters will still effectively decontaminate the exhaust stream, but their lifetime is usually shortened. The air heater reduces the humidity of the air after it passes through the de-entrainer. Each DS tank farm primary vent system has an air heater upstream of the HEPA filters. A minimum differential temperature across the heater is specified to prevent rapid buildup of moisture on the HEPA filters.

Radionuclide collection on the HEPA filters creates a radiation field in the vicinity of the filter bank. Administrative controls exist to prevent this field from exceeding 200 mR/h. The AP Tank Farm has concrete shielding walls surrounding the primary vent system to provide additional protection (see chapter 8).

The primary exhaust systems in AN, AP, and AW Tank Farms each have two subsystems consisting of heater, two HEPA filters in series, and fan. One subsystem is in operation while the other is in standby. Detection of high differential pressure (DP) across the first HEPA filter annunciates an alarm indicating service is required. Detection of low DP across the second HEPA filter in the operating subsystem is electrically interlocked to switch over to the standby subsystem.

The primary exhaust system in SY Tank Farm has one heater, two HEPA filters in series, and one fan. Detection of high DP aross the first HEPA filter annunciates an alarm indicating service is required. Detection of low DP across the second HEPA filter is electrically interlocked to shut down the fan.

The exhaust-stack monitoring systems each have a continuous monitor and a proportional record sampler. The CAM samples the exhaust stream and is interlocked to shutdown the exhaust fan when high radiation is detected. The exhauster CAMs also have remote alarms for device failure. The record sampler accumulates the particles from a portion of the exhaust stream. If there is an airborne contamination release, the record sample is used to determine the amount released. These two systems are independent so that failure of one will leave the other in service. Prompt repair of failed-air monitoring equipment is administratively controlled.

A loss of power to the ventilation system will cause shutdown of the exhaust fans and monitoring equipment until power can be restored. There are no backup power supplies for the ventilation systems in AN, AW, AP, or SY Tank Farms. During a loss of power, the tank vapor space pressure will

equalize with atmospheric pressure. Airflow during tank "breathing" would travel along the path of least resistance. A loss of instrument air to the tank farm will cause a loss of the tank vapor space pressure transmitters and associated alarms. An analysis of the consequences of a loss of power incident is presented in chapter 9, section 9.4.

6.5 REFERENCES

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2. Rockwell, Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the Hanford Defense Waste - Environmental Impact Statement, RHO-RE-ST-30 P, Rockwell Hanford Operations, Richland, Washington (May 1980) pp. 2-12.

3. Ibid, pp. 2-16.

4. Kaiser Engineers, Construction Specification for the 241-AW Tank Farm Completion Project B-120, B-120-C7, Kaiser Engineers, Hanford, Richland, Washington.

5. Kaiser Engineers, Construction Specification for the 241-AW Tank Farm Completion Project B-130, B-130-C7, Kaiser Engineers, Hanford, Richland, Washington.

6. Kaiser Engineers, Construction Specification for 241-SY Tank Farm Project B-101, B-101-C3, Kaiser Engineers, Hanford, Richland, Washington.

7. ANSI, Testing of Nuclear Air-Cleaning Systems, ANSI N510-1980, American National Standards Institute, New York, New York.

8. Rockwell, Environmental Protection Manual, RHO-MA-139, Rockwell Hanford Operations, Richland, Washington (June 1981).

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7.0 WASTE MANAGEMENT AND CONFINEMENT

The general waste management objectives for the operation of the DS Tank Farm facilities are: (1) to protect people and the environment from radioactive materials and other hazardous substances, and (2) to ensure compliance with DOE and other pertinent federal, state, and local laws, rules, or regulations.

7.1 NONRADIOACTIVE WASTES

The compositions of the waste streams are controlled by their process specifications at the source facilities. Nonradioactive liquid and vapor constituents from these streams are required to comply with the release standards in RHO-MA-139.[1] Nonradioactive liquid waste streams may include sanitary and chemical wastes. The sanitary waste is disposed of in accordance with Benton County Health Department guidelines. Chemical solutions used for decontamination are collected and eventually discharged in accordance with applicable mixed waste disposal regulations. Nonradioactive solid waste is composed of common trash (e.g., paper) and is compacted and disposed of in the Hanford Site sanitary landfill (600 Area). No chemical or hazardous waste streams are generated by DS Tank Farm Operations.

7.2 RADIOACTIVE WASTES

Some radioactive wastes are generated during the routine operation of the Tank Farms. The wastes, in airborne, liquid and solid forms, are discussed below.

Airborne radioactive effluents (primarily fission products) result from ventilation of both the tanks and the tank annuli. Tank ventilation is provided by a filtered exhaust system that also removes moisture from the offgas. The annuli ventilation systems provide filters on the air inlets and outlets from the tank annuli, even though the air in the annuli is not normally contaminated. The filtered air is released through the Tank Farm stacks. The ventilation systems are described in detail in chapters 5 and 6.

7.2.1 Gaseous Effluents

The airborne effluent treatment system is described in detail in chapters 5 and 6. The nominal flow through the primary tank exhaust stack is 1,000 ft^3/min. When either the K1-1 or K1-2 exhauster is operating for AW, AN, or AP Tank Farms, an average vacuum of 1 in. to 4 in. w.g. (per tank) is created. The SY Farm (consists of only three DS tanks) does not have a backup exhauster.

The annulus ventilation system has a similar effluent treatment and monitoring system to that of the primary tank but it is not a part of the confinement system for the DS Tank Farms. Flow through the annulus system stack is based on a maximum of 800 ft^3/min air flow through each tank annulus. All DS Tank Farms have provisions for HEPA filtering the inlet air prior to entry to each annulus except for SY, which only has a prefilter.

The primary tank air effluent treatment consist of a de-entrainer, prefilter, and two HEPA filters in series. The efficiency for moisture removal of the de-entrainer is 90%. The minimum efficiency for particulates (0.3 microns and larger) is 35%, 99.97%, and 99.9% for the above systems, respectively. The decontamination factor (DF) is therefore at least 3.3×10^6 and is assumed to be 5×10^7. Under the listed conditions for each tank, i.e., cold air infiltration, 110 °F saturated air exhausted at 100 cfm for each tank, one can compute that the evaporation rate is 440 gal/wk. This moisture could contains 1.7×10^{-3} Ci/gal of ^{137}Cs and the same concentration of ^{90}Sr for a total activity concentration of 3.4×10^{-3} Ci/gal (assuming a partitioning coefficient of 10^3 between the liquid and moisture) for existing DSS. The potential effluent concentration at the stack exhaust under these conditions is 5.3×10^{-13} $\mu Ci/c^3$ for ^{137}Cs or ^{90}Sr, which is well below the concentration guidelines[1] shown in table 7-1, for an assumed DF of 5×10^7 (about 10 times higher if the DF is 3.3×10^6). The ^{241}Am concentration of the stack exit is estimated to be about 8×10^{-16} $\mu Ci/c^3$.

Table 7-1. Department of Energy Airborne Concentration Guidelines for Selected Radionuclides (RHO-MA-139).[1]

Effluent	Table I (μCi/mL)	Table II (μCi/mL)
^{3}H[a]	5 E-06	2 E-07
^{14}C[a]	4 E-06	1 E-07
^{85}Kr[a]	1 E-05	3 E-07
^{90}Sr (beta)	1 E-09	3 E-11
^{129}I (beta)	8 E-10	2 E-11
^{137}Cs (beta)	6 E-08	2 E-09
^{238}U (alpha)	7 E-11	3 E-11
^{239}Pu (alpha)	2 E-12	6 E-14
^{241}Am (alpha)	6 E-12	2 E-13

[a]H-3, C-14 and Kr-85 are not included in total beta values because they are considered to be "special cases." If they are present, these radionuclides are measured and reported separately.

If the DF for the de-entrainer or filters decreases or if the concentration in the liquid or vapor increases, the effluent concentration will increase but it is not expected to exceed the ALARA guidelines of 1/10 Table II. The failure of the HEPA system results in diversion to the backup exhaust system except for the SY Tank Farm. A portable exhauster can be used if required during filter replacement.

A review of the measured annual average concentrations for DS Tank Farm facilities reveal no examples that the values in table 7-1 were exceeded. Table 7-2 presents the calendar year 1984 annual average concentrations.(11)

The dose offsite to the average individual from the entire Hanford Site operations has been estimated to be about 0.01 mrem/yr.(12) Dose contributions offsite from the normal operations of the tank facilities would be undetectable.

Failures of any of the filters in the ventilation systems are minimized by design features of the system, by the quality assurance and quality control applied to the design, purchase and installation of the filters, and by the regular HEPA filter efficiency tests that monitor the performance of the filters.

In addition to the design features and the routine testing program, the airborne releases are controlled by operating procedures that assure the effluents remain within the regulatory limits at the site boundary. This assurance is provided by controlling the effluent concentrations at the point of release (normally the top of the exhaust stack).

- Annual average concentrations shall not exceed the concentrations listed in Table I of RHO-MA-139(1) for SY and Table II for AN, AW, and AP Tank Farms.

- The 168 h average concentrations shall not exceed four times the concentrations listed in Table II of RHO-MA-139 for AN, AW, AP, and Table I for SY Tank Farms.

Table 7-2. Average Annual Gaseous Effluent Concentrations (reference 11) (μCi/cc) and Total Annual Released Activity (Ci) for Calendar Year 1984.

Source	Total beta concentration (μCi/cc)	Total beta activity (Ci)
Primary tank exhausts		
241AW (296-A-27)	2×10^{-11}[a]	2×10^{-4}
241AN (296-A-29)	3×10^{-13}	3×10^{-6}
241SY (296-P-23)	1×10^{-13}	2×10^{-6}

[a]Principle beta emitter identified as ^{125m}Te, which has an annual limit of 10^{-7} μCi/cc.

- The instantaneous concentrations shall not exceed 5,000 times the concentrations listed in Table II of RHO-MA-139.

A filter system failure could result in the release of effluents in excess of the instantaneous concentration controls listed above. If the controls are exceeded, RHO-MA-139 requires the violation to be handled per RHO-MA-100, section 8-12.[13] The air monitoring equipment provides alarms so that diversion of the airborne effluent stream to the backup filter system can be made (except where a portable exhauster is available). Readouts of system status are provided in the Tank Farm control room.

7.2.2 Liquid Effluents

There are no liquid effluents discharged to the environment from the normal operation of DS tanks. Accidental discharges of liquid waste and vapors are discussed in chapter 9.

7.2.3 Solid Wastes

Solid wastes, such as contaminated equipment, pipes, and HEPA filters, are buried in accordance with RHO-MA-222.[14]

7.3 EVALUATION

This section provides a brief discussion of the significance of the potential environmental impacts described above.

7.3.1 Releases and Acceptability

For airborne effluents, the concentration of radionuclides released during normal operation is below the release limit values.[1] The calculated releases of gaseous effluents for the accident cases show that for credible accidents, the projected airborne releases at the site boundary would be within regulatory guidelines (see chapter 9). The accidental releases exceed the concentration limit guidelines and contaminate the ground in proportion to the quantity which is assumed to be released.

7.3.2 Monitoring and Sampling Systems

Radiation detection equipment is used in service pits, and leak detection pits. Alarms and interlocks operate automatically when radiation is detected by the monitoring equipment. Any fans or pumps in the leaking system would be shut down by the action of these interlocks. Additional conductivity probes are installed in the annulus, process pits, and encasements to detect and alarm if liquid is present in these normally dry

portions of the systems. Overall site surveillance also covers the Tank Farm area, monitoring the airborne and liquid effluents. Records of the monthly and annual release rates are maintained.

7.3.3 Confinement Assurance

Confinement of the contaminated effluents is provided by engineering design, filter systems with duplicate standby filter banks or portable exhausters, equipment maintenance and calibration, monitoring programs, automatic diversion systems, quality control, and formal operating procedures. The system design features are assumed to be adequate to confine the liquid and airborne effluents projected for the accident cases.

7.4 REFERENCES

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8.0 HEALTH PROTECTION

The Rockwell Safety Program, which includes the areas of radiation protection, industrial hygiene and safety, and environmental protection (chapter 7.0) is the subject of this chapter. The diverse elements of this program are focused on minimizing the exposure of the public, employees, and the environment to radioactive and hazardous materials by considering all potentially significant sources within the scope of this safety analysis.

8.1 INTRODUCTION

In support of health/radiation protection, Rockwell management has developed a policy(1) which ensures that occupational and population exposures from Rockwell activities will be maintained ALARA. This policy is implemented by an ALARA program(2) which covers all phases of plant activities: plant design, operating techniques and procedures, radiation surveillance and control programs, training, decontamination and decommissioning, skin contaminations, emergency warning and response procedures and training, hazardous materials handling, and hazardous waste disposal.

The ALARA program is implemented in accordance with the DOE orders and manual chapters: DOE Order 5480.1A, chapter XI, "Requirements for Radiation Protection;"(3) DOE Order 5484.1, chapter I, "Notification of Occurrences;"(4) DOE Order 5481.1, chapter II, "Investigation Requirements;"(5) and DOE Order 5484.1, chapter III, "Effluent and Environmental Monitoring Program Requirements."(6) Additional guidance is provided in reference 7.

The ALARA Program requires that a Facility ALARA Plan (FAP) for each facility be formalized and improved to meet the requirements of the ALARA concept. Under this program, each operating facility which could potentially expose personnel to radiation establishes annual ALARA reduction goals.

The 1985 ALARA goals for all tank farms were approved and transmitted to the DOE-RL on December 18, 1984.(8)

8.2 SAFETY MANAGEMENT AND ORGANIZATION

This section provides a brief description of the responsibilities of Rockwell organizations and personnel which contribute to the Rockwell Safety Program. The organizational structure is shown in figure 8-1. Although this structure is current at the time of SAR preparation, and is subject to change, such change will not affect the safety aspects of this SAR. Any organizational changes will be incorporated in future revisions.

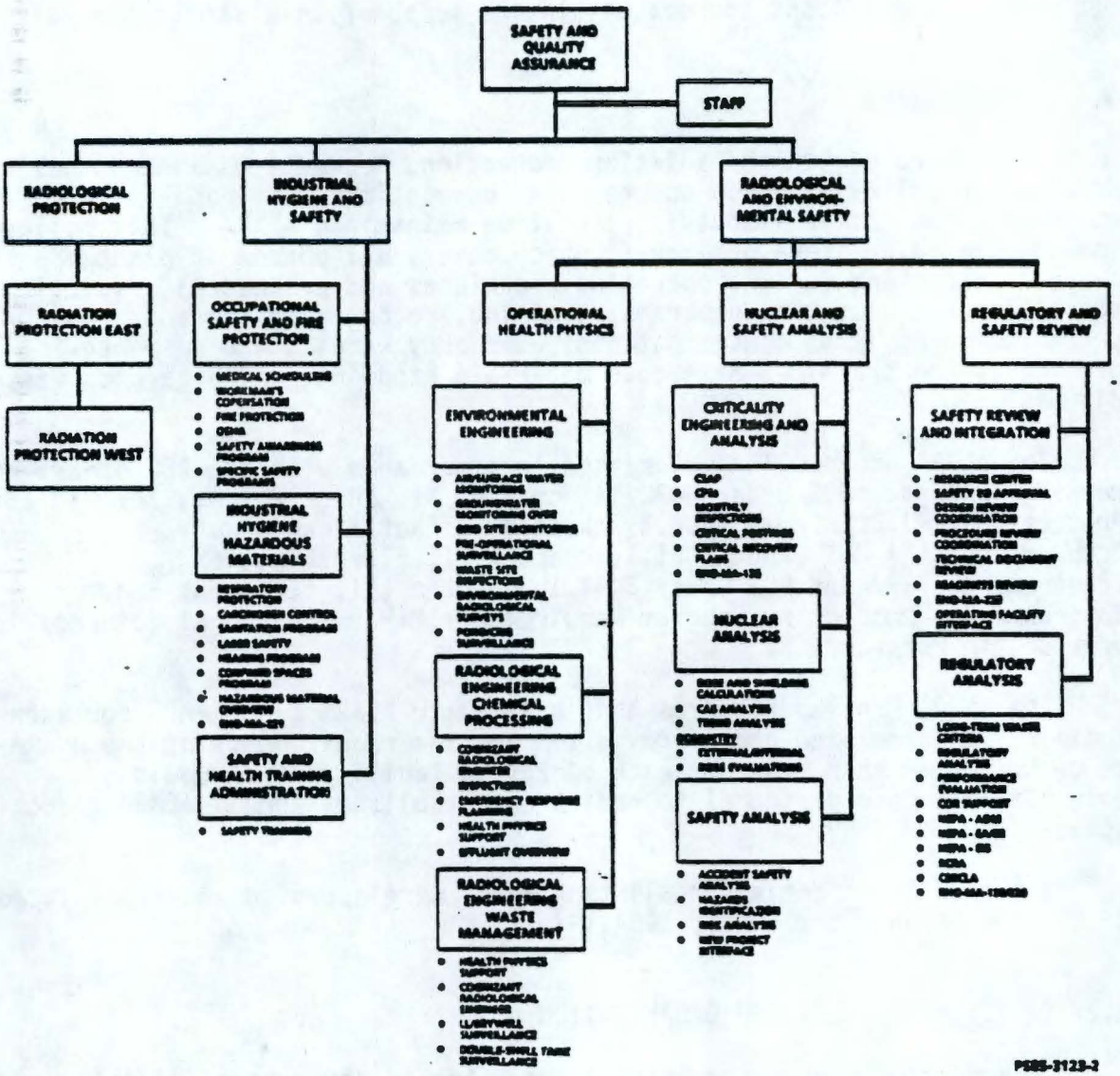

Figure 8-1. Safety and Quality Assurance.

8.2.1 Safety and Quality Assurance (S&QA) Function

The S&QA function is responsible for supplying technical assistance and advice to management in matters concerning the Rockwell S&QA policies. To accomplish this task, S&QA interprets applicable requirements for federal, state, and local governments. The results are published in S&QA assurance manuals containing criteria, standards, guidelines, procedures, and descriptions of specific programs. The S&QA function is comprised of six departments reporting to the Director of S&QA. The director, S&QA, supervises and directs all Rockwell safety programs and reports to the Vice President and General Manager. The three safety departments will be addressed here; the three Quality Assurance (QA) departments are discussed in chapter 12.

8.2.1.1 Radiological Protection Department. The Radiological Protection Department is responsible for providing radiation monitoring services to all facilities and areas operated or controlled by Rockwell. The department has two groups. Radiation Protection (RP) east and west. One unit in each area is devoted to radiation monitoring in tank farms. Group personnel include Radiological Protection Technologists (RPTs), unit managers, and other technical and support personnel. The responsibility of the Radiological Protection Department includes air sampling/monitoring, radiation and contamination control/surveys, stack sampling, monitoring personnel dosimetry, and radiological documentation, reviews of proposed operational changes and modifications, and preparation of radiation work permits.

8.2.1.2 Radiological and Environmental Safety Department. The Radiological and Environmental Safety (R&ES) Department exercises broad authority in implementing the Radiological Safety program, environmental monitoring and analysis, safety and regulatory analysis, and design document reviews.

Work is accomplished through three groups. Operational Health Physics Group has three units: (1) Environmental Engineering, (2) Radiological Engineering, Chemical Processing, and (3) Radiological Engineering, Waste Management. The Nuclear and Safety Analysis Group has three units: (1) Criticality Engineering and Analysis, (2) Nuclear Analysis, and (3) Safety Analysis. Regulatory and Safety Review Group has two units: (1) Safety Review and Integration and (2) Regulatory Analysis.

