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Facility Effluent Monitoring Plan for the T Plant

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Prepared for the U.S. Department of Energy
Office of Environmental Restoration
and Waste Management

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

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Facility Effluent Monitoring Plan for the T Plant

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FACILITY EFFLUENT MONITORING PLAN FOR THE THE T PLANT FACILITY

ABSTRACT

A facility effluent monitoring plan is required by the U.S. Department of Energy in DOE Order 5400.1 for any operations that involve hazardous materials and radioactive substances that could impact employee or public safety or the environment. This document is prepared using the specific guidelines identified in* A Guide for Preparing Hanford Site Facility Effluent Monitoring Plans, WHC-EP-0438**. *This facility effluent monitoring plan assesses effluent monitoring systems and evaluates whether they are adequate to ensure the public health and safety as specified in applicable federal, state, and local requirements.*

This facility effluent monitoring plan is the first annual report. It shall ensure long-range integrity of the effluent monitoring systems by requiring an update whenever a new process or operation introduces new hazardous materials or significant radioactive materials. This document must be reviewed annually even if there are no operational changes, and it must be updated as a minimum every three years.

---

*General Environmental Protection Program, *DOE Order 5400.1, U.S. Department of Energy, Washington, D.C., 1988.*

**A Guide for Preparing Hanford Site Facility Effluent Monitoring Plans, *WHC-EP-0438, Westinghouse Hanford Company, Richland, Washington, 1991.*

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FOREWORD

What is T Plant's Role at Hanford?

T Plant is a set of buildings in the 200 West Area of the Hanford Site (Figure 1-1) that is operated for the U.S. Department of Energy (DOE) by the Westinghouse Hanford Company. The original buildings were constructed in the mid-1940s to extract plutonium for use in nuclear weapons. That mission changed in 1957 when T Plant became primarily associated with decontamination processes. In 1959, the 2706-T Building was constructed specifically to decontaminate railroad equipment, buses, trucks, automobiles, road-building equipment, and plant process equipment that had been contaminated with low levels of radiation. Today, the T Plant's primary function is to safely remove radioactive contamination from equipment and vehicles.

Why is Effluent Monitoring Needed at T Plant?

Although World War II-era plutonium extraction equipment has been removed, there are still chemicals and radioactive substances in the buildings because of experiments, the decontamination process, or chemical storage. T Plant has a system of monitoring devices and sampling programs to meet applicable regulations and DOE orders. These regulations and orders have been established to protect the health and safety of employees, the general public, and the environment.

Why is a Facility Effluent Monitoring Plan Required?

A Facility Effluent Monitoring Plan (FEMP) is required by the DOE Order 5400.1 (DOE 1988) for any operations that involve hazardous materials, including radioactive substances, that could impact employee and public safety and/or the environment. The FEMP must be prepared using specific guidelines. Each FEMP assesses effluent-monitoring systems and evaluates if they are adequate to ensure the public health and safety as specified in applicable federal, state, and local requirements. To perform these evaluations at T Plant, independent health physicists reviewed historical monitoring data, factored in present and past building uses, and considered current inventories of potentially hazardous or radioactive chemicals. They also postulated potential upset conditions where a protective barrier theoretically failed, and they documented the current effluent monitoring systems and sampling programs. Using this basis, they identified three places in T Plant that needed to be evaluated in the FEMP. While all these had monitoring systems in place that are generally adequate, some equipment upgrades and procedure recommendations are made to further ensure compliance.

Beyond these initial recommendations, the FEMP ensures long-range integrity of the effluent-monitoring systems by requiring an update whenever a new process or operation introduces new hazardous materials or significant radiation sources. Even if there are no operational changes, this document must be annually updated and reviewed.

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LIST OF TERMS

ACGIH	American Conference of Governmental Industrial Hygienists
ACV	Administrative Control Value
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
APCA	Air Pollution Control Authority (Benton-Franklin-Walla Walla Counties)
ARCO	Atlantic Richfield Hanford Company
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
BACT	best available airborne control technology
BAT	best available technology
BEP	Building Emergency Plan
BPT	best practical control technology
CAM	continuous air monitor
CEM	continuous emission monitoring
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	Code of Federal Regulations
CQL	Contractual Quantitation Limits
CSTF	Containment System Test Facility
DCG	derived concentration guide
DF	Decontamination Factor
DOE	U.S. Department of Energy
ECL	Environmental Control Limit
ECM	Environmental Compliance Manual
Ecology	Washington State Department of Ecology
EDE	effective dose equivalent
EHW	extremely hazardous waste
EMS	Effluent Monitoring System
EPA	U.S. Environmental Protection Agency
FEMP	Facility Effluent Monitoring Plan
GE	General Electric
HEPA	high-efficiency particulate air (filter)
ICRP	International Commission on Radiation Protection
LLW	Low-Level Waste
LWR	light water reactor
MCL	maximum contamination level
MDL	minimum detectable level
MRP	Management Requirements and Procedures Manual
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
OHP	Operational Health Physics
ONC	Occurrence Notification Center
OSR	operational safety requirement
PCB	polychlorinated biphenyl
PFP	Plutonium Finishing Plant
PNL	Pacific Northwest Laboratory
POTW	Publicly-Owned Treatment Works
PSD	Prevention of Significant Deterioration
PWR	Pressurized Water Reactor
QA	Quality Assurance

LIST OF TERMS (continued)

QAPP	Quality Assurance Project Plan
RCG	Radioactive Concentration Guide
RCRA	*Resource Conservation and Recovery Act of 1976*
RHO	Rockwell Hanford Operations
RQ	reportable quantity
RPD	Relative Percentage Difference
SAIC	Science Applications International Corporation
SAP	Sample Analysis Plan
SAR	Safety Analysis Report
SARA	*Superfund Amendments and Reauthorization Act of 1986*
SPCC	Spill Prevention Control and Countermeasure Plan
TRUSAF	Transuranic Waste Storage and Assay Facility
TSD	treatment, storage, and disposal
UBC	Uniform Building Code
WAC	Washington (State) Administrative Code
WAP	Waste Analysis Plan
Westinghouse Hanford	Westinghouse Hanford Company

METRIC CONVERSION CHART		
1 inch	=	2.54 centimeters
1 foot	=	30 centimeters
1 gallon	=	3.8 liters
1 ton	=	0.9 metric tons

$$1\ °F = \left(\frac{9}{5}\ °C\right) + 32$$

1 Btu/h = 2.930711 E-01 watts
(International Table)

FACILITY EFFLUENT MONITORING PLAN FOR T PLANT FACILITY

1.0 INTRODUCTION

1.1 OVERVIEW

This document is the Facility Effluent Monitoring Plan (FEMP) for T Plant, a decontamination facility located in the 200 West Area of the Hanford Site in south-central Washington (Figure 1-1). The T Plant Facility and its ancillary systems (Figure 1-2) are operated for the U.S. Department of Energy (DOE) by the Westinghouse Hanford Company (Westinghouse Hanford). This document provides the following information:

- Description of the T Plant facility and processes
- Identification and characterization of T Plant source terms during both routine and upset operating conditions
- Identification and characterization of liquid and airborne effluent streams and their routine and potential releases
- Review and characterization of the effluent-monitoring system design criteria and sampling programs
- Review of historical monitoring and sampling data for each effluent stream
- Assessment of the compliance of the monitoring systems and sampling programs with applicable DOE, federal, and state regulations.

1.2 POLICY

According to the DOE and Westinghouse Hanford policy, operations on the Hanford Site must be conducted in compliance with the DOE and other applicable federal, state, and local requirements that safeguard the public and environment. In accordance with this policy, monitoring is routinely conducted for effluents--liquids that are discharged or emissions that are released--from the DOE facilities. To ensure that effluent-monitoring programs meet high standards of integrity, DOE Order 5400.1 (DOE 1988) requires FEMPs for operations that involve hazardous materials, including radioactive substances, that could impact employee and public safety and/or the environment.

A FEMP is required if:

- The total projected dose at the site boundary from airborne radionuclides exceeds 0.1 mrem effective dose equivalent (EDE) from any one discharge point

Figure 1-1. T Plant Location in 200 West Area.