The Operational Health Physics Group fulfills the following responsibilities which include but are not limited to the following: reviewing process and operational changes and modifications, providing cognizant radiological engineers for operating facilities, providing radiological and criticality safety training expertise, providing necessary technical input to establish Rockwell personnel exposure guidelines, auditing radiation practices for compliance with DOE operational requirements and Rockwell criteria, developing new radiation protection programs and updates existing programs as part of the general ALARA program, and providing tank farm surveillance.

The Nuclear and Safety Analysis Group provides dose and shielding calculations, performs trend analyses, prepares criticality safety analyses and specifications, prepares facility SARs, prepares hazards identification and risk analysis, and performs dosimetry and dose evaluations.

The Regulatory and Safety Review Group coordinates design reviews, develops criteria and standards, leads RCRA/CERCLA compliance activities, leads NEPA compliance including EIS coordination, prepares and maintains RHO-MA-139 and 220, and coordinates functional reviews of designs and technical documents.

8.2.1.3 Industrial Hygiene and Safety Department. The Industrial Hygiene and Safety (IH&S) Department has the administrative responsibility for six major areas of the Rockwell Safety Program: industrial hygiene, respiratory protection, general and industrial safety, hazardous waste, fire protection engineering services, and safety training.

This department provides technical service support and assistance to line management in complying with nonradiological requirements of the Safety Program, which includes: operational appraisals, facility inspections, hazardous materials control and disposal, respiratory protection implementation and administration, accident investigation/reporting, and safety training.

8.2.2 Safety Committees

8.2.2.1 Executive Safety Committee. The Executive Safety Committee provides top-level management support and guidance by approving safety policies, goals, and objectives; it also evaluates safety performance. Membership includes the Vice President and General Manager (Chairman), the Director of S&QA (Secretary), Functional Directors, and key Program Directors. Department Managers within the S&QA function, and the chairman of the Accident Prevention Council serve as advisors to the committee.

8.2.2.2 Safety Review Committees. The safety review committees were established to implement part of the Safety Review Program. These committees, composed of senior staff personnel and technical experts, provide independent review of all Safety Analysis Reports, Criticality Safety Analysis Reports, and Safety Analysis Reports for Packing.

8.2.3 Communications and Manuals

Radiochemical processing has been performed at Hanford for over 40 yr. This long experience has resulted in detailed, written radiation work procedures and protection standards that comply with the guidelines of reference 2 for maintaining exposures ALARA. The procedures and standards are documented in references 9-15.

Constant updating of existing procedures is conducted and new procedures are initiated when necessary. Standard operating procedures, plant operating procedures, and job performance aids are developed to assure that the operators can complete all assignments concerned with the processing, collection, containment, storage, and transport of radioactive materials without undue risks of personnel exposure or release of contaminants to the environment.

8.2.4 Audits and Inspections

Audits or comprehensive appraisals are performed jointly by auditing groups in Rockwell to provide management with evaluation of facilities.

Joint audits are established at the direction of the Joint Audit Committee composed of a representative of each auditing organization in accordance with RHO-MA-100.(1)

In addition to the joint audits, each functional organization is required to perform inspections of Rockwell facilities on a regular basis. Inspections informally provide management information on the current facility and operational safety conditions and the effect of these conditions on personnel and the environment.

8.3 TRAINING

8.3.1 General

Rockwell is responsible for the training of their employees in safe work practices, for controlling the hazards involved in their jobs, and for incorporating required safety topics/training into New Employee Orientation, and other training courses conducted under their cognizance.(13)

The IH&S Department is responsible for periodic issuance of general and special meeting topics and additional materials to managers for use in general safety meetings. Presentation of this material does not relieve managers of the responsibility for conducting such additional meetings as may be necessary to ensure that employees have adequate information pertaining to specific job procedures and job hazards.

The IH&S Department is responsible for the identification of special DOE industrial safety training requirements and for the dissemination of safety training materials and/or information on affected organizations to ensure compliance with such requirements.

8.3.2 Tank Farms Personnel

All personnel assigned to or performing work in tank farms complete all required safety training as designated by their manager. Managers of employees who are exposed to potential radiation hazards (radiation workers) identify and document specific radiological training/retraining needs of each employee.

Radiation Monitoring East or West Tank Farms Unit is responsible for providing facility orientation for all employees assigned to or performing work in tank farms. The IH&S Department is responsible for providing radiation safety training and respirator fit/use.

In addition to the above, responsible managers provide and document appropriate job-specific training for radiation workers as they are assigned to physically handle radioactive materials or directly supervise the handling of radioactive materials.[12]

8.3.2.1 Tank Farm Operating Personnel. Rockwell has adopted a three-phase training program for radiochemical operating personnel. The three courses of study are General Radiochemical Operation, Plant Specific, and Job Specific training. The General Radiochemical Operation phase of this program includes training for tank farm operators.

This first phase of training provides the most in-depth training the new operator will receive on radiation safety. The course outline is contained in reference 15.

The facility specific training phase of this program is concerned with operators assigned to the tank farm facility. It is designed to familiarize the operator with radiological conditions and control measures specific to tank farms.

Job specific training is based on each task performed in tank farms having an individual certification package developed to familiarize the new operator with the hazards which potentially may occur during the operation. Early indicators of potentially hazardous conditions and corrective measures to eliminate them are covered for the various processes. Contamination control practices are also reviewed for the routine tasks.

Each of the three phases of this training program has a test which is administered at the completion of the study courses.

8.3.2.2 Radiation Protection Personnel - Tank Farms. Rockwell has established a Radiation Protection Technologist certification program for which newly hired RPT personnel must qualify. Each employee must successfully complete the training curriculum required in his present job classification and have a current evaluation prepared by the Unit Manager and approved by the Group Manager.[14]

8.4 HEALTH PHYSICS PROGRAM

8.4.1 Personnel Dose Assessment - Dosimetry

The DOE regulatory limits for occupational exposure are given in table 8-1. Additional information on the occupational dose limits and guidelines can be found in references 3 and 12.

Rockwell has established more conservative occupational dose guidelines to ensure that the DOE regulatory limits are not exceeded. These are presented in table 8-2. Special approvals are required for a worker to exceed the Rockwell occupational dose guidelines of table 8-2. Each approval must be in the form of a memorandum from the cognizant manager to the manager of Radiological Protection or his designee. It must state the increase to be authorized, best-dose estimate of work to be done, and the basis for authorizing the increase, including specific measures to ensure that the accumulated dose is ALARA. Approving management must obtain the concurring signature of the manager of Radiological Protection Department on this memorandum before allowing guidelines to be exceeded.

The N&SA Group maintains the radiation dosimetry program applicable to all Rockwell personnel and visitors. The dosimetry program includes external and internal dosimetry and provisions for refined employee dose estimation in the event of an accident involving radioactive materials.(12)

The total occupational dose includes external dose and dose contributed by radionuclides deposited in the body as a consequence of work with radioactive materials. Natural background radiation, diagnostic and therapeutic exposure for medical purposes, and internal dose from naturally occurring radionuclides is not included.

8.4.1.1 External Dosimetry. The Hanford Multipurpose Thermoluminescent Dosimeter (TLD) and the Hanford Basic TLD are the principle devices for measuring personnel radiation doses in Rockwell facilities. Except as discussed in reference 12, dose values determined by processing dosimeters are used as the legal record of dose received.

If a dosimeter is lost or a dose measurement is proven erroneous, an estimate of the dose received by the individual during the period in question shall be established by N&SA and documented as a part of the employee's dose record. Criteria to be used to establish the dose estimate can be found in reference 12.

8.4.1.2 Internal Dosimetry. Rockwell has developed two programs, routine bioassay and in-vivo counting, for internal dose measurements. The programs are directed toward determining whether employees have experienced an uptake of radioactive materials as a consequence of their employment at Rockwell and the magnitude of any related dose to internal organs.

Table 8-1. Department of Energy Occupational Dose Equivalent Limits (rem).[a]

Type of exposure	Annual	Calendar quarter
Whole body, head and trunk, gonads lens of the eye, red bone marrow, active blood-forming organs	5	3
Unlimited areas of the skin (except hands and forearms).[b] Other organs, tissues, and organ systems (except bone)	15	5
Bone, forearms	30	10
Hands, feet	75	25

[a]Reference DOE Order 5480.1A, chapter XI.
[b]All reasonable effort shall be made to keep exposures to forearms and hands to the general limit for the skin.

Table 8-2. Rockwell Occupational Dose Guidelines (rem).

Type of exposure	Annual	Quarter	Week
Whole body, head and trunk gonads, lens of eye, red bone marrow, blood-forming organs	3	1.25	0.3
Skin (except hands and forearms)	9	3	0.9[a]
Other organs (except bone)	7.5		
Bone	15		
Forearms	15	5[b]	
Hands	15	5	1.5[c]
Feet	15	5	1.5[b]

[a]As measured by: (1) the "unfiltered" chip in the record TLD, (2) an "unfiltered" supplementary TLD, or (3) timekeeping with open window CP.
[b]As measured by a closed window CP and timekeeping or a supplemental TLD.
[c]As measured by: (1) finger ring worn with TLD chip oriented toward the source, or (2) an open window CP and timekeeping.

8.4.2 Exposure Control - Tank Farms

Per the Tank Farm Facility ALARA Plan, all tasks, where the estimated total crew dose will exceed 500 mrem, shall be reviewed by the Tank Farm ALARA Team to investigate the possibilities and feasibility of modifying procedures, techniques, and equipment to determine if changes can be made that will reduce exposure.

In addition to the ALARA Team review, all nonroutine tasks which have the potential for high exposure rates or contamination levels are reviewed in pre-job planning meetings. During these meetings, the hazards anticipated are discussed further with personnel assigned to perform the task. The input received from these meetings is an integral part of keeping exposure and contamination levels ALARA.

8.4.2.1 Timekeeping. Timekeeping is most commonly used during specific tasks where the exposure during job duration could possibly exceed Rockwell's limits for exposure control, table 8-2. All tank farm operators are instructed on the method of timekeeping used by all Rockwell facilities during their General Radiochemical Operating Training.[15]

8.4.2.2 Supplementary Dosimetry. Four types of supplementary dosimeters are used in tank farms: pencil dosimeters, pocket alarm dose integrators (PADI), finger ring dosimeters, and supplemental TLDs.

The above mentioned supplementary dosimeters must always be accompanied by a regularly assigned multipurpose TLD. Supplemental dosimeters are not worn in place of a multipurpose TLD.

8.4.2.3 Shielding. Shielding is used in tank farms to reduce radiation exposure to levels that are ALARA.

8.4.2.4 Design. The basic design criterion employed in the construction of DS tank farms is the safe transfer and storage of radioactive waste in Hanford's tank farms. In terms of the radioactive and hazardous materials present in the waste, adequate protection from direct and scattered radiation, airborne radioactivity, or airborne hazardous effluents (see chapter 7) are incorporated into facility design (chapters 4 and 5) to reduce exposure to ALARA.[7]

8.4.3 Protective Equipment

Radiation Protection will prescribe protective equipment requirements for tasks performed in tank farms, including minimum clothing and respiratory protection according to radiological conditions and hazards. The IH&S Department determines the requirements for nonradiological (industrial) hazards. Protective apparel and respirators are available. Full-face, mechanical filter respirators are used for routine maintenance and operational tasks in which airborne contaminants may be encountered.

Full-face respirators are stored in strategic areas throughout the tank farm to be used in emergency situations. The filters on these respirators are tested by the Hanford Environmental Health Foundation upon initial receipt and are checked again when the respirators are sent to the mask cleaning station located in the 200 West Area. Self Contained Breathing Apparatus units are also available for use in tank farms. The units are to be used in accident conditions, or in areas where it is not feasible to wear a full-face mechanical filter respirator.

8.4.4 Radiologically Controlled Areas

Physical and administrative measures are in place to control the radiological areas within the DS tank farms.[12] The radiological areas as defined in reference 12 vary depending on contamination, airborne activity, and source dose rates.

The facility Radiological Engineer and RPT is required to concur with changes and to check that posting requirements are consistent with actual dose rates measured in the field. The boundaries of radiation areas, are clearly indicated by fences, ropes, chains, and signs. Radiation areas can only be entered when individuals are accompanied by an RPT, except when personnel have been qualified in advance to self survey and self monitor. Administrative controls of access and stay time in radiation areas described above are accomplished by posting and procedures. Radiation areas are marked with signs indicating the radiological conditions. Radiation work permits and operating procedures describe in detail the monitoring procedures that must be followed upon entering the area, the radiological conditions of the area, and the protective apparel that must be worn upon entering the area.[10,11]

8.4.4.1 Routine Radiological Control. The standards for conducting radiation surveys at Rockwell are detailed in reference 12; while the methods and procedures for implementing the standards are detailed in reference 10.

Health Physics Procedures (HPP) are used for special and routine tasks. HPPs for audits and inspections assure compliance with radiological controls, radiation work permits, and ALARA practice.

8.4.5 Health Physics Instrumentation

8.4.5.1 Portable/Personnel Survey Instruments. Portable radiation detection and measurement instruments are provided to all Hanford contractors, including Rockwell, from a central Hanford instrument pool operated for DOE by Pacific Northwest Laboratory. Table 8-3 lists the portable radiation detection equipment available from the central pool. The instruments are described in detail in documents available in the Radiation Protection offices.[10,14]

Table 8-3. Portable Radiation Detection and Measurement Instruments.

Type of instrument	Type of detector	Radiation(s) detected	Instrument range	Accuracy
CP	Air ion chamber	β, γ	0-5,000 mR/h	-5 to +10%
Extended CP	Air ion chamber	β, γ	0-5,000 mR/h	-5 to +10%
HPC	Thimble-type air ion chamber	γ	0-10,000 R/h 0-5,000 rads/h	N/R
MPC	Thimble-type air ion chamber	γ	0-500 R/h	-5 to +10%
LPC	Thimble-type air ion chamber	γ	0-50 R/h	-5 to +10%
Snoopy	BF_3 proportional counter surrounded by moderator	n	0-2,000 mrem/h	±25%
EGM	Geiger-Mueller	β, γ	0-100,000 cpm[a]	N/A
Lunlum model 177 and 1778	Geiger-Mueller	β, γ	0-500,000 cpm	N/A
PAM	ZnS scintillator	α	0-100,000 cpm	N/A
PAC-6	Air proportional	α	0-100,000 cpm	N/A
Weyco (Hanford Poppy)	Air proportional	α	0-500,000 cpm	N/A

[a]Counts per minute.
N/R = Not rated.
N/A = Not applicable.

All counters are routinely checked to determine if they are working properly.

8.4.5.2 Fixed Radiation Detection System. Outdoor area radiation monitoring systems are installed in all DS tank farms. Each system is composed of a photomultiplier with a visible and audible alarm set at 5 mR/h above background. The monitors are sensitive to gamma radiation in the range of 0.1 to 10.0 mR/h. Radiation levels detected by the monitors are continuously recorded. Alarms are located in the continuously occupied Tank Farm control rooms and at the CASS control room in the 2750-E Building. Fail safe alarms are included in each system.

The CAMs are used to monitor the control room air and the DS tank farm ventilation system exhausts (chapter 7).

8.4.5.3 Offsite Environmental Surveillance Program. The Environmental Surveillance and Monitoring Program is designed to determine if the impacts on the environment from all Rockwell operations are ALARA, or pose a hazard to the public or the environment.

Effluent releases are monitored by obtaining and analyzing representative gaseous and liquid samples from effluent streams entering the environment.

Routine environmental surveillances are conducted in the 200 Areas and associated sites and at the 600 Area retired waste disposal site. Monitoring of field activities that may cause impacts to the environment are also conducted. Data are analyzed to determine trends, compliance, environmental impacts, and adequacy of radioactive waste containment systems. Results are issued in a series of regular, special, and topical reports.

Routine evaluations are performed on data generated by the CASS and from operational data sheets supplied by Tank Farm Surveillance and Operations. Data is evaluated to detect releases of radioactive materials from containment failures and to ascertain whether or not discharges originating from Rockwell's waste storage tank and evaporator facilities to the environs meet the specified guidelines.

8.4.5.4 Instrument Calibration and Maintenance. All portable surveillance instruments in use in the tank farm facilities are maintained and repaired by the central Hanford instrument pool and calibrated by Pacific Northwest Laboratory. Calibration procedures used by PNL are contained in references 10 and 17. Photomultiplier tubes and CAM units are checked by Instrument Maintenance and source checked by Radiation Protection Personnel monthly.

8.4.6 Radioactive Sources and Doses

Shielding in DS tank farms has been designed to reduce radiation levels over pits, cover block, tanks, transfer piping and ventilation systems, to a maximum of 1.0 mR/h in controlled areas and 0.5 mR/h in uncontrolled areas.

Effluents discharged to the environment from DS tank farms shall meet the Table II concentration guide of reference 3 at the point of discharge for all radioactive materials except tritium in liquids.(9)

Reference 18 includes calculations of the dose rates from DS tanks in 241 AY and 241 AZ Tank Farms, which are specially designed to store fresh (aging) radioactive waste. This waste contains a much greater fission product content (237 Ci/gal) than do the DS tanks which are the subject of this SAR. The design basis source term for nonaging DS tanks is 6 Ci/gal of ^{137}Cs.(19) The shielding in both the aging waste tank farms and the non-aging tank farms is adequate. The worst-case analysis in the aging waste farms showed the dose rates from cover block, pits, and other critical areas in the tank farm to be acceptable (tables 8-5 and 8-6 of ref. 19). The source term (6 Ci/gal) in the DS tanks is smaller. Offsite exposures resulting from normal operations will, as in the case of aging waste tank operation be negligible.

Dose rates actually received by tank farm operators in calendar year 1984 averaged 319 mrem on a time weighted average. Operators are indicative of actual tank farm exposure because they consistently receive the highest exposure. This compares to a company-wide time weighted average among radiation workers of 409 mrem for the same period. Actual exposure rates run well below the strict limits Rockwell sets in table 8-2.

8.5 INDUSTRIAL SAFETY PROTECTION

All activities associated with work in the DS tank farms are subject to industrial hazards. Work is conducted in compliance with reference 13. Work place safety is regularly assessed through audits and inspections, and formal job safety analyses are required for tasks determined to possess high industrial risk potential hazard.

8.5.1 Industrial Injuries

Fifty-four minor injuries occurred throughout all tank farms in 1984. These injuries were limited to minor cuts, abrasions, bruises, and insect stings. Two OSHA recordable cases (a slip and a fractured right hand) occurred in tank farms over the same period. One was a lost time injury.

8.5.2 Design Considerations

Design considerations for industrial safety include the following: guardrails where potential falls of 4 ft or greater exist; guards on pumps, motors, and fans to preclude physical injury from rotating and moving equipment parts; supply steam header overpressure bleedoff performed in a non-occupied area; noise levels generally 85 dBA at 3 ft from equipment (high noise potentials, such as the air compressors and emergency generator, are segregated in structures, with appropriate warning signs); lighting provided in all normally occupied work areas (backup battery-powered lights are installed to provide ~72 h of backup protection); wet automatic sprinkler system provided in tank farm control rooms for fire protection (this system, as well as the heat detectors provided in the remainder of the facility), alarms at the 200 Areas fire station. Emergency showers and eyewash stations are provided at locations with a potential for exposure to materials that require use of such facilities; traffic safety associated with the tank farms is accomplished through established traffic patterns in this vicinity, with posted speed limits.

8.5.3 Toxic Materials/Hazardous Waste

Operation of the DS tanks involves the transfer and storage of a variety of hazardous materials including organic complexants and heavy metals, in addition to radioactive materials. Two of these (nitrates and ammonia) are of concern because they may volatilize and pass through the ventilation systems into the environment. Their presence in the tank farm ventilation exhaust is unsampled and unmonitored.

Their concentration in the tank farm has been high enough to be detectable and cause a slight irritation to sensitive individuals. Concentrations have not been high enough to pose a serious hazard to workers and no potential for offsite impacts is present.

No asbestos-bearing materials are present in the Tank Farms.

8.6 REFERENCES

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9.0 ACCIDENT SAFETY ANALYSIS

Wastes designated for DS tanks are segregated and concentrated by waste type for reasons of safety, operations, and economics. Liquid wastes are transferred to and from storage tanks, processing facilities, and related operational units (vaults, evaporator/crystallizers). Waste transfer and routing facilities include: diversion boxes, valve pits, catch stations, pipelines, and support equipment such as utility systems (fig. 9-1).

The configurations and systems operations shown in figure 9-1 were reviewed to identify potential hazards. A listing of identified hazards, together with postulated event sequences, consequences, mitigating and preventative design features is shown in tables 9-1 through 9-4. All discussion of risk, acceptable dose rates or Hazard class is based on that described in the Safety Analysis Report Preparation Guide.[1]

9.1 ABNORMAL OCCURRENCES

These events include those which could result in injury and/or risk to operating personnel from direct exposure to radiation or to inhalation from releases to the environs due to the disruption of normal operations. The events which result from the release of minor amounts of radioactivity to the immediate environs would pose no risk to the offsite population.

Included in this category are: tank overpressurizations (loss of containment) and high radiation levels from activity deposited on prefilters or HEPAs. Non-critical component failures are also in this category. Nonradiological emissions and industrial injury accidents are addressed in both abnormal and accident categories. A discussion of unusual occurrences (UOs) for DS tank farm facilities is presented in appendix B. Measurement[2] of individual radioisotopes in the primary tank exhaust of each tank is underway. Preliminary results for gamma emitters indicate that the concentrations (at the time of sampling) in the tank vapor space which are available for release are less than 5,000 times Table II limits (see chapter 7); however, there was no overpressurization (>0 in. w.g.) during sampling, even though the samples were obtained during transfer of solution from PUREX and the evaporator.

9.2 ACCIDENTS

Accidents refer to credible events which are beyond the control capabilities of the system that may result in breach of the primary and secondary confinement features. Major hazards resulting in serious injury or death are selected from the events identified in tables 9-1 through 9-4.

The tables describe a sequence of events which result from or lead to the hazard being described. The tables also give the potential consequences in terms of health or environmental effects. Preventative features in the design and mitigating measures provided by administrative controls at the facility are given.

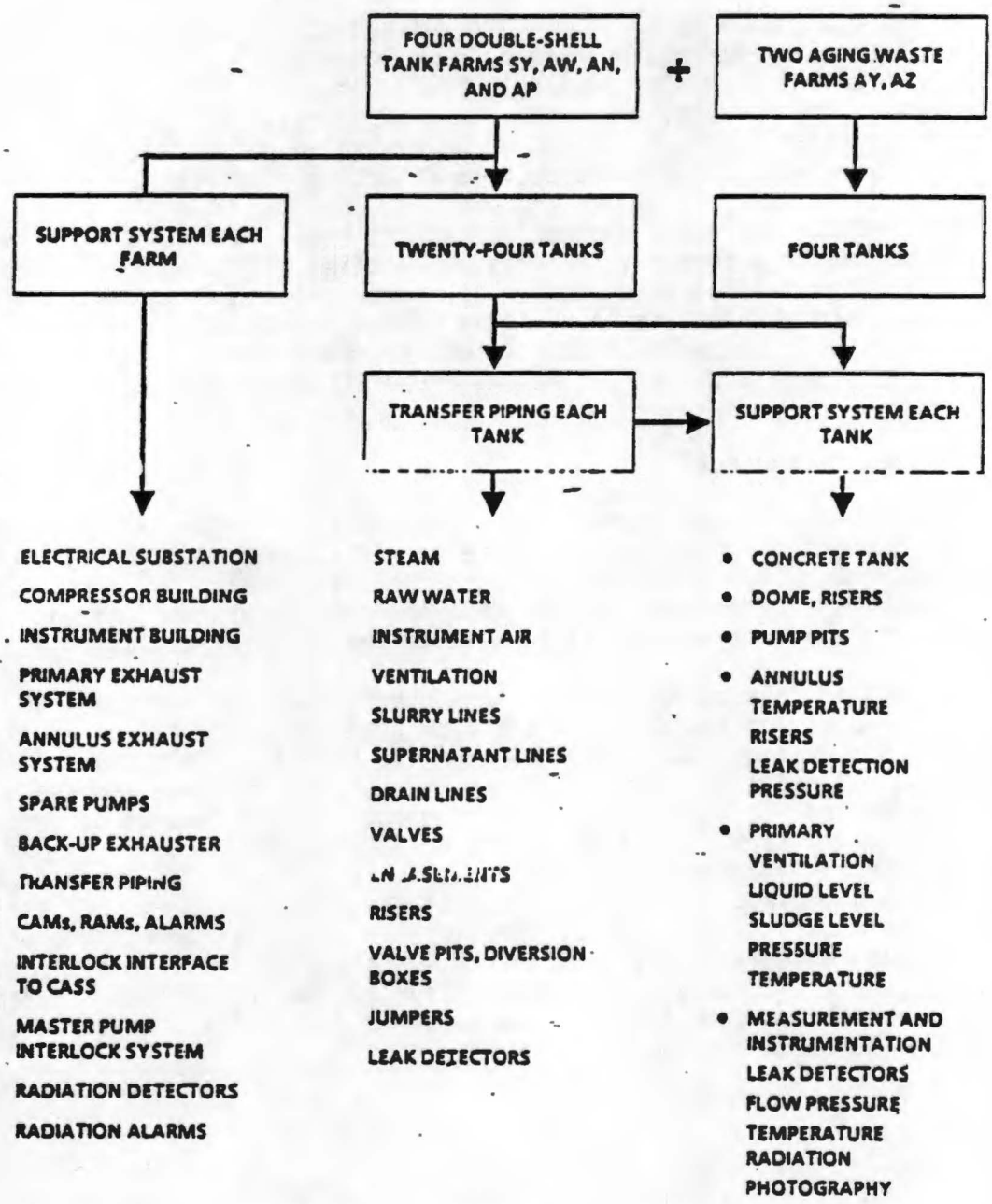

Figure 9-1. Double-Shell Tank Farm Facility Relationships Reviewed For Potential Hazards.

Table 9-1. Double-Shell Tank Facility Hazards Analysis.[a] (sheet 1 of 2)

Event	Possible sequence	Source term[b]	Potential consequence(s)	Preventative features	Mitigating measures
Seismic Activity	Earthquake occurs and support utilities disrupted; piping severed.	100 Ci/wk (0.01 Ci/min) per farm t <200 min	Loss of tank support systems and ventilation containment; loss of continued usage of tanks.	Tanks constructed to Safe Shutdown Earthquake (SSE) criteria. Support facilities (UBC).	Probability of SSE at Hanford is 1.8×10^{-4} per year. Emergency procedures are established. Ventilation components replaced prior to extensive overheating.
High Winds	Support structures and utilities subjected to high winds and associated debris and support utilities disrupted.	100 Ci/wk per farm, 0.01 Ci/min t <200 min	Loss of tank support systems and of ventilation containment.	Support structures and utilities designed to withstand 85-mph winds.	The peak gust wind measured at Hanford was 80 mph. Emergency procedures are established. Replace ventilation components.
Tornado	Above-grade structures and systems subjected to tornadic winds and associated missiles and ventilation filters destroyed and tank vapor spaces evacuated through open ventilation ducting.	100 Ci/wk, per farm (0.01 Ci/min) t <200 min	Loss of tank ventilation system containment; personnel injury; personnel contamination.	Administrative controls.	Probability of Design Basis Tornado (DBT) at Hanford is 10^{-6} per year. Emergency procedures are established.
Thunderstorm	Lightning strikes facility and causes a loss of facility electrical power.	100 Ci/wk, per farm (0.01 Ci/min) t <200 min	Overpressurization of primary vessel.	Gas and liquid temperature rise is limited by heat content of solution (<70,000 Btu/h). Some of excess pressure is relieved through HEPA filter.	All transfers are stopped during power outage.
Freezing Weather	Ice forms on power lines, mechanical devices, and walkways.		Possible disruption of support services; personnel injury associated with falls.	Hand rails installed on external stairways.	Selected equipment protected; emergency procedures for utility failure; sanding of walkways.

[a]See reference 2 for source term definitions and assumptions.
[b]The CRW feed >180d cooled, but less than 1 yr.

Table 9-1. Double-Shell Tank Facility Hazards Analysis.[a] (sheet 2 of 2)

Event	Possible sequence	Source term[b]	Potential consequence(s)	Preventative features	Mitigating measures
Industrial Accident (Major)	Personnel injured by falling objects or missiles or injuries related to falls or chemical burns and fume inhalation or back strains from lifting or man falls down a 42-in. riser or man hit by moving crane.		Lost work days; possible personnel fatality.	Prejob planning and scheduling; training; roped pathways; procedures. Area lighting for increased visibility. Safety meetings.	Trained emergency medical personnel are available at the E-W fire station 24 h/d. Accident prevention standards and audits.
Industrial Accident (Normal)	Entry into confined space containing toxic, caustic, or radioactivity or shock from faulty electrical equipment or eye damage from welding or slips from ladders or inuury from faulty tools pinch point - cover lock removal or replacement.		Poison, fractured bones, back injury, cuts, shock, abrasions.	Job safety analysis, hazard work permit.	Trained emergency medical personnel are available at the E-W fire station 24 h/d. Accident prevention standards and audits.

[a]See reference 2 for source term definitions and assumptions.
[b]The CRW feed > 180d cooled, but less than 1 yr.

Table 9-2. Waste Transfer Piping Hazards Analysis.[a] (sheet 1 of 3)

Event	Possible sequence	Source term[b]	Potential consequence(s)	Preventative features	Mitigating measures
PRIMARY High Radiation Level	Person is standing directly over transfer piping (without earth cover) and waste transferred while person is standing there.	<1,000 R/h	Occupational radiation exposure.	Earth cover over piping to reduce radiation levels to 0.5 mR/h based on anticipated nuclide content. Administrative controls when lines are excavated during construction.	Radiation Monitoring will conduct a survey above piping upon initial waste transfer. Areas will be posted as appropriate before subsequent transfers.
	Person is standing on a pump pit cover block and waste is routed through pit while person is standing there.	<1 R/h	Occupational radiation exposure.	Cover block thickness sufficient to reduce radiation levels to 1 mR/h based on anticipated nuclide content.	Radiation Monitoring will conduct a survey of appropriate pit cover blocks. Cover block will be posted or shielded as necessary.
	Pump fails during transfer and pump requires maintenance to complete transfer or jumper fails and requires maintenance.	<5 R/h	Occupational radiation exposure.	Administrative controls.	Radiation Monitoring coverage required during maintenance; stay times established; remote equipment available for inspection and maintenance in high dose rate areas; use of temporary shielding to reduce personnel exposure.
Misrouting	Jumper alignment routes waste to a tank not prepared to receive it.		Thermal stress of tank.	Administrative controls.	Verification of liquid level prior to transfer per SOP. Relatively small quantity of waste transferred per single batch, diversion station can only route flow after routing path is established per SOP. Annulus leak detector alarms are provided.

[a]See reference 2 for source term definitions and assumptions.
[b]The CRW feed >180d cooled, but less than 1 yr.

Table 9-2. Waste Transfers Piping Hazards Analysis.[a] (sheet 2 of 3)

Event	Possible sequence	Source term[b]	Potential consequence(s)	Preventative features	Mitigating measures
Pipe or Valve Leak	Waste gels within pipe forming a blockage and pipe ruptures during attempts to free blockage or acid solution is transferred and primary pipe corrodes and encasement pipe leaks.	10 Ci/gal	Radioactive material released to soil; loss of primary piping.	Administrative controls. Pipes are encased. Pipelines are designed to withstand dead head pressure from pumps.	Batch transfers minimize the transfer time waste is contained in the pipe. Pipe and encasement sloped 0.25% toward tank. Maximum compaction of soil around encasement to minimize sagging of encasement and to inhibit leakage infiltration rate. Piping is flushed following transfer to minimize buildup of solids.
	Pipe (or valve) leaks due to thermal stress, corrosion, and overpressurization	10 Ci/gal	Radioactive material released to soil; loss of primary piping.	Piping contained by either larger piping, concrete encasement, or pit.	Encasement or pit either is monitored by leak detection devices directly or drains to a location which is monitored.
	Waste is transferred from PUREX, jumper fails or is missing in diversion box or jumper nozzle seal deteriorates due to radiochemical action and seal leaks.	< 10 Ci/gal 75 gal/min	Radioactive material contaminates diversion box, and fraction is released to air or ground. Personnel exposure during cleanup.	Administrative controls. Valves and jumpers contained by pit.	Release limited to batch size. Liquid drains to catch tank with 5,000 gal capacity. Catch tank can be pumped to a DS tank. Leak detectors and alarms are provided in all pits and interlocked to shutdown pump. RPT smears cover block as it is lifted to determine contamination. Face masks must be worn during pit entries.

[a]See reference 2 for source term definitions and assumptions.
[b]The CRW feed > 180d cooled, but less than 1 yr.

Table 9-2. Waste Transfers Piping Hazards Analysis.[a] (sheet 3 of 3)

Event	Possible sequence	Source term[b]	Potential consequence(s)	Preventative features	Mitigating measures
Pipe or Valve Leak (cont.)	A primary tank leak occurs requiring waste to be transferred to spare tank and flex jumpers must be installed prior to transfer	<20 r/h	Occupational radiation exposure; delay in transfer.	Administrative controls.	SOP and RWP controls required prior to maintenance.
	Slurry transfer to tank plugs slurry distributor causing leak into pit and leak detector fails.	<10 Ci/gal <5,000 gal	Pit overflows and radioactive material released to soil and air.	Area radiation monitors interlocked to master pump shutdown. Leak detectors are fail-safe.	Tank liquid level readings are recorded every 2 h during slurry transfers. PMs.
Cover Block or Pump is Dropped	Cover block is removed for maintenance and lifting ball breaks and cover blocks fails on pit and cracks pit sides or pump falls during its installation or removal.	25 Ci/wk (0.0025 Ci/min) Exposure time < 1 h Liquid leaks to soil	Possible missile hazard causing personnel injury. Damage to piping and equipment requiring major repair effort. Exposure (chemical fumes, radioactive particulates, and ionizing radiation) to personnel during maintenance. Tank bottom is damaged.	Lifting bales and choker cables periodically inspected/load tested and certified; SOPs require hard hats in area where cranes are working and only trained persons necessary to perform the work are to be in the immediate area.	Accident Prevention Standards require inspection of cranes.

[a]See reference 2 for source term definitions and assumptions.
[b]The CRW feed > 180d cooled, but less than 1 yr.

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Table 9-3. Storage Tanks Hazards Analysis.[a] (sheet 1 of 3)

Event	Possible sequence	Source term[b]	Potential consequence(s)	Preventative features	Mitigating measures
Nuclear Criticality in Tank	High concentration plutonium solution is transferred to tank and a critical mass accumulates.	Fission products and gases. 10^{19} total fissions	Environmental release; personnel radiation exposure; possible loss of continued tank usage.	Quantity of fissionable material and area over which it would precipitate makes the event not credible. Administrative control on concentration of fissionable material in transfers.	Batch transfer would be diluted by contents of tank, thereby creating an unfavorable environment for accumulation of a critical mass. Criticality specifications exist. SOP requires analysis. This event is considered incredible.
Acid Solution Transferred to DS Tanks	Operator error.	10 Ci/gal	Failure of pipelines, jumpers. NO_x fumes generated will be exhausted to atmosphere.	Administrative controls.	Batch transfers would be neutralized by contents of tank. Tank contents is monitored and SOP and operation specification control content of solution to be transferred.
Burping and Liquid Level Increase	Complexant degradation reactions produce gases and rapid increase in liquid level occurs and explosive mixture is produced and reaction reduces nitrite, nitrate, or hydroxide concentration.	Gaseous products; NO_2, N_2O, CO, H_2, CO_2, CH_4, NH_3 and NO_x are available. Entrained radioactive particles in vapor space.	Release of unfiltered toxic gases. Mechanical and thermal stress from liquid height. Corrosion rate enhanced by hydroxide reduction.	Sampling of tank content and liquid level allows operators to take action.	Control of organic content by SOP. Unfilterable noxious fumes are discharged from stack and allowed to disperse. Filter systems on exhauster remove filterable fumes and radioactive particulates.
Burping in Tank 101SY Only	Complexant degradation and radiolysis produce gases and crust entrains gases, which are released when liquid level decreases and H_2 concentration exceeds 5% and ignition source is available.	H_2 concentration in bubble - 5 - 50%	H_2 concentration could exceed 5% in tank 101SY resulting in ignition and burning. See Hydrogen Explosion.	Liquid levels and temperatures are monitored and the crust is lanced periodically. Waste can be transferred to a tank that has airlift circulators.	Exhauster or portable exhauster must be operated at all times to flush out emitted gases.

[a]See reference 2 for source term definitions and assumptions
[b]The CRW feed > 10d cooled, but less than 1 yr.

Table 9-3. Storage Tanks Hazards Analysis.[a] (sheet 2 of 3)

Event	Possible sequence	Source term[b]	Potential consequence(s)	Preventative features	Mitigating measures
Fire/Explosion	Organic material is transferred to waste tanks and an electrical spark or short ignites the fumes, vapor explosion produces pressure, destroys ventilation system filters and produces structural damage to primary tank or vent system.	14 Ci/wk (0.0014 Ci/min) per tank Exposure time < 1 h >5,000 MPC	Environmental release; possible loss of tank use.	No source for electric spark in tank.	Control of organic concentration and temperature of transferred liquids by SOP.
Hydrogen Explosion and Dome Damage	Pits (sluice and pump) are seal taped to reduce in-leakage and maximize DP between tank and atmosphere. This creates a stagnant area in the pits or exhaust system fails and hydrogen builds up in the pit air space or the tank vapor space and a spark (electrical or mechanical) occurs igniting the hydrogen and the resulting explosion causes a portion of the pit or dome to fail.	14 Ci/wk (0.0014 Ci/min) per tank Exposure time < 1 h >5,000 MPC	Damage of instruments, vessels, or dome stress. Loss of tank containment; environmental release; personnel exposure and/or injury.	Taping of pits does not prevent in-leakage but restricts it; in-leakage to the pits will purge hydrogen into the ventilation system. H_2 generation rate is limited by fission product concentration of liquid and by the exhaust air.	Tank farms are not normally occupied, reducing likelihood of personnel injury. Hydrogen accumulation rate (30 ft^3/d) requires 23 d without ventilation to accumulate concentration of 2% H_2. Alarm indicates loss of vacuum immediately.

[a]See reference 2 for source term definitions and assumptions.
[b]The CRW feed >180d cooled, but less than 1 yr.

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Table 9-3. Storage Tanks Hazards Analysis.[a] (sheet 3 of 3)

Event	Possible sequence	Source term[b]	Potential consequence(s)	Preventative features	Mitigating measures
Primary Tank Failure	Excessive temperature rise and temperature gradients or excessive corrosion or tank overfills and hydrostatic head increases or vacuum in tank excessive causing bottom to uplift. Any one can cause the structural integrity of primary tank to collapse.	5,000 gal of liquid to annulus	Primary tank leaks and tank usage is lost.	Design limit exceeds operating specifications.	Temperatures monitored during hot transfers per SOP. Corrosion rate is minimized by waste chemical composition. Redundant high liquid level alarms exist. Minimum liquid levels are specified for primary tanks to prevent bottom from uplifting.