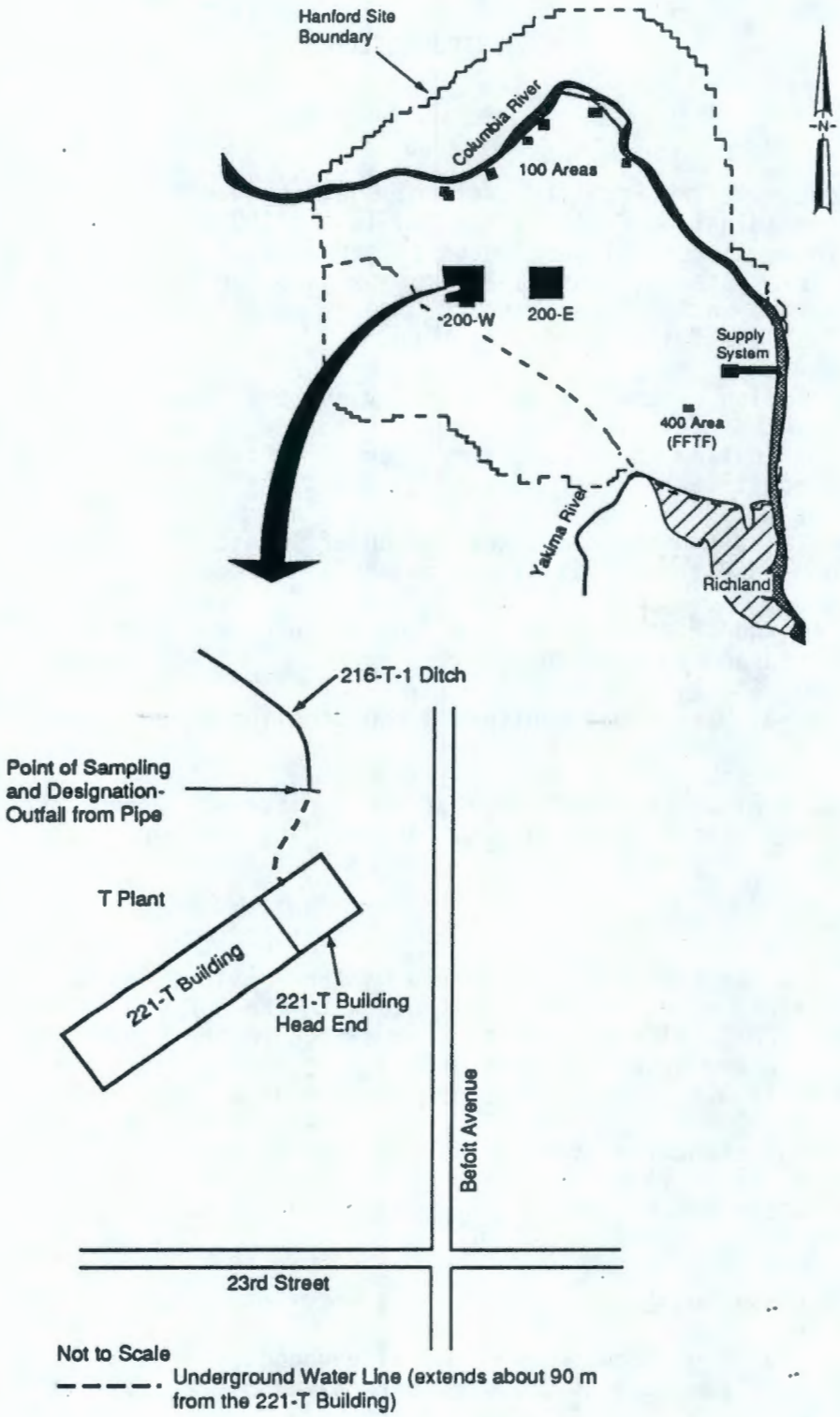
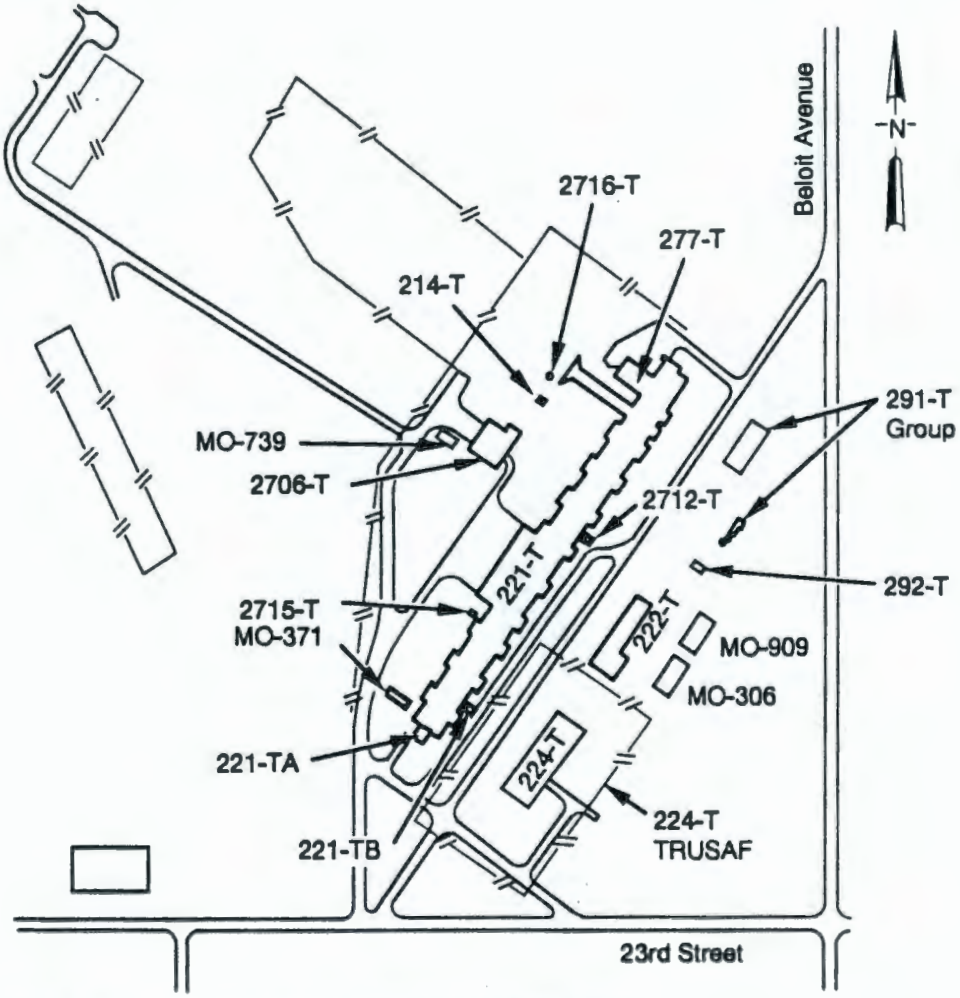