[a]See reference 2 for source term definitions and assumptions.
[b]The CRW feed >180d cooled, but less than 1 yr.

Table 9-4. Support Systems Hazards Analysis.[a] (sheet 1 of 3)

Event	Possible sequence	Source term[b]	Potential consequence(s)	Preventative features	Mitigating measures
PRIMARY VENTILATION Ducting Failure	Below grade ducting corrodes, welds crack, etc. and condensate leaks in the soil.	0.01 Ci/gal in condensate	Radioactive material released to soil.	Ducting is coated and cathodic protected, reduces leakage to enhance drainage toward the deentrainer.	Maximum soil compaction minimizes sags in ducting.
Ducting Isolation Valve Opened or Failed	Tank vent line isolation valve fails and there is no means of balancing ventilation flow causing some tanks to receive insufficient exhaust ventilation.	4 Ci/wk per tank <1 h exposure >5,000 x MPC	Loss of tank ventilation containment.	Type of valve is easily replaced. Valves used have very high reliability.	A low vacuum alarm in tanks occurs at -0.1-in. water gauge vacuum warning personnel in the control room of an impending loss of ventilation.
Deentrainer Drain Plugged	Drain becomes plugged by corrosion products, crystal growth, etc. and condensate accumulates in deentrainer and forms a seal loop shutting off ventilation to tanks.	4 Ci/wk per tank <1 h exposure >5,000 x MPC	Tank farm ventilation is lost. Maintenance personnel radiation exposure.	Deentrainer pressure drop is monitored. Backup exhaust deentrainer is available.	Maintenance via RWP and SOP. Excessive pressure drop readings would cause personnel to initiate corrective action.
Deentrainer Failure Worst Case Accident	Deentrainer shell corrodes causing a loss of deentrainer integrity or wire mesh corrodes allowing moisture to pass through the deentrainer and HEPA filters become moisture ladened.	2 - 5 Ci released in <0.5 h t <0.5 h	HEPA filter failure followed by airborne particulate release.	Stainless steel construction. HEPA filter will remove water droplets and reduce releases to the atmosphere until it fails.	Differential pressure instruments provided and monitored daily. Backup exhauster available (portable unit only in SY).

[a]See reference 2 for source term definitions and assumptions.
[b]The CRW feed >180d cooled, butless than 1 yr.

Table 9-4. Support Systems Hazards Analysis.[a] (sheet 2 of 3)

Event	Possible sequence	Source term[b]	Potential consequence(s)	Preventative features	Mitigating measures
Deentrainer Failure (cont.)	Moisture in exhaust impinges on the wire mesh and radioactive particles in the moisture are trapped in the wire mesh causing radiation levels to rise and when deentrainer is flushed, moisture-saturated air is supplied to HEPA filters causing excessive moisture loading. Filters would be affected causing a slow decrease in system vacuum.		Occupational radiation exposure.	On-line flush system is incorporated in design so deentrainer can be back flushed without shutting ventilation down.	Personnel are not normally in the immediate area. Radiation Protection Technologist periodically surveys the area to determine radiation levels and posts requirements. Deentrainers are shielded with concrete.
			Filter failure; environmental release.	Secondary exhauster with deentrainer is available for use while primary exhaust system is repaired.	
HEPA Filter Failure	A high DP develops due to plugging causing filters to fail	Rapid release of unfiltered air. 5×10^{-4} Ci/min t < 100 min >5,000 x MPC	Environmental release through infiltration leak paths if flow is restricted and release through exhaust stack without filtration if filters fail.	Two HEPA filters in series are used to filter the exhaust stream. Backup bank of filters available.	HEPA differential pressures monitored daily.
	or radionuclides build up on filter media during tank transfer operations and a high radiation level develops and filter changeout is required.	>0.1 rad/h at monitoring station.	Occupational radiation exposure.	Filter change is based on radiation levels designed to minimize exposure.	
			Internal occupational radiation exposure; environmental release.	Automatic exhauster shutdown upon failure of final HEPAs. Effluent stream is monitored for contamination and interlocked to shut down fan when high radiation is detected. CAMs are fail-safe.	Portable air monitor in the immediate area is used to determine concentrations and inventories available for inhalation/release. In the past, levels have not been detectable.

[a]See reference 2 for source term definitions and assumptions.
[b]The CRW feed >180d cooled, but less than 1 yr.

Table 9-4. Support Systems Hazards Analysis.[a] (sheet 3 of 3)

Event	Possible sequence	Source term[b]	Potential consequence(s)	Preventative features	Mitigating measures
Fan Motor Failure	Freezing weather causes fan motor failure from seized bearings or freezing weather seals up all in-leakage pathways or electrical power to motor is lost or an electrical short in operating motor ignites lubricants in both motors causing both motor windings to short out.	5×10^{-4} Ci/min t < 100 min >5,000 MPC	Loss of tank ventilation; equipment. Excessive vacuum if in leakage decreases while fan is running.	Redundant fan will automatically start when failure of operating fan occurs (except SY). Motors are grounded to minimize electrical arcing. Grease lubricants do not catch fire readily.	Backup portable exhauster is available if both fans are inoperative. Fan is shut off if excessive vacuum exists. With no ventilation fan running tanks will breathe through path of least resistance which will be through vent piping and HEPA filters.
<u>ANNULI SYSTEM</u> Primary Tank Leak	A primary tank leak occurs filling the annulus with waste and heater fails and moisture from waste plugs HEPA filters.	5×10^{-4} Ci/min t < 200 min >5,000 MPC	Leakage to environs through infiltration paths if overpressure in annulus.	Annulus pump available. Waste can be transferred to another tank. Standby filter system is available for annulus vent except SY. Air inlet has filter.	Liquid waste temperature and chemical composition controlled by operating specifications to prevent corrosion and tank failure.
	Liquid waste from tank leak enters the annuli and secondary tank leak occurs while waiting for tank space in the spare tank, or spare pump fails, or setting up annulus pump route.	10,000 gal	Delay in transfer, causes secondary tank failure occurs and leakage to soil.	More than one spare pump is available. Secondary tank design criteria is similar to that for the primary tank.	Spare tank space is maintained at all times to contain the normal volume from the leaking tank. Drainage from secondary tank would drain to leak detection pit where it can also be recovered.

[a]See reference 2 for source term definitions and assumptions.
[b]The CRW feed >180d cooled, but less than 1 yr.

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Source terms are defined in terms which are proportional to the consequences and are given as dose rates, concentrations, and release rates. For example, a pipe with a given activity concentration is defined in terms of the dose rate at the pipe surface or at a point some distance from the pipe. The conversion to dose rate is made for clarity in defining the hazard.

If a leak occurs underneath the soil cover, then the potential consequences are directly related to the product of the concentration and the volume which leaks (i.e., the total activity). The eventual dose consequence is related to rate of entry into elements in the food chain such as water or plants. Such events are usually considered to cause low hazards. Transfers from PUREX to the tanks is normally limited to 7,000 gal batches. A DS tank leak to the soil will probably never exceed 10,000 to 20,000 gal because of the pumping cababilities in the annulus and the leak defection pits.

When events are described which result in inhalation of contaminated air by an individual, the source term is defined as a release rate (activity per unit time). The product of release rate, dilution during transport, breathing rate, time of exposure, and the dose factor (Sv/Bq inhaled or rem/Ci inhaled) is used to estimate the dose to various organs in the exposed individual. Tables 9-5 and 9-6 present the dose to various organs for a release of 1 gal of waste containing various concentrations of fission products. The doses are estimated for individuals located at three distances from the release point (see table 9-5). Table 9-6 compares the dose from existing waste to other waste being processed.

The first year bone dose to an onsite worker located at 100 m from the release point is 40 rem when 3.4 Ci is released over a 30 min period and the individual is exposed throughout the release period. The bone dose (D) to this individual can be expressed as the product of the ratio 40 rem/3.4 Ci or [D = 11.76 Rt (rem)], the release rate being (R) and the exposure time being (t). If a dose limit to the bone is desired, one must control the product Rt. If D equals 3 rem,[1] Rt equals 0.26. When R is 0.0026 or 0.026 Ci/min then t must be limited to 100 or 10 min, respectively, for a dose of 3 rem to the bone.

If the estimated exposure time (t) is less than 0.26/R per event and the probability of the event per year (P) is $10^{-1} > p \geq 10^{-3}$, the bone dose (3 rem) to an onsite worker meets the criteria for risk acceptance.[1] Most of the events described in tables 9-1 through 9-4 are infrequent (P in the range given above) but may occur during the lifetime of the facility (50 yr per tank). The exposure times and release rates are given in the table and their product can be used to show the relative risk of the event. The ratio rem/Ci varies with each waste type (table 9-6). The critical organ and the ratio of its dose to the quantity released in curies also varies with the waste type. The dose criteria for risk acceptance varies with the critical organ. For CRW feed, D = 1.13 Rt (rem) to the lung after 180 d cooling. The criteria for risk acceptance is 1.5 rem,[1] and Rt = 1.33 Ci. The release rate R decreases because of decay of the radioisotopes in the waste.

Table 9-5. Dose From the Release of One Gallon of Existing Double-Shell Tank Waste (rem).[a]

	Onsite worker[b]		Highway 240[b]		Site boundary farmer[c]	
Location:	0.10-km		8.7-km		19.0-km	
X/Q	2.9 E-02		3.1 E-05		1.8 E-05	
Pathway	1 Year	50 Year	1 Year	50 Year	1 Year	50 Year
Body	3.3 E+00	3.3 E+01	3.6 E-03	3.6 E-02	9.3 E-03	5.6 E-01
Bone	4.0 E+01	4.9 E+02	4.3 E-02	5.4 E-01	4.0 E-02	2.3 E+00
Lung	2.3 E+00	2.4 E+00	2.5 E-03	2.6 E-03	2.7 E-03	1.9 E-02
Thyroid	6.9 E-03	7.0 E-03	7.6 E-06	7.6 E-06	6.3 E-04	1.7 E-02
LLI	8.8 E-01	8.8 E-01	9.6 E-04	9.6 E-04	8.7 E-03	8.3 E-02
Liver	1.8 E-00	2.7 E+01	1.9 E-03	3.0 E-02	7.9 E-03	4.4 E-02
Kidney	6.7 E-01	1.2 E+01	7.3 E-04	1.4 E-02	3.7 E-03	2.8 E-02
Spleen	7.3 E-01	7.9 E-01	8.0 E-04	8.6 E-04	5.3 E-03	2.4 E-02
Skin[d]	2.2 E-02	2.2 E-02	2.4 E-05	2.4 E-05	6.6 E-04	1.9 E-02

NOTE: The 50-yr ingestion doses are the cumulative doses from 50 yr of continuous exposure to the contamination deposited during the release.

[a]The release duration was 30 min. There are 3.4 Ci of fission products per gallon.

[b]Inhalation dominates dose.

[c]Ingestion dominates dose.

[d]Air submersion dominates dose.

Table 9-6. Comparison of Dose for the Release of One Gallon of Existing and Coating Removal Waste (CRW).

Existing waste[c]		CRW[a]						PFP[b]
		180 day			1 year			
1986 ~ 1990		~1986			~1987			
	DSS/CC	Feed	DSS[d]	Sludge[e]	Feed	DSS	Sludge[e]	Sludge[e]
Body	3.3	.5	1.7	1.3	.2	1.4	.34	.13
Bone	40	1.9	4.7	4.8	.6	3.4	1.1	3.0
Lung	2.3	15.4	1.5	50.2	3.5	1.0	11.1	235
Kidney	.7	1.6	7.8	3.1	.7	5.0	.9	
LLI	.9	2.0	2.6	5.8	.5	1.6	1.2	
Liver	1.8	.7	1.7	1.6	.3	1.7	.4	
Ci/gal (fission products)	3.4	13.6	15.4	40.	3.3	7.1	8.7	~0
Ci/gal (TRU)	0.0025			0.0003			0.00032	0.095

NOTE: 1 Year Collective Dose to an Onsite Worker at 100 m (Total Body and Critical Organ Dose, rem).

[a]Concentrations assumed are about a factor of 2 higher than that allowed for the limiting heat content for a full tank, i.e., 10% of FP in CRW feed.[(2)]

[b]Plutonium Finishing Plant waste.

[c]See table 9-5.

[d]Double-Shell slurry concentration does not include that associated with the salt well liquor that is mixed with the supernatant.

[e]Partition Factor--Ratio of concentration in vapor to that in solution is lower for sludge (much less than 10^{-3}).

The assumptions used to estimate the source terms are defined in reference 2. Briefly, for seismic events or tornadoes, the release rate is computed as the product of the vapor generation rate from the heat in the waste and 10^{-3} of the activity concentration in the liquid. For existing waste, 10^{4} gal/wk per farm (i.e., evaporation rate at 70,000 Btu/h for 7 tanks) containing 3.4×10^{-3} Ci/gal is released (34 Ci/wk or 0.0034 Ci/min). If the tank contained CRW as DSS after 1 yr of cooling, then about 70 Ci/wk would be released (table 9-6).

For tank overpressurizations a pressure of +1 in. w.g. is assumed and the leak rate is estimated as 100 ft^3/min. The moisture content is based on that existing in 110 °F saturated air, 4.4×10^{-4} gal of moisture per ft^3. The activity in the moisture for existing waste is 3.4×10^{-3} Ci/gal; therefore, 1.5×10^{-4} Ci/min is released per tank (1.5 Ci/wk). For CRW feed the release is about 5×10^{4} Ci/min at >180 d cooling.

9.2.1 Aging Waste Versus Non-Aging Waste Comparisions

The source terms presented in tables 9-1 through 9-4 can be compared to the source terms used for aging waste tanks(4) to show that the potential consequences for DS tanks are much less than for aging waste. These comparisons are shown below:

- Heat content is ~4 Btu/h gal versus ~0.07 Btu/h gal
- Fission product inventory is ~237 Ci/gal versus ~6 Ci/gal
- Evaporation rate is ~11 to 22 in/wk versus ~0.1 to ~0.4 in/wk (2,750 gal/in.)
- Exhaust rate (primary) is ~600 cfm versus ~150 cfm
- Number of air lift circulators (ALC) is ~22 at (5 to 20) cfm each tank versus 2 tanks with 2 ALC
- Moisture in vapor space is 210 gal versus 20 gal
- Conservative estimate of the activity in moisture is 0.237 Ci/gal versus (.003 - .004) Ci/gal
- Vapor space gas temperature is 190 °F versus 80 - 100 °F.

The major (worst case) accidents which were identified for the aging waste tanks(3) may be compared for use in this SAR:

- Pipe leak between PUREX and the tank farm
- Hydrogen explosion within the primary tank

- o Tank bump
- o Major tank leaks into the soil.

9.2.1.1 Pipe Leak. Pipe leaks are considered to be mitigated by administrative surveillance and design features. However, an operator error (procedure violation) in 1985 has resulted in the failure of the primary piping used to transfer waste from PUREX to the AW Tank Farm (appendix B). While there were no releases to the environs there will be some economic and occupational risks resulting from the repair/replacement of the piping.

Operator errors are major contributions to most accidents in the scenarios described in tables 9-1 through 9-4, and in appendix B.

9.2.1.2 Hydrogen Explosion. The hydrogen explosion scenario for an aging waste tank is deemed to be incredible. The generation rate of ~1,190 ft^3 of H_2/d can be compared to 30 ft^3/d for DS tanks. Two volume percent H_2 could accumulate in about 1 d in an aging waste tank and in 23 d for a DS tank, if the ventilation system was lost. However, the steam generation rate for aging waste is such that the H_2 would be purged from the void space faster than it could be accumulated. The accumulation rate in nonaging waste is slow enough so that allowance for steam dilution is not required.

A sudden relief of accumulated gas beneath a tank (101-SY)[4] crust might cause the hydrogen concentration exiting the vapor space to exceed 4% if the released gas plume is vented without mixing with the air in the vapor space. A very high hydrogen release rate can cause the concentration to exceed 4% in the tank vapor space even if mixing occurs. Tank 101-SY contains a mixture of DSS in complex concentrate, which accounts for this phenomenon. Other tanks containing DSS may also form a crust and eventually burp.

9.2.1.3 Tank Bump. A sudden release of energy due to super heating in the form of steam. The tank bump scenario for aging waste results in a release of 36 gal of liquid droplets containing 8,500 Ci which settles within the tank farm fenceline. Four gallons (950 Ci) of liquid is released as a fine mist over a period of 70 min. The maximum onsite dose commitment for an individual located 100 m downwind (for an exposure time of 5 min) resulted in a 1 yr dose commitment to a maximum exposed onsite worker in the moderate to high category. Although a bump scenario is deemed incredible for typical DS tank liquids since it is a boiling phenomena, a somewhat conservative estimate of the consequences is given. Table 9-5 shows the computed dose commitment to the onsite worker if 1 gal of existing DS slurry is released (See chapter 6 for a description of the inventory) over a 30 min period for an exposure of 30 min. If 4 gal is assumed to be released and the exposure time is 7.5 min, the product Rt equals 3.4 Ci and the committed dose is the same as that given in table 9-5. A maximum bone dose of 40 rem would be received in 1 yr from the release of (as a fine mist) 4 gal.

Table 9-6 presents a comparison of the dose commitment in 1 yr for existing double-shell slurry complexant concentrate (DSS/CC) to that from CRW at 180 d and 1 yr due to the release of 1 gal of the liquid as a mist. Over the lifetime of the DS tanks the existing waste provides the most conservative estimate for the consequence of all of the scenarios which are discussed in this SAR.

9.2.1.4 Major Tank Leak Into Soil. Reference 4 gives the probability of a leak from a secondary tank as 0.01 per tank year. Studies utilized is preparing an Environmental Impact Statement on "Disposal of Hanford High-Level, and Transuranic Waste" assumed 100% leakage of all of the liquid in aging and DS tanks after 160 yr (CY 2,150). Calculations of the dose commitment assuming 0.5 cm/yr recharge were made at a 2 km well and after contaminant migration to the Columbia River. The dose commitments are given in tables 9-7 and 9-8 for these computations. The study postulated a total of 10^7 gal of DS waste would be leaked in the 200 East Area from 25 tanks and 2×10^6 gal from 3 tanks in the 200 West Area. A leak of 10^5 gal would represent 0.01 and 0.05 of the dose commitment given in tables 9-7 and 9-8 for the 200 East and 200 West tank leaks respectively. The dose consequences for this accident is extremely low.

Events associated with operations in regions above the design specification limits for corrosion stress for the primary, secondary, and concrete tanks involve breach of confinement and uncontrolled release of liquid and moisture containing radioactivity.

A major release of liquid waste into the ground at concentrations existing in DS tanks would have considerable impact even though it has been shown that the dose consequences to the public are far below 0.5 rem whole body dose in 1 yr. A loss of piping or the availability of a DS tank could impact the operation and the schedule for most of the major facilities at the Hanford Site. Accident scenarios which lead to major releases can occur when the operation design limits are exceeded. These design limits are specified in chapter 4 and in Tank Farm Operating Specifications.[6]

9.3 DOUBLE-SHELL MAXIMUM CREDIBLE ACCIDENT

Failure of the ventilation system (and the associated decontamination system) for any DS tank farm will result in its shutdown. A scenario is postulated in which the activity which has been collected on the de-entrainer, prefilter, and 1st stage HEPA is dislodged and released into the environs. Rupture of a HEPA filter with subsequent release of a fraction of the activity in the de-entrainer, prefilter, and HEPAs is assumed to occur as a de-entrainer is being chemically flushed. Heat is liberated as the salts are dissolved by the flush solution. Rapid expansion of the vapor causes the pressure to exceed the design limit of the filter

Table 9-7. No Disposal Action (Continued Storage) Alternative--Public Doses From Contamination Migration to the Columbia River for 0.5-cm/yr Recharge.

Waste form	Average downriver individual, lifetime dose, during peak release period							10,000-year integrated population dose	
	Total body dose (rem)	Drinking water contamination (%)	Critical organ	Critical organ dose (rem)	Time (years after disposal)	Dominant nuclide: Total body	Dominant nuclide: Critical organ	Total body dose (man-rem)	Dominant nuclide
Existing double shell tanks tank residuals 200 East	9 E 06	11	Thyroid	5 E-04	700	57% ^{14}C	99% ^{129}I	4 E +02	57% ^{239}Pu
Future double shell tanks tank residuals 200 East	2 E 04	76	Bone	3 E-03	6,300	100% ^{239}Pu	100% ^{239}Pu	4 E +04	99% ^{239}Pu
Existing double-shell tanks tank residuals 200 West	1 E 06	11	Thyroid	1 E-04	700	63% ^{14}C	99% ^{129}I	7 E-01	63% ^{239}Pu

Table 9-8. No Disposal Action (Continued Storage) Alternative--Individual Maximum Potential 1 Year Radiation Dose From Drinking Water.[a]

0.5 cm/yr recharge					
Waste form	Total body dose (rem)	Critical organ	Critical organ dose (rem)	Time (years after disposal)	Dominant nuclide
Existing double-shell tanks Tank residuals 200 East	6 E-01	Thyroid	3 E+01	400	^{129}I
Future double-shell tanks Tank residuals 200 East	9 E-01	Bone	1 E+01	3,600	^{239}Pu
Existing double-shell tanks Tank residuals 200 West	4 E-01	Thyroid	3 E+01	400	^{129}I

[a]Well located 2 km from tank farm.

housing. The flush solution is driven into the duct work and out of the stack. The total activity which is released is based on the following assumptions.(3)

- At the time of the accident the prefilter radiation level is 100 mrem/h and the first stage HEPA is 200 mrem/h.
- The dose rate at the monitoring station is ~3 rem/h per Ci of cesium for either filter.
- 1.5×10^{-6} Ci/ft^3 of existing waste is the concentration in the vapor space of each of six tanks in a tank farm (110 °F saturated air)
- 1.5 Ci/wk per tank enters the decon system. (100 cfm is equivalent to 10^6 ft^3/wk)
- Under the effluent decontamination design conditions, the efficiencies are 90%, 35%, and 99.97% for the de-entrainer, prefilter, and 1st stage HEPA, respectively. The total quantity associated with the maximum credible accident equals 2 Ci of which 1.8, 0.067 and 0.133 Ci is contained in the de-entrainer, prefilter and first HEPA respectively.

It is unlikely that all six of the tanks will have the same concentration, however, frequent prefilter changes are common when transfers of waste are being made into the AW Tank Farms. A release of 10% of the collected activity (0.2 Ci) results in a body dose of about 0.2 rem, and a bone dose of 2.4 rem in the first year after exposure (table 9-5). The total release is equivalent to about .06 gal of existing DS tank waste. The backup exhauster is started after this event occurs. The PFP waste contains high TRU in the sludge, but the tank vapor concentration is low and filter loading is low.

Leaks in the transfer system pits and subsequent release to the environs have potential release source terms which are below that described above because of the existence of the cover blocks.

9.4 EVALUATION OF THE CONSEQUENCES FOR LOSS OF POWER OR LOSS OF HVAC FROM A SAFE SHUTDOWN EARTHQUAKE (SSE)

In the event of a seismic event (SSE) the power/vent system for a farm is assumed to be lost until backup equipment can be provided. An earthquake is a limiting fault and is not expected to occur during the life of a facility $p < 10^{-3}$ (y^{-1}). The radiological dose criteria for risk acceptance under these circumstances is 300 rem to the bone and 75 rem to the lung (lifetime).[1]

The 50-yr bone dose to the "maximum offsite individual" based on exposure times of 4 wk is 1 rem. This dose results from injestion and inhalation pathways to a farmer located at Ringold. The bone is the critical organ for the inventory at risk. The maximum onsite individual is assumed to be exposed for 1/2 h, prior to evacuation or protective measures, resulting in a 14 rem dose to the bone from an inhalation pathway. These dose estimates are much less than that deemed acceptable by RHO-HS-MA-1 and are very conservative. The release rate for this analysis[3] is based on the evaporation from seven tanks; 7×10^{4} Btu/h each - with moisture concentration equal to 10^{-3} of that in existing waste. The tank vapor space concentrations are 50,000 and 900,000 times the Table II concentration guidelines (see chapter 7) for ^{137}Cs and ^{90}Sr respectively, when the moisture is assumed to be 10^{-3} of that in existing waste.

9.5 EVALUATION OF THE CONSEQUENCES DUE TO OVERPRESSURIZATION EVENTS

Measurements[2] in the tank vapor exhaust indicate that ^{137}Cs is the dominant radioisotope at levels about 10^{3} times the concentration guidelines in Table II (CG-II) in one tank (102 AW). The measured values are considerably less than those utilized for the SSE analysis. All other tanks have radioisotopic concentrations which are <50 CG-II. Tank 102 AW contains two air lift circulators which accounts for the higher vapor concentrations.

The primary tank pressure exceeds 0 in w.g. when loss of power or ventilation occurs. The concentration in all of the tanks during this time is assumed to be 5,000X CG-II (a worst case concentration based on currently available data).[2] Exposure to this unmonitored, undiluted released concentration for 18 h results in a whole body dose of 5 rem in one year to an operator located within a farm. The dose of 5 rem is the allowable annual occupational dose (see chapter 8). Since more than one event may occur per year the following relation is imposed. The product of the number of events per year and the time of exposure during each event cannot exceed 18 h for a dose of 5 rem, when the leaked concentration is 5,000 x CG-II.

Tank farm operators are required to have respirators available or evacuate the tank farm. Audible alarms shall be provided so that evacuation of the operators can be initiated in the event that the tank vacuum is lost. Alarms will be received at the evaporators and at CASS in the event of loss of power in the tank farms. Tank farm operations would then be notified by the CASS operator.

Typically, about ten events are expected to occur annually. Alarms, respirator use, and evacuation will assure that the exposure time is much less than 1.8 h (allowable time for each event).

During the overpressurization time, exposure to a worker outside of the farm can also occur. The dose is proportional to the distance, the release rate, the number of tanks, the leak duration and the exposure time. Assuming that 25% is released [50% into vent system, 50% of the remainder condensed on leak paths in dome], the total release to the environs for this scenario is 100 mCi of ^{137}Cs if the concentration is 5,000 x CG-II over 40 h. A dose of 100 mrem would be received after a 40 h exposure at 100 m. The dose criteria for risk acceptance to an onsite worker, when $P = 1(y^{-1})$ is 0.1 rem (100 mrem).[1] The product of the number of events and the time duration of each event should not exceed 40 h to assure the annual dose does not exceed 100 mrem.

If ten events occur per year per farm (eight tanks), then the recovery time must be less than four hours to limit the total dose to onsite personnel (at 100 m) not involved in the subject facility, to <100 mrem. Actions must be taken to stop transfers, shut off air lift circulators (if the vacuum is lost), and provide adequate backup systems to restore the ventilation system and the tank vacuum within 4 h.

It may also be postulated that a pressure event (primary tank pressure >0 in w.g.) occurs when the exhauster is operating. Events of this nature do not normally last for long time periods. Considerable excess pressure (5 in w.g.) for 6 h, from each of the eight tanks is needed to give a dose of 100 mrem at 100 m. The release volume per tank associted with this differential pressure (>100,000 ft^3) is far in excess of the tank vapor space volume (50,000 ft^3), and therfore it is judged incredible for a single event.

9.6 CONTROLS TO PREVENT ACCIDENTS FOR DOUBLE-SHELL TANKS

Mitigation of the potential accidents listed in this chapter is contingent upon adherence to the operation specification documents[6] and the SOPs for tank farms. The OSRs given in chapter 11 are designed to ensure that the Tank Farm Operation meets the controls and requirements that are imposed to prevent damage to equipment, facilities, or personnel.

Controls and limits to prevent excessive corrosion and minimize structural stresses include: (1) composition limits for specific ions, organic material, and hydrogen, (2) primary tank liquid levels and leak detector pit liquid levels, (3) dome hydrostatic load, (4) primary and annulus tank pressure, (5) temperature gradients and rate of temperature change for solutions and concrete. Limits are also established for the ventilation requirements for cooling and control of the release of radioactivity to the environs which include: (1) vacuum requirements to limit unfiltered releases; (2) HEPA filter controls on pressure drop, inlet temperatures, and efficiency; (3) monitoring and records of discharge; and (4) discharge limits.

9.7 OPERATIONAL SAFETY REQUIREMENTS GUIDELINES

Reference 8 lists the OSR upper bound limits necessary to ensure that the following consequences are not exceeded:

- Acute exposure to a member of the public or to onsite personnel not involved in the subject facility of 0.5 rem whole body or equivalent dose to any organ (DOE Order 5480.1A, chapter XI) (The onsite personnel included in this item would be determined on a case basis either on non-acceptance of risk or for which credit for immediate evacuation cannot be taken)

- Acute exposure to the occupational worker of 5.0 rem whole body or equivalent dose to any organ

- Limiting Conditions for Operation (LCO) are not written for prevention of criticality since the CPS provide an equivalent level of control

- Hazards unique to the facility (e.g., fire, explosion) that are not a commonly accepted occupational risk

- Major release of radioactive and/or hazardous materials to the environment.

The onsite personnel who are not involved in DS tank farm facilities are located 100 m from the release point. For existing DS tank waste it has been shown that a bone dose of 3 rem is committed in 1 yr to an individual if the product of release, R, in Ci/unit time and the exposure time, t, equals 0.26 (Rt = 0.26). The exposure time must be reduced proportionally if the release term increases.

Immediate evacuation can only be taken when the source is released over a prolonged period. For short term releases no evacuation or emergency plan is adequate. Events which exceed 2.6 Ci/h and a 6 min exposure or 0.26 Ci/min and a minute exposure are in the later category. Tables 9-1 through 9-4 list source terms for all appropriate accidents.

The current operations in DS Tank Farms involve the receipt of CRW feed and its ultimate conversion to sludge and DSS. The source terms listed in table 9-1 through 9-4 are those for CRW feed cooled for greater than 180 d but less than 1 yr. The dose per curie of the CRW waste decreases with time and is less than that of existing waste (see table 9-6). For conservatism, the maximum credible accident used the inventory for existing waste rather than CRW Feed or DSS because the dose per curie released results in a higher dose to the exposed individual. For existing waste the dose in 11.8 rem/Ci to the bone, for feed at 180 d it is 1.13 rem/Ci to lung, and for DSS at 180 d it is 0.5 rem/Ci to the kidney.

9.8 REFERENCES

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2. Kimura, R. T., "Characterization of Shielded Double-Shell Tank Vapor Space Radionuclides," (Internal Letter 65950-85-586 to W. H. Trott), Rockwell Hanford Operations, Richland, Washington (January 1986).

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5. Sasaki, L. M., "Results of Hydrogen Monitoring in Tank 101 SY," (Internal Letter 6511-85-157 to K. G. Carothers), Rockwell Hanford Operations, Richland, Washington (September 16, 1985).

6. Rogers, L. H., Operating Specification Documents and Standards for the Operation of Radioactive Waste Tank Farms and Associated Facilities, Manual No. PS 39A (OSD-T-ISI-00007), Rockwell Hanford Operations, Richland, Washington (October 31, 1984).

7. Critical Engineering and Analysis, Criticality Prevention Specification, CPS-T-149-00010, Rev. 0, Rockwell Hanford Operations, Richland, Washington (April 25, 1984).

8. Smith, D. A., Operational Safety Requirement Criteria, SD-SQA-AR-001, Rockwell Hanford Operations, Richland, Washington (July 1985).

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10.0 CONDUCT OF OPERATIONS

The DS tank farm facilities provide storage space for neutralized liquid waste resulting from processing facilities at the Hanford Site. Operations conducted within a facility include receipt of waste, measuring and monitoring of major parameters to ensure continued containment of the waste, transfer of wastes, and the collection and reporting of data to operational management. The facility is manned 5 d/wk on the 8-to-4 shift. Off-shift coverage is provided by the CASS and centrally located operations personnel.

10.1 OPERATING ORGANIZATION

Many of the operations conducted within a tank farm facility require the interaction of several Functions including Research and Engineering, Safety and Quality Assurance (S&QA), and others. Overall responsibility for operation of the facility is assigned to the Tank Farm Surveillance and Operations (TFS&O) Department. The relationship of TFS&O and tank farm groups within the Rockwell management organization is shown in figure 10-1.

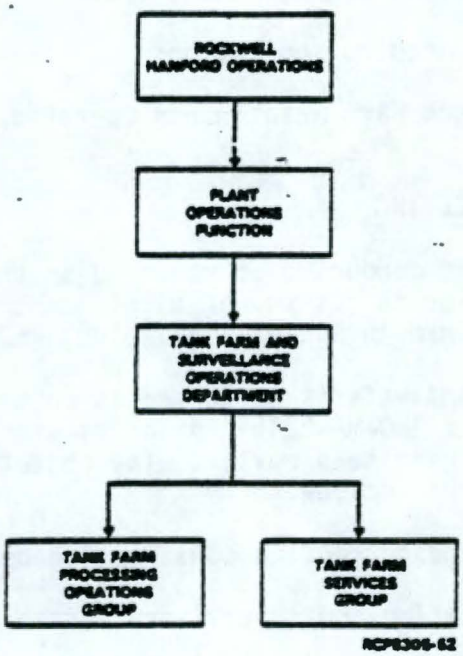

Figure 10-1. Tank Farm Operations Organization.

10.1.1 Tank Farm Processing Operations

The Tank Farm Processing Operations Group is responsible for the following activities that directly pertain to the DS tank farm facility:[1]

- Receipt of waste transfers into the tank farm facility
- Shift coverage of Tank Farm
- Collection of surveillance data from waste storage tanks
- Control and operation of CASS
- Surveillance of tank farm processing facilities.

10.1.2 Tank Farm Services

Tank Farm Services is the lead group for providing the following activities within a DS tank farm facility:[1]

- Radioactive waste storage and disposal
- Contamination control operations
- Support of Tank Farm Maintenance Operation.

10.2 PREOPERATIONAL TESTING

Readiness review is conducted as required in the QA Manual, RHO-MA-150 Procedure 9.301,[2] prior to startup of significant processes that qualify under the criteria defined in Rockwell Policies, RHO-MA-100.[3]

A pre-job safety analysis is performed as required in Accident Prevention Standard 2 of RHO-MA-221[4] prior to startup of operations which do not qualify for the readiness review. The objectives of these two types of preoperational reviews include:

- Identifying and correcting construction deficiencies
- Training operation and supervisory personnel
- Demonstrating the operational readiness of the facility on an integrated system basis.

10.3 TRAINING

It is the policy of Rockwell to ensure that personnel are qualified to perform their duties in a safe, efficient, and effective manner. To implement this policy, formal and on-the-job training is conducted. Training programs associated with the operation of the double shell tank farm facilities provide employees with both knowledge and skills required to perform assigned work. The training programs also prepare individuals to take prompt, effective action in response to abnormal or emergency conditions.

Currently, there is formal certification of each operator and field manager at a facility. To become certified, the manager and operator must demonstrate a thorough knowledge of the facility, its operation, and responses to normal and off-standard situations. Documentation of certification is maintained by the Rockwell Training Department.

10.4 NORMAL OPERATIONS

Plant Operating Procedures are prepared for anticipated and frequent activities performed within all DS tank farm facilities. The procedures are prepared in accordance with the Engineering Procedures Manual.(5) Prior to acceptance, procedures undergo review, and a "walk-through" to ensure the safe performance of the task.

Changes to an approved procedure can be accomplished either by issuing a revised procedure or by altering the existing procedure using a Procedure Departure Authorization (PDA).(6) PDAs include S&QA review and approval before implementation. The use of PDA is restricted to one of the following situations.

- A temporary departure from the procedure is needed due to temporary equipment or process changes of such duration (normally less than 2 mo) that make the normal procedure change and release process impractical.

- A permanent change must be implemented immediately to either correct procedural errors/ambiguities that could result in operating errors or unsafe procedure performance or to provide for essential equipment or process changes not anticipated previously.

10.5 EMERGENCY PLANNING

Emergency plans for the Tank Farms are contained in RHO-MA-111.5.(7) This emergency manual contains procedures for coping with various types of emergencies. The procedures define actions to be taken, including specific individual responsibilities, to achieve protection of personnel, facilities, and the environment. The emergency action coordinator is the TFS&O Manager. The on-duty shift manager acts as the emergency action coordinator during off-shift hours until relieved by the TFS&O Manager.

10.6 PROCEDURAL REQUIREMENTS

Various procedures and standards, developed on the basis of experience in processing nuclear materials at the Hanford Site since the 1940s, are documented in Rockwell Policy manuals. Compliance to all Rockwell policies is mandatory. Specific policies in regard to safety and conduct of operation is provided below. The operational safety requirements described in chapter 11, which specifically apply to DS tank farm operations, supplement these Rockwell Policies.

- RHO-MA-100, Volumes 1 and 2, Rockwell Hanford Operations Policies Manual

  This manual includes organization charts and charters of the various Rockwell Hanford functions.(3)

- RHO-MA-136, Nuclear Criticality Safety Standards

  This manual covers criticality safety principles, training, controls, and other practices.(8)

- RHO-MA-139, Environmental Protection Manual

  This manual details the standards for release of radioactive and nonradioactive materials into the air, water, and soils; the environmental surveillance program; testing and schedule of filter systems covering DS Tank operations in this area and the effluent sampling and monitoring program.(9)

- RHO-MA-145, Radiation Monitoring Manual of Standard Practices

  This manual is a documented collection of methods, routine practices, controls, exposure guides, supporting data, and other information developed to serve as a guide to radiation protection technologists (RPTs) in performing and maintaining a uniform and sound radiation control program. The technical basis of the limits and procedures contained in the manual stem principally from authoritative bodies such as the National Council on Radiation Protection and Measurements (NCRP), the now defunct Federal Radiation Council (FRC), and the International Commission on Radiological Protection (ICRP). In addition, requirements of DOE and other Federal regulations have been included where appropriate.(10)

- RHO-MA-172, Radiation Work Permits

  This manual sets up regulations and practices governing the various phases of work and radiation work areas as well as defining the methods for positive containment covering DS Tank operations in this area.(11)

- RHO-MA-220, Rev. 1, Radiological Standards and Operational Controls

  This manual details the radiation protection standards and controls in effect at Rockwell.[12]

- RHO-MA-221, Accident Prevention Standards

  This manual contains accident prevention standards and chemical safety guides to promote general industrial safety.[4] Standard No. 6 covers fire protection and storage of combustible materials governing DS tank farm operation in this area.

In addition to the referenced manuals, there is constant updating of existing procedures and initiation of new procedures when necessary. These procedures are known as standard operating procedures (SOPs) and are developed to assure that operators can complete all assignments in a safe manner.

10.7 REFERENCES

1. Rockwell, Tank Farm Surveillance and Operations, Number TF 2-001, RHO-MA-272, Departmental Responsibilities, Rockwell Hanford Operations, Richland, Washington (November 1981).