Figure 1-2. T Plant Buildings and Ancillary Structures.



TRUSAF = Transuranic Waste Storage and Assay Facility

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- Any one regulated material stored in a facility has the potential for release or discharge within any 24 h period that exceeds 100% of a reportable quantity (final reportable quantity [RQ]) as listed in 40 Code of Federal Regulations (CFR) 302.4 (EPA 1989a) or is designated a Dangerous Waste in Washington (State) Administrative Code (WAC) 173-303-70 through 173-303-103 (Ecology 1989)

- Any potentially contaminated liquid effluent is present. (The sanitary sewer is exempted.)

DOE orders require a FEMP evaluation to include the possibility of an upset condition which results from the failure of one engineering control or barrier. This would be an event of probability per year of 1×10^{-2} or greater.

1.3 SCOPE OF T PLANT FACILTIY EFFLUENT MONITORING PLAN

This FEMP describes the airborne and liquid effluent paths and the associated sampling and monitoring systems now in use at T Plant. The document must provide sufficient information on effluent characteristics and monitoring systems so that a compliance assessment may be performed for both routine and upset conditions. Guidelines for preparing a FEMP are outlined in *A Guide for Preparing Hanford Facility Effluent Monitoring Plans*, WHC-EP-0438 (WHC 1991a). The T Plant FEMP is not intended to be a replacement for the T Plant Safety Analysis Report (SAR) issued in 1972, although some of the SAR information necessarily was updated in the process of preparing this document. A major revision of the SAR is scheduled for the mid-1990s.