2. Rockwell, Quality Assurance Manual, Procedure 9.301, RHO-MA-150, R. D. Hammond, Rockwell Hanford Operations, Richland, Washington (June 1977).

3. Rockwell, Policies Manual, RHO-MA-100, Rockwell Hanford Operations, Richland, Washington (December 1983).

4. Rockwell, Accident Prevention Standards, Vol. 1 and 2, RHO-MA-221, Rockwell Hanford Operations, Richland, Washington (March 1979).

5. Rockwell, Engineering Procedures Manual, section 2-8.5, Operating Procedures, RHO-MA-115, Rockwell Hanford Operations, Richland, Washington (October 1981).

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7. Rockwell, Emergency Plan - Tank Farms, RHO-MA-111.5, Rockwell Hanford Operations, Richland, Washington (January 1983).

8. Owens, G. C., April 1983, Nuclear Criticality Safety Standards, RHO-MA-136, Rockwell Hanford Operations, Richland, Washington.

9. Boothe, G. F., January 1985, Environmental Protection Manual, RHO-MA-139, Rockwell Hanford Operations, Richland, Washington.

10. Radiation Monitoring Group, April 2, 1979, Manual of Standard Practices, RHO-MA-145, Rockwell Hanford Operations, Richland, Washington.

11. Radiation Monitoring Group, April 1985, Radiation Work Permits, RHO-MA-172, Rev. 1, Rockwell Hanford Operations, Richland, Washington.

12. Radiological Engineering, February 1983, Radiological Standards and Operational Controls, RHO-MA-220, Rev. 1, Rockwell Hanford Operations, Richland, Washington.

11.0 OPERATIONAL SAFETY REQUIREMENTS

11.1 INTRODUCTION

Operational Safety Requirements (OSRs) define acceptable conditions, safe boundaries, and management controls required to assure safe operation of DS Tank Farm facilities during the processing of radiochemical wastes. Operations outside of the specified boundaries and conditions could result in an unacceptable level of risk to the public and site workers; facility integrity could also be compromised. The OSRs specific to DS Tank Farms are discussed later in this chapter. Sections 11.2 and 11.3, below, describe the general characteristics of all OSRs.(1)

11.2 DEFINITIONS

11.2.1 Title

This is the title of the individual OSR being defined.

11.2.2 Applicability

Applicability applies to that portion of the process/activity/facility addressed in the particular OSR.

11.2.3 Objective

The objective is the reason for the OSR and the specific condition(s) it is designed to prevent or promote.

11.2.4 Requirements

The requirements are concerned with actual safety limits, control settings, inventory maxima, temperatures, inspections, test frequencies, etc., being controlled. This section provides the safety limits for control settings, limiting conditions for operations, surveillance requirements, design features, and administrative controls which must be in place and observed to assure safe conduct of the activity. The OSRs are binding upon operations of the facility.

11.2.4.1 Safety Limits and Limiting Control Settings. The safety limits (SL) refer to those values of measurable safety-related variables outside of which serious consequences may occur. Violation of a safety limit constitutes violation of an OSR. The limiting control settings (LCS) are established within safety limits to allow for activation of alarms and for subsequent corrective action before the safety limit is reached.

Exceeding a Limiting Control Setting is not an OSR violation, but failure to respond to the agreed-upon recovery plan for a Limiting Control Setting violation is an OSR violation. Violations of safety limits or Limiting control settings shall be dealt with according to any specific recovery steps provided with the requirement as well as the provisions of section 11.2.6.1 or 11.2.6.2.

11.2.4.2 Limiting Conditions for Operations (LCO). The specifications in this section define the minimum acceptable operating conditions and practices consistent with the required assurance of safety of the environs, public, and operating personnel.

The LCO are, in general, action restrictions or requirements as opposed to specific limits, and an infraction could constitute a breach of a safety barrier or, if repeated frequently, could lead to a serious hazard. An infraction of an LCO, therefore, requires immediate investigative and corrective action, and notification of appropriate Rockwell management.

11.2.4.3 Surveillance Requirements. The specifications in this section define the minimum requirements for testing of backup or emergency equipment and the minimum frequencies of calibration of instruments and equipment necessary for verification of operation within the boundaries of the safety limits and limiting control settings. Upon determination that these requirements are not met, the recovery steps provided in section 11.2.6.3 shall be followed.

11.2.4.4 Design Features. The design features addressed in this section are limited to those equipment characteristics specifically required by safety considerations. Violations of these requirements shall be dealt with according to section 11.2.6.4.

11.2.5 Basis

This section is a discussion of the bases from which the objective and specification are derived. They refer to the accident analysis, chapter 9, and may include reference to equipment, inventory, physical conditions, personnel qualifications, DOE Orders, or Rockwell Policy.

11.2.6 Recovery

The recovery constitutes steps taken to return to normal operation if OSRs are violated; it defines the time allowed for recovery and the required notification or approval sequence. Violation of a requirement is normally detected at the time of occurrence of an accident because the specific control features provide early warning. Violation of a requirement can, however, be detected after the violation during routine process control review or periodic inspection or audit. Actions to be taken in response to OSR violations are delineated in the following general recovery steps.

11.2.6.1 Violations of a Safety Limit. When a violation of a safety limit is detected, the following action shall be taken:

- o Immediate action shall be taken to initiate a prompt and orderly shutdown of that portion of the operation involved. This may require a shutdown of the entire facility. If the violation or responsible action is addressed in an emergency procedure, that procedure shall be followed

- o Notification of the Rockwell management and DOE-RL shall be made in accordance with Rockwell procedures

- o Circumstances of the violation shall be investigated, the cause shall be established, and appropriate corrective action shall be determined. A report shall be prepared by the Rockwell investigation team for review and approval by Rockwell management

- o Facility startup shall be permitted only after the following action items have been completed satisfactorily, as determined by the appropriate review committees, and approved by Rockwell management with concurrence of DOE-RL Waste Management Division

- Action to return facility, system, or process to a safe condition

- Action or controls have been established to reduce the probability of a recurrence.

11.2.6.2 Violation of a Limiting Control Setting or Limiting Condition for Operation. When a violation of a Limiting Control Setting or LCO requirement is detected, the following action shall be taken:

- o Immediate action shall be in accordance with the recovery statement provided with the requirement. Additional actions taken shall be in compliance with a recovery plan approved by Rockwell management. Continued operation without implementation of the above recovery actions is considered an OSR violation and shall be treated as a safety limit violation (section 11.2.6.1)

- o Notification of Operations, R&E, and S&QA shall be made immediately or as soon as possible

- o The incident shall be investigated and reported by Rockwell management or specified delegate. If the incident involved shutdown of a portion of the operations, restart shall require approval of Rockwell management.

11.2.6.3 Violation of a Surveillance Requirement. Upon determination that a surveillance requirement has not been met, management shall take immediate corrective action to resolve the failure to perform the surveillance requirements. Investigation and recovery of surveillance requirements shall be in accordance with Rockwell Nonconformance Reporting System[3].

Continued operation without implementing this recovery action is considered an OSR violation and shall be treated as a safety limit violation (section 11.2.6.1).

11.2.6.4 Violation of Design Feature Requirement. Upon determination that a design feature has not been provided or implemented, management shall take immediate corrective action to resolve the failure to provide or implement the design feature. Failure to provide or implement a design feature shall be treated as a safety limit violation (section 11.2.6.1).

11.2.7 Audit Point

The physical records (e.g., log sheets) used to demonstrate compliance with OSRs are identified, and the responsible organization that maintains the records is also specified. The retention period shall be according to Rockwell requirements.

11.3 REVISIONS

Revisions to the OSR document to correct discrepancies, reflect process flowsheet or equipment changes, etc., shall be initiated by Tank Farm Process Engineering. This group will also apprise the Safety Analysis Group of the revision. Review and approval of revisions to the OSR shall be at the same organizational level as the original OSR.

11.4 PRIMARY TANK LEAK DETECTION

- Applicability - This requirement applies to the 241 SY, AN, AW, and AP Tank Farms.

- Objective - The purpose of this requirement is to verify the integrity of the primary tank.

- Requirement - Limiting Conditions for Operation: The annuli of each tank shall be equipped with at least one operable leak detection device.

- Surveillance - Annulus CAMs and leak detector alarms are tested monthly, leak detector relays are tested quarterly, and CAM radiation switches are tested annually per Instrument Calibration Documents. Radiation Alarm set points are determined by RHO-MA-139.[5] The annulus monitoring system is continuously scanned by CASS. Alarms are displayed in the Instrument Buildings at the evaporators.

- Basis - This requirement must be satisfied in order to comply with U.S. Department of Energy Order 5820.2,[2] which requires routine assessment of the integrity of containment systems. Leak detection in the annulus is necessary so that corrective action

can be initiated if a primary waste tank develops a leak. Each annulus contains three conductivity probe leak detectors and one annulus exhaust CAM.

- Recovery - If the LCO is violated, the manager of TFS&O, TF&EPE and S&QA shall be notified. Transfers shall not occur if leak detection capability cannot be provided and shall be terminated if lost. Recovery action may include the use of temporary leak detection devices. Restoration of permanent leak detection systems shall be on a priority basis. If a surveillance requirement is violated, actions defined in section 11.2.6.3 shall be taken.

- Audit Points - Records of both Radiation Monitor Functional Tests and Leak Detector Functional Tests are maintained by Tank Farm Maintenance.

11.5 PRIMARY TANK MINIMUM LIQUID LEVEL

- Applicability - This requirement applies to the 241-SY, AN, AW, and AP DS Tank Farms.

- Objective - The purpose of this requirement is to assure that tank integrity is not jeopardized due to excessive vacuum.

- Requirement - Limiting Condition of Operation: The ventilation system shall not be operated unless the liquid level is 6 in. (241-SY, AN, AW and AP Tanks).

- Surveillance - Level indicating transmitters (LIT) in each tank are calibrated during Acceptance Test Procedures (ATPs) and Operability Test Procedures (OTPs) prior to start up. The LIT in each tank is continuously scanned.

- Basis - The bottom of double-shell tanks is subject to high stresses and possible uplifting at low hydrostatic head. Design specifications show the lowest permissible hydrostatic head to be -6 in. w.g. for AP farm tank and 0 in. w.g. for AN, AW, and SY farm tanks.

  Design capability of the ventilation exhausters is -12 in. w.g. for AP tanks and -6 in. w.g. for AN, AW, and SY tanks. The LCO requirement of a minimum of 6 in. liquid level in a tank will assure that the design capability of the bottom of the tank are not exceeded when the exhauster is operated.

- Recovery - If the LCO requirement is violated, the shift manager shall contact the managers of TFS&O and TF&EPC. Recovery actions include addition of water or waste and/or manipulation of the primary exhaust system. If a surveillance requirement is violated actions defined in section 11.2.6.3 shall be taken.

- Audit Point - Liquid levels are monitored and recorded on CASS.

11.6 TANK PRESSURIZATION

- Applicability - This requirement applies to the 241-SY, AN, AW, and AP Tank Farm ventilation system.

- Objective - The purpose of this requirement is to minimize personnel exposure in the event of a tank pressurization.

- Requirement: Limiting Condition for Operation - A tank pressure alarm loop (alarm audible in the farm) shall be operable and calibrated. In the event the alarm is not functional, an acceptable alternate is notification of the shift manager by the CASS operator of a tank pressurization event.

  Tank Farm pressurization (per farm) shall be limited to a cumulative total of 40 h during the most recent 12 mo period.

- Surveillance - High tank pressure alarm settings are established at a set point below 0 in. w.g. set forth in Process Specifications. High tank pressure alarm loops are calibrated annually not to exceed 13 mo per Instrument Calibration Documents.

  Tank pressures are continuously recorded on strip charts and reviewed quarterly.

- Basis - Pressurization of a tank could cause release of unmonitored, contaminated effluent to the atmosphere. An exposure of the operator to 10 events for 1.8 h each to the undiluted effluent could result in a whole body dose of 5 rem if the effluent was 5,000 times the concentration guides listed in Table II.[5] Routine measurements in the tank exhaust is used to establish which tank has the highest activity concentration of all DS tanks. Primary tanks are equipped with differential pressure indicating alarms for both excessive and insufficient vacuum. The local alarm will provide the necessary warning to tank farm personnel to evacuate or take protective measures.

  Annual exposure of 100 mrem to a worker located 100 m from the center of an 8-tank farm could result from a total of 40 h at 5,000 x Table II concentrations. This actual exposure would depend upon radionuclide concentrations and the presence of personnel during the event.

- Recovery - If the LCO requirement for the tank pressure alarm loop is violated, the shift manager shall contact the managers of Tank Farm and Surveillance Operations Department and Tank Farm and Evaporator Process Engineering. Notification to the shift manager of tank pressurization events shall be utilized to alert tank farm operators until the alarm is operational. The alarm shall be installed, repaired, or replaced on a priority basis. If the LCO

requirement for tank pressure duration is violated, the actual conditions involved in the pressurizations shall be evaluated to determine if the dose to personnel located at 100 m is approaching 100 mrem.

If a surveillance requirement is violated actions defined in section 11.2.6.3 shall be taken.

- Audit Point - Tank Farm and Evaporator Process Engineering maintains records of the measurements of the activity concentrations and cumulative hours pressurized per farm. Data sheets and strip charts records are maintained by Waste Management Health Physics.

11.7 WASTE TRANSFER SYSTEM LEAK DETECTION

- Applicability - This requirement applies to process pipelines and associated encasements, pits, and boxes in the DS Tank Farm facilities.

- Objective - The purpose of this requirement is to verify the integrity of the transfer system and to provide prompt notification of leaks from primary to secondary containment.

- Requirement - Limiting Condition for Operation: Transfer system leak detectors shall be verified as operable (not failed) before a transfer is initiated, or applicable diversion boxes/catch tanks shall be constantly surveyed with portable conductivity probes during the transfer.

- Surveillance - Leak detector probes are tested in raw water, per Operability Test Procedure (OTP) before startup. Alarms and annunciators are tested per Instrument Calibration documents. Standard Operating Procedures require verification of leak detector circuit operability prior to transfers (this is considered part of transfer route verification) constant surveillance shall be provided if leak detectors are inoperable.

- Recovery - If the LCO is violated the manager of TFS&O, TF&EPE and S&QA shall be notified. Transfers shall be terminated if leak detection capability cannot be provided and shall be terminated if lost. Recovery action may include the use of temporary leak detection devices. Restoration of a permanent leak detector shall be completed on a priority basis. If a surveillance requirement is violated actions defined in section 11.2.6.3 shall be taken.

- Basis - Immediate detection of liquid which has leaked from primary piping to encasements, pits, or boxes allows corrective action to be taken promptly to minimize the risk of discharge of radioactive material to the environment.

The leak detector system provides a test switch for checking of the warning light and external circuitry; a relay-controlled primary alarm circuit; and a fail-safe secondary circuit. It is not considered necessary to test the circuit from the probe to the relay, based on fail safe design; or the probe itself, based on a history of reliability.

- Audit Points - Records of leak detector circuit checks are recorded on data sheets in accordance with operating procedures and maintained by the shift manager of TFS&O.

11.8 REFERENCES

1. DOE-RL, Safety of Nuclear Facilities, DOE Order 5480.5, U.S. Department of Energy, Richland Operations, Richland, Washington (October 15, 1984).

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3. Rockwell, Accident Prevention Standards, RHO-MA-221, Rockwell Hanford Operations, Richland, Washington (March 1979).

4. DOE, Environmental Protection, Safety, and Health Protection Program for DOE Operations, DOE Order 5480.1A, Chapter XI, "Requirements for Radiation Protection," U.S. Department of Energy, Richland Operations, Richland, Washington (August 1981).

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12.0 QUALITY ASSURANCE

12.1 SCOPE

This chapter identifies quality assurance elements associated with the operating programs developed for the DS Tank Farms. The Quality Assurance Program was established through a Quality Assurance Program Plan to confirm that engineered quality requirements for DS Tank Farms have been accomplished in a safe and reliable manner.

12.2 ORGANIZATION

Organizational structures and respective charters for Rockwell functions participating in this operation are contained in the Rockwell Policies Manual.(1) These policies identify functional responsibilities, lines of communication within the individual organization, and the interface with peer groups for activities affecting quality and safety. The Quality Assurance organizational structure is represented in figure 12-1.

12.3 QUALITY ASSURANCE PROGRAM

The quality assurance program for Tank Farms is based on the ANSI/ASME Standard NQA-1,(1) as endorsed by DOE-RL Order 5700.1A.(2)

A series of policies and procedures, prepared collectively by Rockwell organizations as a proper response to the quality and safety aspects of the endorsed standard is represented in figure 12-2.

Elements and events described in the Quality Requirements Control Chart (see fig. 12-2) for the DS Tank Farms are applicable when imposed by program management, with functional managements concurrence, or when specified in quality assurance program plans for the Tank Farms.(4)

12.4 PERSONNEL TRAINING

Quality Assurance will assure that personnel scheduled to perform or observe operations associated with DS Tank Farms are trained and qualified as specified by Plant Safety Policies.(1) As a minimum, those performing tasks in radiation areas will have successfully completed training requirements specified in section 6.0 of the Radiological Standard and Operational Control Manual.(5)

Quality Assurance personnel will also be trained as specified in Quality Assurance Manual(6) Procedure 4-201 in accordance with Plant Safety Policies.(1)

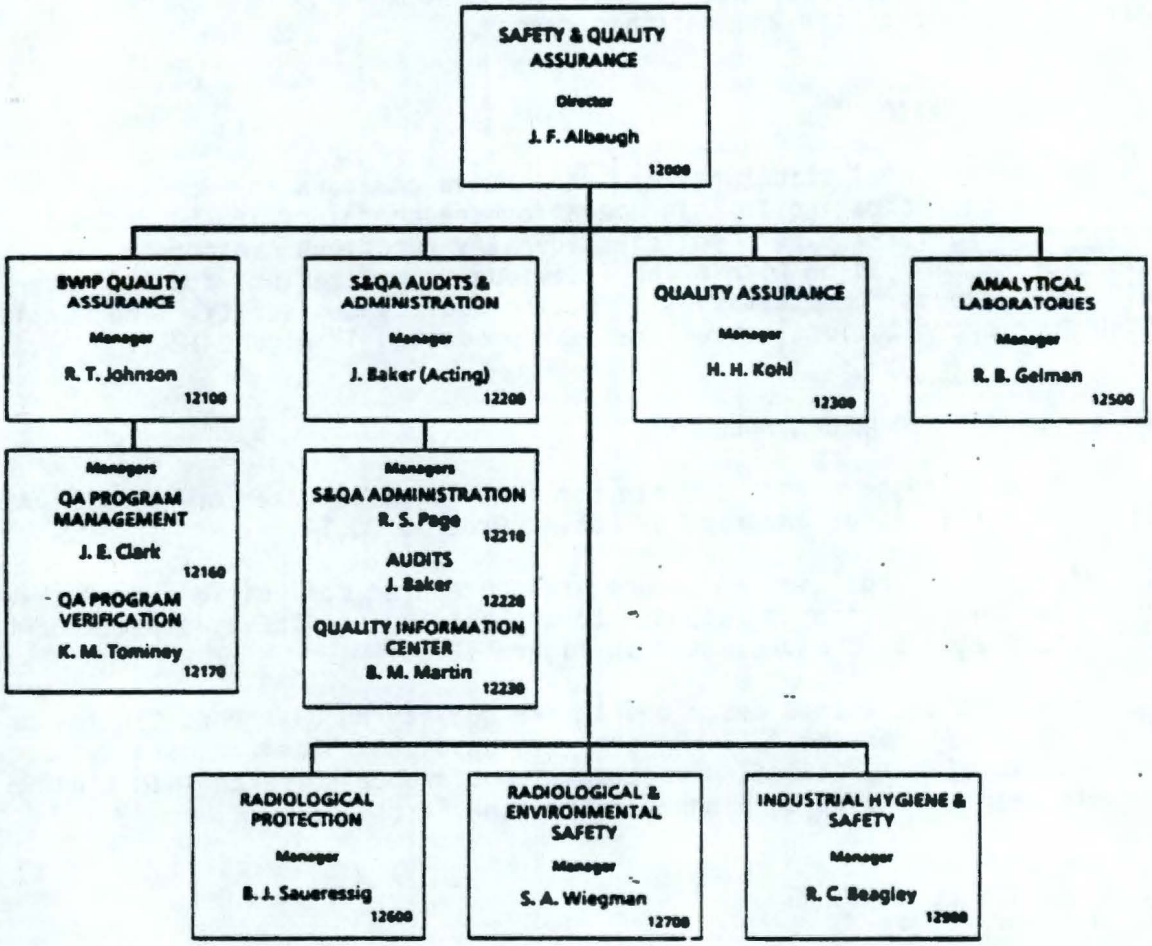

Figure 12-1. Quality Assurance Organization.