1.4 EVALUATION METHODS

In order to evaluate effluent-monitoring systems' capability and compliance:

- Radioactive and hazardous materials were identified at the point of generation* so they could be tracked to specific effluent streams and discharge points

- Actual effluent monitoring data were used, where possible, to project potential radiation doses to the public

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*Characterization of dangerous waste pollutants at the point of generation is required by 40 CFR 261.3(b) (EPA 1989c). This requirement is only for dangerous waste as defined by the WACs. Other regulations, such as National Emissions Standards for Hazardous Air Pollutants (NESHAP), provide guidance on the adequacy of emissions monitoring. However, all potential pollutants should be characterized at the point of generation for two reasons: it is necessary to assess the preventative capabilities of engineered and administrative barriers as well as the consequences of an upset condition release resulting from the failure of one of these barriers, and to verify that the sampling and monitoring programs address all potentially hazardous constituents at the point of discharge.

- A protection factor of 3,000 was assumed for emissions-monitoring systems that are normally filtered with high-efficiency particulate air (HEPA) filters.

In those cases where data was incomplete or non-existent:

- The best available source term data were used
- Individual radionuclides were used to calculate radiation doses wherever possible
- ^{239}Pu and ^{90}Sr (^{90}Y) were used to represent total alpha and beta activity, respectively, in those cases where only total alpha and total beta release data was available.

The calculations for estimating offsite radiation doses for projected radionuclide releases were prepared by Pacific Northwest Laboratory (PNL) [WHC-EP-0499 (WHC 1991h)]. Airborne releases were assumed to occur from either a 290-ft stack or at ground level from a central location within either the 200 East or 200 West Area. The distance from the 200 West release point to the offsite location was assumed to be about 12.8 mi. The computer models used were CAP-88 and GENII.

1.5 T PLANT FACILITIES AND EFFLUENT STREAMS

Tables 1-1, 1-2, and 1-3 provide information on the buildings, structures, areas, liquid effluent streams, and airborne effluent streams that are discussed in the T Plant FEMP. Only those effluent streams potentially associated with radioactive or hazardous materials are presented in the tables. For example, neither the wall exhausters in the 221-T Building electrical gallery (see Section 2.1.2.2) nor the various bathroom exhaust pipes are presented because there is no potential for hazardous or radioactive materials to be introduced to these effluent streams. Also, neither the stack near the 221-T Head-End bay area roll-up doors nor the West Exhauster Head-End Stack are included because there is no potential for release from these stacks. Details on these two stacks are provided in Section 2.1.2.4.

Table 1-1. T Plant Buildings, Structures, and Areas.

Building	Date built	Current use
221-T	1943-44	Radioactive decontamination, repair, and decommissioning of process equipment
2706-T	1959-60	Low-level radioactive decontamination/repair of railcars, large vehicles, and equipment
221-T Head-End	1957	Experiments (none conducted since March 1990), offices, lunchroom
214-T	1985	Chemical storage
271-T	1943-44	Offices
291-T	1943-44	Houses exhaust ventilation fans for 291-T Main Stack
221-TA	1943-44	Houses supply ventilation fans for 221-T canyon
211-T (Area)	1943-44	Bulk liquid chemical receiving and storage, hazardous waste storage

Table 1-2. Liquid Effluent Streams at T Plant.

Stream	Potential effluents	Monitoring required?
216-T-4 Chemical Sewer and Pond	Radioactive waste slurries, spent fuel cooling water, organic carbons, caustics	Yes
T Plant Aqueous Waste Transfer	Radioactive waste slurries, solvents, caustics	No
216-T-1 Ditch	Steam condensate, cooling water, floor wash water	No

Table 1-3. Airborne Effluent Streams at T Plant.

Stream	Potential effluents	Monitoring required?
291-T-1 Main Stack	^{239}Pu, ^{241}Am, ^{90}Sr, ^{137}Cs, ^{106}Ru, ^{103}Ru, ^{113}Sn, ^{125}Sb	Yes
296-T-13 Roof Stack	^{239}Pu, ^{241}Am, ^{90}Sr, ^{137}Cs, ^{106}Ru, ^{103}Ru, ^{113}Sn, ^{125}Sb	Yes
296-T-7 Stack	Gross Alpha, Gross Beta	No
2706-T Roof Exhauster	Gross Alpha, Gross Beta	No

1.6 DISCUSSION

Two T Plant stacks were identified* as requiring monitoring based on the potential of their airborne emissions releasing enough radioactivity to exceed the annual EDE guideline of 0.1 mrem. These stacks, which exhaust air from the 221-T Building canyon, are the 291-T-1 Main Stack and the 296-T-13 Roof Stack. One liquid stream, the 216-T-4 Chemical Sewer and Pond, also was identified as requiring monitoring based on its potential within any 24-h period to discharge greater than 100% of the final RQ for hazardous materials. Details of these stacks, the liquid effluent stream, and the associated monitoring systems are included in this FEMP.

*EDE calculations for each airborne effluent stream were conducted for and documented in the "Facility Effluent Monitoring Plan Determination for the T Plant Facility" (WHC-EP-0438, WHC 1991a). These calculations were made for routine operations and upset conditions. Summaries of the calculations are included in Appendix C of this document.

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2.0 FACILITY DESCRIPTION

This section contains descriptions of the T Plant Facility: its physical characteristics, primary processes, and potential process source terms.

The original buildings at T Plant were constructed in the mid-1940s to extract plutonium from production reactor fuel. The plant continued to perform this function until it was deactivated in 1956. Most of its original process equipment was subsequently removed. In 1957, T Plant was placed in service as a beta-gamma decontamination facility and as a support complex for experiments and other operations requiring containment or isolation. It currently functions primarily as a decontamination facility (Hinckley 1985).

The T Plant Facility consists of two primary decontamination buildings: 221-T and 2706-T. Building 221-T was built during 1943 to 1944. Building 221-T provides services in radioactive decontamination, reclamation, and decommissioning of process equipment contaminated with fission products and other highly contaminated pieces of equipment. The 2706-T Building was built during 1959 to 1960. Building 2706-T was constructed as a low-level* radioactive decontamination facility and is used to decontaminate railroad equipment, buses, trucks, automobiles, road-building equipment, and plant process equipment (Hinckley 1985).

2.1 BRIEF FACILITY PHYSICAL DESCRIPTION

The T Plant Facility is located in the 200 West Area of the Hanford Site, which is located in the south-central region of Washington State. Buildings, structures, or special facilities included as part of this FEMP are the 221-T and 2706-T Buildings, 221-T Building Head-End, and 214-T Chemical Storage Building. Ancillary buildings, structures, and areas included are the 271-T, 291-T and 221-TA Buildings, and the 211-T Chemical Storage Area. The 221-T and 2706-T Buildings are the locations of decontamination processes. The 221-T Building Head-End is the location of special experiments and operations. The 214-T Building is used to store chemicals. The 211-T Chemical Storage Area consists of a 90-d permitted pad that stores nonradioactive hazardous waste and a tank that stores NaOH. This tank is surrounded by a concrete berm which provides secondary containment. The 271-T Building provides office space to Westinghouse Hanford staff supporting T Plant operations and maintenance. The 291-T Building houses the exhaust ventilation fans for the 291-T-1 Main Stack. The 221-TA Building houses the supply ventilation fans for the 221-T Building canyon. Liquid effluent systems and streams discussed are the 216-T-4 Chemical Sewer and Pond, including the 207-T Retention Basin, T Plant Aqueous Waste Transfer, and 216-T-1 Ditch. Emissions systems and streams discussed are the 291-T-1 Main Stack, 296-T-13 Roof Stack and 296-T-7 Stack.

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*Low-level radioactive equipment is defined as equipment or material that is contaminated to less than 100 mrad/h at the surface and has no smearable alpha contamination present.

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The decontamination process at the T Plant Facility has the capacity to be fully operational. The primary function or processes associated with the T Plant Facility are decontamination and equipment repair. The functions or processes associated with this facility results in the use, storage, management, and disposal of radioactive and hazardous materials. The functions or processes associated with this facility has the potential to generate radioactive and hazardous emissions and discharges.