Quality Assurance elements	Design and construction support	Facility operation	Maintenance operation	Material and equipment procurement
Element developed and implementation	Construction management (1-3,7)	Facility management (1-4,7)	Maintenance management (1,8,19)	Materials management (1,7,8,11,12)
	Codes and standards (7,16)	Personnel training and qualification (2,6,8,9,17,20,21)	Production support (1,8,13,14,18,19,21)	Supplier control (1,8,11,12)
	Drawing preparation (7,8,16)	Engineering (1,7,16)	Fabrication control (1,8,18,21)	Purchase requisition control (1,8,11,12)
	Impact Levels (7,8,16)	Plant operations control (1,5,8,14,15,17)	Calibration control (1,8l,13,14)	PQA surveillance and receiving controls (1,8,9,11)
	Nuclear criticality planning (1,5,22)	Radiological controls (1,5,15)	QE&C planning and inspection verification (1,2,4,8,9)	Material certification (1,7,8,11)
	Design review (7)	Nuclear criticality safety (1,22)		Hypalon glove controls (1,8)
	Test plans (7)	Waste handling (1,5,15,23)		
	Plant safety (1,15)	QE&C planning and surveillance inspection (1-4,6-8)		
	Packaging Committee (PSSC) (1,7,23)	Analytical laboratory (1,6,8,10,15)		
		Glove control system (8)		
		Plant safety (1,15)		

Implemented Element Evaluation

Readiness Review (1,8)

Safety Analysis (1,5,15)

Scheduled QA Audits (1,8,9)

Scheduled S&QA Joint Audits (1,8)

Note: Numbers in parentheses identify Paragraph 12.11 references.

Figure 12-2. Quality Requirements Control Chart.

12.5 DESIGN SUPPORT

Engineering provides an effective design support system in the Engineering Procedures Manual[7] that addresses the quality and safety aspects associated with the operation of Tank Farms.

Quality Assurance groups review and approve design documentation, and utilize released documents to prepare quality verification plans for the acceptance of prescribed design attributes in accordance with instructions in QA Manuals.[8-10]

12.6 PROCUREMENT

Procurement Quality Assurance (PQA) conducts surveys of potential suppliers and monitors the performance of suppliers under contract to ensure that the level of quality planned for, and maintained commensurate with the quality and safety standards designated for Tank Farm programs.

The Materials Function and PQA maintain procedural manuals[8,9,11,12] that provide the necessary procurement guidance for ensuring that all technical elements associated with B Plant are performed as ordered by engineering documentation.

PQA maintains a quality verification system that confirms compliance of the received product.

12.7 INSPECTION

Quality Assurance manuals[8,9] and Quality Program Plan[4] dictate the planning for inspection and the practices to be used by inspectors to assure compliance with design requirements.

Verification media can range from visual surveillance to complex machine set-ups, with the prime consideration being the documented acceptance of quality and safety requirements. To that end, inspections:

- Are planned in a concise manner to minimize the potential for error
- Take place at the earliest practical point in the work sequence
- Are recorded and maintained readily available when significant to the history of the item or applicable to subsequent operations
- Are applied commensurate with the potential impact on personnel or environmental protection.

Tank Farm Quality Control performs tasks as follows:

- o Operational Test Procedures (OTPs) on facility to assure function and acceptability of all systems
- o The OTPs on all modifications to the facility
- o Witness installation and changes of equipment used to transfer tank inventories
- o Witness routing and valving operations
- o Witness ventilation and cooling filter changes and tests
- o Surveillance activities which are detailed by the assigned Quality Assurance Engineers and are specific to the individual Tank Farm or facility. (Subjects include: Computer Automated Surveillance System, sampling and monitoring programs, instrumentation and associated calibration verification.)

12.8 CALIBRATION AND CONTROL

Instruments, test equipment, and working standards are calibrated using approved calibration procedures,(13) to recognized national standards Instruments in use, other than those identified for "indication only," will have valid evidence of a current calibration.(14)

Laboratory instrument calibration is conducted to approved laboratory procedures.(10) Recalibration frequency is determined by the Applied Technology staff based on the instrument manufacturer's recommendation and equipment performance records. Calibration recall activities are monitored on the Rockwell Production Support Maintenance Engineering Recall System.(14) Actual calibration work is performed by trained technicians or chemists.

12.9 INCIDENTS, NONCONFORMANCES, AND CORRECTIVE ACTION

Nonconforming conditions observed by Quality Assurance during material, component, or equipment acceptance are reported and dispositioned on the Nonconformance Report (NCR) in accordance with Quality Assurance procedures.(8,9)

Incidents that occur during the (B Plant) operational phase which could affect safety are reported as Unusual Occurrences per Accident Prevention Standard 32,(15) or Off-Standard conditions when noted in the Analytical Laboratories.(10)

Where corrective action is required to prevent a discrepancy recurrence beyond the scope of the NCR disposition, Corrective Action Requests[8,9] are generated by the individual recognizing the need for such action. Timely responses are submitted by management.

12.10 QUALITY ASSURANCE LABORATORY

Analytical Laboratories (AL) are responsible for maintaining a safe and effective operation in accordance with approved plans and procedures.[8,10] Analytical Laboratory management reviews AL operations on a continuing basis to maintain the safe condition status.

12.11 RECORDS

Records attesting to the conformance or nonconformance of activities and equipment related to the AP Tank Farms and associated facilities will be reviewed for completeness and thereafter archived in the Quality Assurance Information Center. Retention and retrievability of these records will conform to requirements of Document Control or Productive Records,[8] Procedures 9-201.

12.12 AUDITS

Audits will be performed to verify compliance to requirements of the quality assurance program and will document findings and observations. These planned and scheduled audits will be made to written procedures and checklists and continued at intervals commensurate with the importance of the activity. Follow-up action will be taken to assure audit responses are adequate to prevent recurrence.

12.13 REFERENCES

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3. DOE, RL 5700.1A, Quality Assurance, U.S. Department of Energy, Richland Operations, Richland Washington (July 1983).

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7. Rockwell, Engineering Procedures Manual, RHO-MA-115, Rockwell Hanford Operations, Richland, Washington.

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18. Matthews, J. W., Fabrication Services Manual, RHO-PO-MA-2, Rockwell Hanford Operations, Richland, Washington.

19. Molnaa, J. D., Utility Operations and Services Manual, RHO-PS-MA-2, Rockwell Hanford Operations, Richland, Washington.

20. Kohl, H. H., NDE Special Process Procedures Manual, Rockwell Hanford Operations, Richland, Washington.

21. Serl, L., Welding Procedures Manual, RHO-MA-181, Rockwell Hanford Operations, Richland, Washington.

22. Rockwell, Nuclear Criticality Safety Standards, RHO-MA-136, Rockwell Hanford Operations, Richland, Washington.

23. Pauly, T. R., Hanford Radioactive Solid Waste Packaging, Storage, and Disposal Requirements, RHO-MA-222, Rev. 3, Rockwell Hanford Operations, Richland, Washington (August 1985).

APPENDIX A

AW TANK FARM DESIGN CRITERIA

References: (1) ARH-CD-362, Functional Design Criteria, Additional High-Level Waste Storage Facilities, K. H. Tanaka (June 30, 1975).

(2) SD-RE-TI-008, Compilation of Basis Letter Referenced in 241-AN, AW, AY, AZ, and SY Process Specifications, T. J. Venetz (January 27, 1982).

Number of Tanks	- 6
Liquid Storage Capacity, Each Tank	- 10^6 gal (sp. gr. 2.0)/tank - 1.14×10^6 gal (sp. gr. 1.7)/tank
Primary Tank Diameter	- 75 ft
Secondary Tank Diameter	- 80 ft
Earth Cover (Backfill)	- 6.5 ft
Live Loading on Backfill Over Tank	- 40 lb/ft^2 uniform plus 50 tons concentrated
Internal Vacuum	- 6 in. H_2O maximum
Internal Pressure	- 60 in. H_2O maximum
Waste Characteristics:	
Temperature	- 350 F, maximum*
Heat Generation Rate	- 100,000 Btu/h/tank maximum
pH	- 8 to 14
Specific Gravity	- 2.0 maximum
Seismic Acceleration	- 0.25g horizontal, 0.17g vertical
Wind Loads	- Uniform Building Code Requirements
Stress Relief (Primary Tank)	- 1,100 F for 1 h

*The tanks were analyzed for structural effects of thermal cycling and liquid level cycling. Even though wastes may enter the tanks up to 350 F, their temperature will fall quickly to less than the maximum tank wall temperature of 200 F by heat conduction and dilution.

Design Life	- 50 yr based on 1 mil corrosion/yr
Tank Wall Temperature	- 200 F maximum
Primary Tank Construction Material	- ASTM A 537, Class 1 Carbon Steel
Secondary Tank Construction Material	- ASTM A 537, Carbon Steel - Reinforced Concrete
Process Piping	- American National Standards - Institute B-31.1 Criteria - 0.25% slope minimum - Pressure: 400 psig - Encased - Heat traced
Annulus Ventilation System	- 4,800 cfm, maximum - Double HEPA filtered - Stack monitor/sampler - Redundant system
Primary Ventilation System	- 1,000 cfm, maximum - Prefilter - Double HEPA filtered - Stack monitor/sampler - Redundant system
Air-Lift Circulators	- 2 air-lift circulators in Tank 102 - AW for feed tank purposes only
Radiation Exposure	- Adequate shielding from coverblocks and earth cover - 1.0 mR/h

APPENDIX A

AN TANK FARM DESIGN CRITERIA

References: (1) ARH-CD-304, Functional Design Criteria, Additional High-Level Waste Storage and Handling Facilities, K. H. Tanaka (May 1975).

(2) ARH-CD-549, Rev. 1, Functional Design Criteria -Additional High-Level Waste Handling and Storage Facilities, R. B. Guenther (April 21, 1978).

(3) SD-RE-TI-008, Compilation of Basis Letter Referenced in 241-AN, AW, AY, AZ, and SY Process Specifications, T. J. Venetz (January 27, 1982).

Number of Tanks	- 7
Liquid Storage Capacity	- 10^6 gal (sp. gr. 2.0)/tank - 1.14×10^6 gal (sp. gr. 1.7)/tank
Primary Tank Diameter	- 75 ft
Secondary Tank Diameter	- 80 ft
Earth Cover (Backfill)	- 7.0 ft
Live Loading on Backfill Over Tank	- 40 lb/ft^2 uniform plus 50 tons concentrated
Internal Vacuum	- 6 in. H_2O maximum
Internal Pressure	- 60 in. H_2O maximum
Waste Characteristics:	
Temperature	- 350 F, maximum*
Heat Generation Rate	- 100,000 Btu/h/tank maximum
pH	- 8 to 14
Specific Gravity	- 2.0 maximum
Seismic Acceleration	- 0.25g horizontal, 0.17g vertical

*The tanks were analyzed for structural effects of thermal cycling and liquid level cycling. Even though wastes may enter the tanks up to 350 F, their temperature will fall quickly to less than the maximum tank wall temperature of 200 F by heat conduction and dilution.

Wind Loads	- Uniform Building Code Requirements
Stress Relief (Primary Tank)	- 1,100 F for 1 h
Design Life	- 50 yr based on 1 mil corrosion/yr
Tank Wall Temperature	- 200 F maximum
Primary Tank Construction Material	- ASTM A 537, Class 1 Carbon Steel
Secondary Tank Construction Material	- ASTM A 537, Carbon Steel - Reinforced Concrete
Process Piping	- American National Standards - Institute B-31.1 Criteria - 0.25% slope minimum - Pressure: 400 psig - Encased - Heat traced
Annulus Ventilation System	- 6125 cfm, maximum - Double HEPA filtered - Stack monitor/sampler - Redundant system
Primary Ventilation System	- 1000 cfm, maximum - Prefilter - Double HEPA filtered - Stack monitor/sampler - Redundant system
Air-Lift Circulators	- 21 air-lift circulators in Tank 107 - AN - currently not operable
Radiation Exposure	- Adequate shielding from coverblocks and earth cover - 1.0 mR/h - 0.5 mR/h (107AN)

APPENDIX A

AP TANK FARM DESIGN CRITERIA

References: (1) SD-340-FDC-001, Functional Design Criteria, C. B. McVey (November 15, 1982).

Number of Tanks	- 8
Liquid Storage Capacity	- 1.16×10^6 gal/tank
Primary Tank Diameter	- 75 ft
Secondary Tank Diameter	- 80 ft
Earth Cover (Backfill)	- 7.0 ft
Live Loading on Backfill Over Tank	- 40 lb/ft^2 uniform plus 50 tons concentrated
Internal Vacuum	- 12 in. H_2O maximum
Internal Pressure	- 60 in. H_2O maximum
Waste Characteristics:	
Temperature	- 350 F, maximum*
Heat Generation Rate	- 100,000 Btu/h/tank maximum
pH	- 8 to 14
Specific Gravity	- 2.0 maximum
Seismic Acceleration	- 0.25g horizontal, 0.17g vertical
Wind Loads	- Uniform Building Code
Stress Relief (Primary Tank)	- 1100 F for 1 h
Design Life	- 50 yr based on 1 mil corrosion/yr
Tank Wall Temperature	- 300 F maximum
Primary Tank Construction Material	- ASTM A 537, Class 1 Carbon Steel

*The tanks were analyzed for structural effects of thermal cycling and liquid level cycling. Even though wastes may enter the tanks up to 350 F, their temperature will fall quickly to less than the maximum tank wall temperature of 200 F by heat conduction and dilution.

Secondary Tank Construction Material	- ASTM A 537, Carbon Steel - Reinforced Concrete
Process Piping	- American National Standards - Institute B-31.1 Criteria - 0.25% slope minimum - Pressure: 400 psig - Encased - Heat traced - Cathodically Protected
Annulus Ventilation System	- 8,600 cfm, maximum - Double HEPA filtered - Stack monitor/sampler - Redundant system
Primary Ventilation System	- 1,000 cfm, maximum - Prefilter - Double HEPA filtered - Stack monitor/sampler - Redundant system
Air-Lift Circulators	- Not applicable
Radiation Exposure	- Adequate shielding from coverblocks and earth cover - 0.5 mR/h - ALARA

APPENDIX A

SY TANK FARM DESIGN CRITERIA

References: (1) ARH-2930, Functional Design Criteria - Salt Cake Storage Facilities - 241-SY Tank Farm, K. H. Tanaka (November 19, 1973).

(2) SD-RE-TI-008, Compilation of Basis Letters Referenced in 241-AN, AW, AY, AZ and SY Process Specifications, T. J. Venetz (January 27, 1982).

Number of Tanks	- 3
Liquid Storage Capacity	- 1.14×10^6 gal/tank
Primary Tank Diameter	- 75 ft
Secondary Tank Diameter	- 80 ft
Earth Cover (Backfill)	- 6.5 ft
Live Loading on Backfill Over Tank	- 40 lb/ft^2 uniform plus 50 tons concentrated
Internal Vacuum	- 6 in. H_2O maximum
Internal Pressure	- 60 in. H_2O maximum
Waste Characteristics:	
Temperature	- 250 F, maximum*
Heat Generation Rate	- 50,000 Btu/h/tank maximum
pH	- 8 to 14
Specific Gravity	- 1.7 maximum
Seismic Acceleration	- 0.25 horizontal - 0.17 vertical
Wind Loads	- Uniform Building Code

*The tanks were analyzed for structural effects of thermal cycling and liquid level cycling. Even though wastes may enter the tanks up to 350 F, their temperature will fall quickly to less than the maximum tank wall temperature of 200 F by heat conduction and dilution.

Stress Relief (Primary Tank Only)	- 1,100 F for 1 h

Design Life	- 50 yr
Tank Wall Temperature	- 250 F maximum
Primary Tank Construction Material	- ASTM - A 515 Grade 60, Carbon Steel
Secondary Tank Construction Material	- ASTM - A 515 Grade 60, Carbon Steel - Reinforced Concrete
Process Piping	- American National Standard Institute B-31.1 Criteria - 0.25% slope minimum - Pressure: 400 psig - Heat traced - Encased
Annulus Ventilation System	- 750 cfm, maximum - Double HEPA filtered - Stack monitor/sampler
Primary Ventilation System	- 1000 cfm, maximum - Double HEPA filtered - Stack monitor/sampler
Air-Lift Circulators	- Not applicable
Radiation Exposure	- Adequate shielding from coverblocks and earth cover

APPENDIX B

UNUSUAL OCCURRENCES (UO)

During the period from 1981 until the present, the following UOs have occurred at the DS Tank Farms.

- 241-AN Fire Incident (81-58)

  At 10:25 a.m. September 15, 1981 (during Reliability Test prior to startup) a loud "pop" was heard at the Central Exhaust Station Motor Control Center. A flame was observed coming out around the edge of the door of the cabinet associated with the K1-2-1 electrical blast heater power components.

  Cause of Occurrence

  A redundant current alarm switch monitoring K1-2-1 power shorted out. The switch should have been removed during construction of the new K1 primary ventilation system.

- Failure to Control Operations (81-61)

  This incident was declared an occurrence on September 16, 1981. Water flush of R. R. Tank Car No. 18579 while J. A. Jones (JAJ) personnel were excavating in S Farm in the vicinity of the transfer process line. There was no exposure to personnel as a result of this incident. The apparent cause was a failure by Tank Farm management to communicate Rockwell Radiation Monitoring, and JAJ construction. Additionally, JAJ did not follow the lock-and-tag procedure prior to sending personnel into the work area.

- Permanent Corrective Action

  To be incorporated into the Tank Farm Transfer Procedure -General TO-025-001: Before starting, and at the completion of a transfer, the person(s) responsible for the transfer shall notify Radiation Monitoring management, Tank Farm Processing Operations, Tank Farm Services, and any or all construction forces working in transfer area. It shall be the responsibility of the involved Tank Farm manager to verify that personnel have been notified and cleared of transfer route. J. A. Jones was contacted and D. J. Heberlein, JAJ 200 Area Superintendent, has told the Jones people that they must contact Tank Farm Operations before entering any farm or moving from one area to another within a farm or receive disciplinary action.

Rockwell, Accident Prevention Standards, RHO-MA-221, Vol. 1 and 2, Rockwell Hanford Operations, Richland, Washington (August 19, 1985).