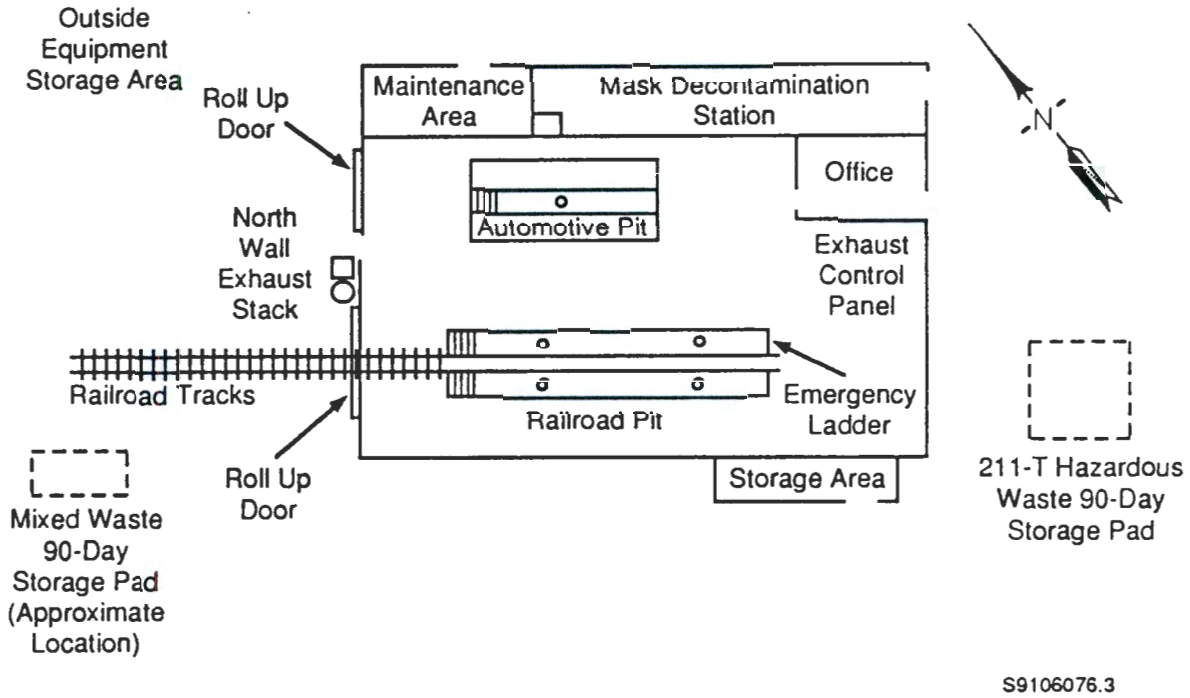
Operations at T Plant are conducted in a manner to protect the natural and human environments against potential health and safety hazards. Application of recognized standards and codes in design, construction, and operations are upheld to maintain a safe working environment. T Plant Operations conducts its activities within the criteria outlined in DOE Order 5480.1A, Chapter I (DOE 1982), and 5483.1 (DOE 1989a).

2.1.1 2706-T Building

Building 2706-T is a ground-level building constructed of prefabricated steel 50 ft wide by 66 ft long by 25 ft high with 20-ft-high side walls. It has two openings on the west end that are fitted with rollup metal doors. The larger door, 16 ft high by 12 ft wide, is the entrance to the railroad pit area (see Figure 2-1). The other door, 9 ft wide by 14 ft high, is the entrance to the automotive pit area. Low-level radioactive decontamination activities are performed in these two pits. The railroad pit is 55 ft long by 17 ft wide by 6 ft 3.5 in. deep. The floor slopes from 24 in. to 0.5 in. to allow drainage. Four recessed lights in the pit provide lighting when workers are cleaning the undercarriages of railroad cars. Two stairways at opposite ends of the pit provide access to the pit floor. One emergency ladder is located at the southwest end of the pit. Except at the center, the pit area is completely covered with steel grating.