- Steam Release from 107-AN Pump Pit (83-28)

Thermally hot radioactive waste (180 to 200 °F) was being transferred into tank 107-AN. A malfunction of the AN Farm stack sampler caused the interlock system to shut off the AN Farm vent fan before the transfer could be shut down. The interlock system responded as designed. Loss of vacuum in the tank, coupled with the elevated temperature of the solution, caused steam to escape from the tank 107-AN pump pits to the atmosphere. Because this type of event can cause a release of radioactivity to the atmosphere, the vapor plume was surveyed for radioactivity. The results, in this case, showed no radioactive release.

Corrective Action

On December 20, 1983, Tank Farm and Evaporator Process Engineering issued their recommendation (65950-83-1715) which resolves this problem. That recommendation was for removing the stack sampler/fan interlock. The design to implement the recommendation in both AW and AN Tank Farms was completed on April 12, 1984. The AN and AW Tank Farms Interlock Systems was modified by July 9, 1984.

- Pressurization of Waste Tanks in 241-AW Tank Farms (83-31)

On November 16, 1983, waste tanks in the AW Tank Farm were pressurized during a planned "dump" of the contents of 242-A Evaporator back into the Evaporator feed tank (i.e., 102-AW). The replacement of a pump within the 102-AW 02E feed pit necessitated the early dumping of the 242-A Evaporator pot. At 11:10 a.m., the 242-A Evaporator panel board operator initiated a planned dump of the contents of the Evaporator pot back into the 102-AW waste tank. The 242-A Evaporator pot contained 28,000 gal of water at 123 °F. The AW Farm waste tanks are maintained at ~2.0 in. w.g. negative pressure for contamination control by use of an HEPA filtered exhauster. At 11:17 a.m., the operator in the AW Tank Farm Instrument Building reported that a tank pressurization alarm had annunciated. The dump sequence was immediately stopped. At this point, ~12,000 gal had been dumped. Six minutes later, the pressures within the tank were again negative in relation to atmosphere and the dump sequence was restarted. The pressurization alarm again sounded after another 4,000 gal were dumped and the sequence was again stopped. The sequence was restarted ~3 min later after the tank pressures were again negative to the atmosphere. The dump was completed without further pressurization alarms.

A review of the tank pressure recorded data subsequent to the event revealed that the 102-AW waste tank had pressurized to +1.0 in. w.g. for ~2 to 3 min total. In addition, 101-AW, 104-AW, and 106-AW waste tanks had been pressurized to a lesser extent.

The 103-AW and 105-AW waste tanks had remained negative throughout the event. Radiological smears taken within AW Tank Farm immediately subsequent to the event revealed no release of contamination.

Immediate Evaluation

The rapid expansion of the tank vapors caused by the increase in vapor temperatures and humidity exceeded the exhaust air flow rate provided by the operating exhauster.

Immediate Action Taken and Results

The dump sequence was stopped upon annunciation of the pressurization alarm and was restarted only after the pressures in the tank were negative in relation to the atmosphere.

Final Evaluation and Lessons Learned

A series of four engineering tests were performed on November 7, 1983, March 5, 1984, March 26, 1984, and May 11, 1984. The conclusion reached from these tests was that the cause of the pressurization was due to the rapid expansion of the tank vapor space as thermally hot waste was dumped into the cooler feed tank. In the event of an emergency dump of the 242-A Evaporator, caused by loss of power or potential excessive solids formation, the potential for future pressurizations exists. Based upon the lack of any past contamination spread beyond containment barriers in the AW Tank Farm, such pressurizations are considered within the scope of acceptable accident scenarios.

Corrective Action

For future planned dumps of the 242-A Evaporator into the Evaporator feed tank, a slow dump has been imposed administratively to prevent pressurizations. Procedures have been modified to incorporate this administrative change.

- Multiple Pressurizations of the 103-AW Waste Tank Upon Receipt of PUREX E-5 Waste Transfers (83-33)

Since November 6, 1983, six out of the last 20 receipts of PUREX E-5 waste into 103-AW have pressurized the receiver tank. Pressurizations were up to 0.5 in. w.g. for periods up to 10 min. Radiological smears taken immediately subsequent to each pressurization revealed no contamination.

Immediate Evaluation

Tests have been performed on E-5 transfers to 103-AW psychrometric data confirmed that pressurization is due to rapid humidification of the tank vapor space. Further tests are being planned to

determine if the extent of the tank pressure rise can be controlled by limiting the temperature of the sending tank. Should limiting of the sending tank temperature be ineffective in controlling tank pressure rise, additional work to humidify the vapor space slowly prior to transfers will be initiated.

Immediate Action Taken and Results

Temperatures of the sending tank are being monitored. Should the temperature of the sending tank prove to be a critical parameter in causing pressurization of the receiving tank, operating limits for the sending tank temperature (prior to transfers) will be established. Temperature evaluation of the sending tank will be completed by February 28, 1984.

- Loss of Contamination Control at J. A. Jones Worksite (272-AW) (84-29)

Normal operations were being conducted in the tank farms. J. A. Jones was excavating a trench between AP and AW Tank Farm.

On May 7, 1984, a Kaiser employee advised Radiation Monitoring that radioactive contamination had been detected on his personal clothes by UNC, 100 N monitors on graveyard shift May 5, 1984. Upon questioning it was determined that he had worked at the JAJ worksite near 272-AW on Friday, May 4, 1984. While at the JAJ site he had knelt down in the excavation where the contamination had apparently been picked up. He had gone home and returned to work graveyard May 5, 1984 at UNC.

East Tank Farms RM surveyed the suspected area and confirmed the source of contamination as being immediately around and under an old PUREX encasement (from PUREX to the 152-A box in A Farm) which intersected the JAJ excavation.

Since the evidence indicated that his general clothing had been worn home, a home survey was performed. No contamination was found in the home, car, or any other clothing.

All personnel who had access to the contaminated excavation were contacted. Ten home surveys were made. In one survey minor spotty contamination was found on clothing and on a car floormat. Dosimeters of involved personnel were exchanged and emergency processing revealed no unusual exposure.

By midnight May 7, 1984, the contamination in the immediate vicinity of 272-AW was identified, stabilized, and under control. Apparently the contaminated soil was removed from the trench and transported to a spoils pile. Spread occurred when the material from the spoils pile was used to construct a ramp/bridge across the trench/excavation. The contaminated soil was removed and the area resurveyed and released. Recovery was completed May 9, 1984.

J. A. Jones had been working at the site periodically since April. When the encasement was encountered in the excavation during the week beginning April 9, 1984, surveys by a RPT revealed a maximum dose rate of 10 mR/h through the encasement and no significant smearable contamination from the top and sides (the underside of the encasement was not exposed). At this time the RPT communicated to JAJ that when they were ready to excavate below the encasement, they should notify Radiation Monitoring. This work being performed by JAJ was not a steady, on-going activity, but was being done as their manpower was available from other projects to do the work. Rockwell RM was not contacted as agreed. The RWP was violated.

Immediate Evaluation

Upon notification by the Kaiser employee on May 7, 1984 of the contamination found on him, action was taken by Rockwell RM to ascertain the source. Once located (May 7, 1984) JAJ was contacted and the workers involved located. Upper management was notified as was Public Relations as to the need to do home surveys.

Immediate Action Taken and Results

Home surveys of the suspected contaminated workers was initiated. Minor contamination at the home of one worker was found. Dosimeters were emergency processed and no unusual exposures were noted. The area was surveyed and stabilized on May 7, 1984. The areas were decontaminated and recovery was completed by May 9, 1984.

Final Evaluation and Lessons Learned

A contributing cause was identified as being a breakdown in communications between the construction contractor and the RM unit supporting the operation. This breakdown was attributed to the sporatic work being performed and the assumption that the worksite was clean.

A major lesson learned was that continuous monitoring is required where encasements or other areas having a high potential for contamination exist.

Corrective Action

The East Tank Farms Radiation Monitoring personnel training records and applicable procedures were reviewed for adequacy (completed). Meetings were held with the East Tank Farm Radiation Monitoring personnel (RPTs) to strongly emphasize the necessity of performing their monitoring tasks in a thorough and complete manner and to communicate their results to management and to one

another (complete). Met with JAJ management, addressing the necessity of following procedures, working closely with and communicating with Radiation Monitoring. The possible repercussions and resulting problems were discussed (complete).

- Unplanned Exposure to Construction Personnel (84-36)

Construction was underway under Project B340, phase 7, to install process piping from AW to AP Tank Farms. 242-A Evaporator Campaign 84-5 was underway. On June 13, 1984, two JAJ craftsmen received 80 mr of unplanned exposure due to poor communications between operating personnel in the 242-A Evaporator and AW Tank Farms.

Background

During the week of March 19, 1984, excavations were initiated in AW Tank Farm to lay the process piping which will connect AW Tank Farm to the new AP Tank Farm. Whereas AW Tank Farm is the most active of the 200 East Tank Farms (continually receiving PUREX waste and supporting 242-A operations) the potential of an inadvertent overexposure of personnel was recognized. To prevent such an occurrence and to mitigate the consequences of such an event, a pre-job planning session was held with Rockwell TFS&O, Rockwell RP, and JAJ construction personnel to institute certain unique controls. These controls included reaffirmation of the procedural requirement to notify appropriate personnel prior to the initiating of any transfer into the farm, all JAJ personnel would wear audible monitoring devices (PADIs), and the presence of an RPT at all times.

Event

On June 13, 1984, two JAJ welders and one JAJ QC inspector were working in an excavation in AW Tank Farm. The area had been previously surveyed by the RPT who determined the fields to be <5 mr. All three were wearing PADIs. Simultaneously, operations at the 242-A Evaporator were returning to normal after a planned backflush of the process condensate ion exchange column. At ~1400, product (slurry) specifications were met and the 242-A Evaporator panel board operator started pumping the slurry to its designated receiver tank (104-AW). No communications were made with personnel in AW Tank Farm. Approximately 30 min later, the RPT requested two welders to check their pencil dosimeters. A check showed an increase of 80 mr since lunch time, although their respective PADIs, set to alarm at 50 mr of accumulated dose, had not alarmed. The excavation was resurveyed and a field of ~150 mr/h at 6 in. from the slurry line was noted. The job was stopped at this point due to the need for additional RPT coverage. A check of the QC inspector's pencil dosimeter the following day showed a net increase of 20 mr.

When interviewed, the acting 242-A Evaporator manager stated that he did not perceive that the procedural requirement for communications was applicable because it was stated in the General Transfer Procedure, not the specific 242-A Evaporator procedure that was being followed.

Immediate Evaluation

(1) Administrative controls established to prevent an occurrence were not effective; (2) no personnel received exposure beyond established guidelines; (3) 242-A Evaporator procedures (and possibly others) do not reference the requirements of the General Transfer Procedure; (4) operating personnel used poor judgment; and (5) PADIs did not function as expected.

Immediate Action Taken and Results

(1) A tag was placed on the slurry pump switch, warning panel board operator that construction personnel were working in AW Tank Farms; (2) A Procedure Departure Authorization (PDA) to the 242-A Evaporator slurry transfer procedure was written invoking the communications requirements; and (3) JAJ retired all PADIs in service and replaced them with a later, state-of-the-art revision called "Super-Dad's."

Final Evaluation and Lessons Learned

The preplanning session invoked three separate controls to prevent or mitigate this kind of an occurrence. Two of the three failed. The third was effective in minimizing the impact of this event. When a potential unplanned exposure situation is recognized, several independent controls must be invoked.

Corrective Action

(1) Personnel action has been taken concerning poor judgment; (2) a procedure review has been completed and all procedures which need to reference the requirements of the general transfer procedure, now do; (3) portable radiation area monitors are now being utilized in any construction excavation where a potential change in fields is possible; and (4) JAJ Safety currently functionally checks all PADIs prior issuances.

- Unneutralized Tank F-18 Transfer From PUREX, Resulting in Pipe Damage at the AW Tank Farm (85-34)

On April 12, 1985, an F-18 transfer was made to AW Tank Farm. The F-18 Tank collects sump and miscellaneous liquid wastes. Solutions are normally acidic and contain low-level radioactivity. Procedures require that all wastes be neutralized prior to transfer to the AW Tank Farm.

Shortly after the F-18 transfer was complete, a leak detection alarm for the AW Tank Farm valve pit went off. Investigation indicated that some piping had been damaged by acid waste and that liquid in the valve pit was the source of the leak detection alarm. Initial investigation indicated that all of the material was retained in the encased piping system and there was no release to the environment.

Immediate Evaluation

Initial evaluation indicated that the F-18 had not been neutralized prior to transfer. Visual inspection of the pits on April 13 indicated piping damage.

Immediate Action Taken and Results

An investigation was initiated and further waste shipments out of F-18 were temporarily suspended except for flushes required for recovery from the incident.

Corrective Action

- A test of the line between the 241-AW-A valve pit and the 241-AW-101 distributor pit verified that this line had failed.

- Testing has been completed of all AW Tank Farm encasements which were used for PUREX F-18 waste transfers. The tests indicated there was no breaching of the encasements. The following procedure changes have been made:

  a. Process Engineering required to review analysis and approve transfer

  b. Pre-neutralization batch must be resampled if analysis indicates a pH >8.

  c. All analyses required on sample schedule must be obtained

  d. All post-neutralization waste batches must be sampled in duplicate with flush and recirculation between the duplicate samples

  e. Sampling procedures will be reviewed with all operating personnel assigned to the sampling area.

o Deentrainer Flush Carry Over and the Associated Contamination Spread at 702-A (Aging Waste Tank Farm Vent System) (85-77)

On September 12, 1985 a chemical flush of the de-entrainer pads was being performed, during normal operation of the 702-A ventilation system. A process alarm indicated an apparent carry over of flush solution to the stack. This carry over resulted in a contamination spread within the Tank Farm areas with very low levels of contamination extending outside the 200 East Area exclusion fence.

The contamination levels ranged from ~50 mr (very localized at an exhauster draain line) to genrally 4,000 cpm ground contamination (within the Tank Farm existing zoned areas), to ~1,000 cpm spotty contamination at the 200 East exclusion fence.

One operator received a hair contamination of 500 cpm, which washed out easily.

Subsequent to the initial occurrence, during the recovery efforts: An operator received a skin contaminaton of ~6,000 cpm on elbow while decontaminating equipment. There was an additional contamination spread when te second 702-A exhaust fan was restarted. This contamination was limited to an area within the Tank Farm and an area just outside the Tank Farm fence. The contamination levels were approximately the same as the initial spread, ~200 to 4,000 cpm.

Immediate Evaluation

The initial evaluation indicated that the de-entrainer flush resulted in the carry over of water vapor and contamination through the vent system and out the stack.

Immediate Action Taken and Results

The 702-A ventilation system was immediately shut down and tank ventilation was restored using the 4,000 cfm backup system. The area was surveyed, posted and stabilized and decontamination efforts were started immediately.

Item 12, Immediate Action Taken and Results

Equipment decontamination was completed and the system returned to service with one exhauster available, on September 18, 1985. On September 22, 1985 the second 702-A exhauster was restarted and the system was fully operational.

o Contamination Spread Within a Radiation Zone Resulting in Personnel Contamination (85-86), October 30, 1985

A normal pit entry and routing change was taking place in the 241-AW B valve pit. When the jumper head on nozzle "E" was loosened liquid started running out, which is not normal in this operation, so the jumper head was retightened.

At this time the manager decided to seek information as to why there was liquid in the line. The RPT while surveying the manager observed higher than normal readings on his outer SWP clothing. The RPT advised the manager of a potential loss of control, the pit cover blocks were replaced, and extra RPTs were called, all personnel were moved to the survey station.

Upon the arrival of the support RPTs all personnel associated with the job and those in the immediate area were surveyed, low levels of skin contamination was found on four nuclear operators and one heavy equipment operator, the contamination was removed with soap and water at the 272-AW Decontamination Station. Four personnel were sent to the whole body counter facility where they were checked for internal contamination, they were released and returned to work.

Immediate Evaluation

Contamination spread appeared related to the liquid which drained from the jumper as it was loosened.

Immediate Action Taken and Results

Jumper retightened and pit blocks replaced.
Job suspended.
Personnel surveyed and decontaminated.
Equipment decontaminated and area stabilized for return to service.

Final Evaluation and Lessons Learned

To be determined by TFS&O and TF&EPE.

Corrective Action

Equipment decontaminated and area stabilized and returned to service. Completed October 31, 1985.

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DOCUMENT CLEARANCE REQUEST

Part 1 – Issuing Manager's Approval

SECTION 1 – Clearance Information

1. Date Clearance Required: 7/21/89
2. Document Identification: WHC- SD-WM-SAR-016 R1
2B. Previous Document Identification:
3. Title (Include UC Category): Double-Shell Tank Farm Facility Safety Analysis Report
4. Author's Name(s): R.E Raymond
5. Phone: 3-2785
6. MSIN: R2-40
7. Desired Clearance/Release: Public Clearance ☐ Open Literature ☐ Oral Public; Limited Clearance ☐ Applied Technology ☐ Foreign Exchange; DOE Directed Release ☐ FOIA ☐ Media ☒ Other
8. Document Type: (Choose One) ☐ Speech/Article ☐ Abs. ☐ Sum. (WHC-SA-XXXX) ☐ Full Paper ☐ Speakers Bureau. Complete Sections 1, 2, 3, 4, submit with four copies of S/A to Doc. Clearance. ☒ Report (WHC-EP-XXXX) Complete Sections 1, 2, 3, 4, submit with two copies of doc. to Doc. Clearance
9. Meeting Name, Location, Date
10. ☐ To Be Published in Journal ☐ Handouts for Attendees Official Publishing Month:

SECTION 2 – Program Office Information

11. WHC Program: W595C
12. Does this document contain Liquid Metal Reactor (LMR) information? ☒ No ☐ Yes (If "Yes" and public clearance or limited clearance for foreign exchange is desired, answer questions 12A and 12B.)
12A. When was the information generated?
12B. What prior dissemination of the information has been made to LMR contractors? (Cite report number, page, date of issuance, and distribution, and/or meeting handouts, date and distribution.)
13. Does this document or its source document contain applied technology information? ☒ No ☐ Yes (If "Yes" and public clearance or limited clearance for foreign exchange is desired, answer questions 13A, 13B, 13C.)
13A. What prior dissemination of the information has been made under international exchange agreements? Identify country, document, and date of release.
13B. Does the information have substantive value for international exchange? (Explain)
13C. What is the justification for the proposed release of this information? (Be specific)
14. Does the document contain Nuclear Waste Policy Act information? (Explain)

NO

SECTION 3 – Patent Legal Info.

Does this document contain or disclose any of the following? If "Yes" identify information and location in document.

15. New or novel (patentable) subject matter? ☒ No ☐ Yes. If "Yes", has disclosure been submitted by WHC or other company? ☐ No ☐ Yes Disclosure No(s).
16. Information received from a foreign country under an exchange agreement? ☒ No ☐ Yes (Identify)
17. Information received from others in confidence, such as proprietary data, trade secrets, and/or inventions? ☒ No ☐ Yes (Identify)
18. Copyrighted material? ☒ No ☐ Yes. If "Yes", has written permission been granted? ☐ No ☐ Yes (Attach Permission)
19. Trademarks? ☒ No ☐ Yes (Identify)

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SECTION 4 – Remarks and Approvals

20. Sponsoring Agency (if not U.S. Department of Energy):
21. DOE/HQ Assistant Secretary For:
22. Remarks: being cleared in response to request from Ecology, date May 22 1989, corresponence number 8902163B

RECEIVED DOE-RL JUL 31 1989

Document is approved as conforming to all applicable requirements. The above information is certified to be correct.

	23. Author	Immediate Manager	Issuing Manager (Level III)	24. Date
Type Name	R.E. Raymond Koontz	R.J. Baumhardt	H.F. Daugherty	7/13/89
Signature		G.L. Dunford	R.J. Baumhardt	7/18/89

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