The automotive pit is 30 ft long by 4 ft 2 in. wide by 6 ft deep. The pit is covered by a steel grating. There is a stairway at one end and an escape ladder at the other next to the rollup door. Two recessed lights provide lighting in the pit. A 3-in.-dia. drain line runs from both pits to two collection sumps. All liquid wastes generated in the 2706-T Building are pumped from these sumps to a larger sump located approximately 40 ft southeast of the building. The larger sump is constructed of 8-in.-thick reinforced concrete, measures 6 ft long by 10 ft wide by 15 ft deep, and is covered by 0.25-in.-thick diamond-plate steel. Liquid waste from this sump is moved into the 221-T Building canyon by steam jet or with an installed sump pump. Liquid wastes generated in the automotive pit drain via a connecting pipe into the railroad pit. Liquid waste generated in the railroad pit and other building-related liquid wastes routed to this pit are collected in two sumps located in the bottom of the pit and connected by a trench. Each sump has a pump that is used to transfer the wastes to the 211-T Sludge Collection Sump, located approximately 40 ft southwest of the 2706-T Building. Two 1.25-in. stainless steel pipes with 2.5-in. stainless steel encasement transfer wastes from the pit to the sump. The sump is constructed of 8-in. thick reinforced concrete, measures 6 ft long, 10 ft wide, and 15 ft deep, and is covered by a 0.25-in.-thick diamond-plate steel. Liquid waste from the sump is moved into the 221-T Building's canyon area by steam jet or with an installed sump pump via a 2-in. single-walled stainless steel process pipe.

Figure 2-1. Overhead Schematic of 2706-T Building and Location of 90-Day Storage Pads.



Building 2706-T was designed and built to then-applicable Uniform Building Code (UBC) requirements for Type IV Buildings. Wind design loads for a vertical projection of the building are not less than 15 lb/ft^2 and for horizontal projections are not less than 20 lb/ft^2. The building's rigid frame is capable of supporting a minimum of 5,500 lb at each load point, which enables it to support the overhead monorail system for its crane. The overhead 10-ton-capacity crane, which travels the length of the building, is available for operations and maintenance use. An electric motor moves the crane across the bridge. The bridge, however, can only be moved by a hand-operated pulley. The building foundation design is based on an allowable soil-bearing load of 4,000 lb/ft^2.

Because the 2706-T Building is constructed of prefabricated steel, the fire hazard potential has been reduced. A minimal amount of combustible materials is stored in the building. Building 2706-T has a fire-detection and alarm system located within the decontamination area. The fire detectors are set to alarm at temperatures above 165 °F. The alarm also can be activated manually at the control panel on the north wall.

A portion of the cement area adjacent to the northwest end of the 2706-T Building has been designated as a 90-d storage area for mixed hazardous waste. The area is designated by stanchions connected by a metal chain. Appropriate warning signs are posted. One edge of the area has a berm; the rest of the area drains into the 2706-T Building railroad pit.

2.1.1.1 Ventilation in the 2706-T Building. The ventilation system for the 2706-T Building consists of one exhaust system for the railroad and automotive pits and three evaporative coolers located on the south wall of the building. The exhaust does not have a filtration system. The system pulls air from the pits into four 15-in.-dia. vitrified clay ducts that flow into a common 2-ft-dia. clay duct. A fan rated at 5,000 ft^3/min exhausts the air up a 26-in.-dia. by 28-ft-high stack. A small roof exhauster is used to remove hot air near the ceiling of the building. Future upgrades to the building ventilation system include the addition of HEPA filtration and elimination of the small roof exhauster.

2.1.2 221-T Building

Building 221-T is made of reinforced concrete and is 850-ft long by 68-ft wide by 74-ft high and covers an area of 57,800 ft^2. The building consists of the canyon with railroad tunnel access, three galleries, one crane way, and a "head-end" facility. Figure 2-2 illustrates a cutaway view of the 221-T Building. Effluent streams associated with the Head-End operations have been added to this FEMP since the Determination Report.

2.1.2.1 221-T Building--Decontamination Operations. Decontamination activities are performed in the canyon area. The canyon area consists of 37 cells and one railroad tunnel entrance. The cells are in a single row running the length of the canyon with two cells, designated left and right, composing a 40-ft section. The building consists of twenty 40-ft sections. The cells are numbered according to building section number. The canyon deck is about 40 ft below a 3-to-4-ft thick concrete roof. Most of the cells are

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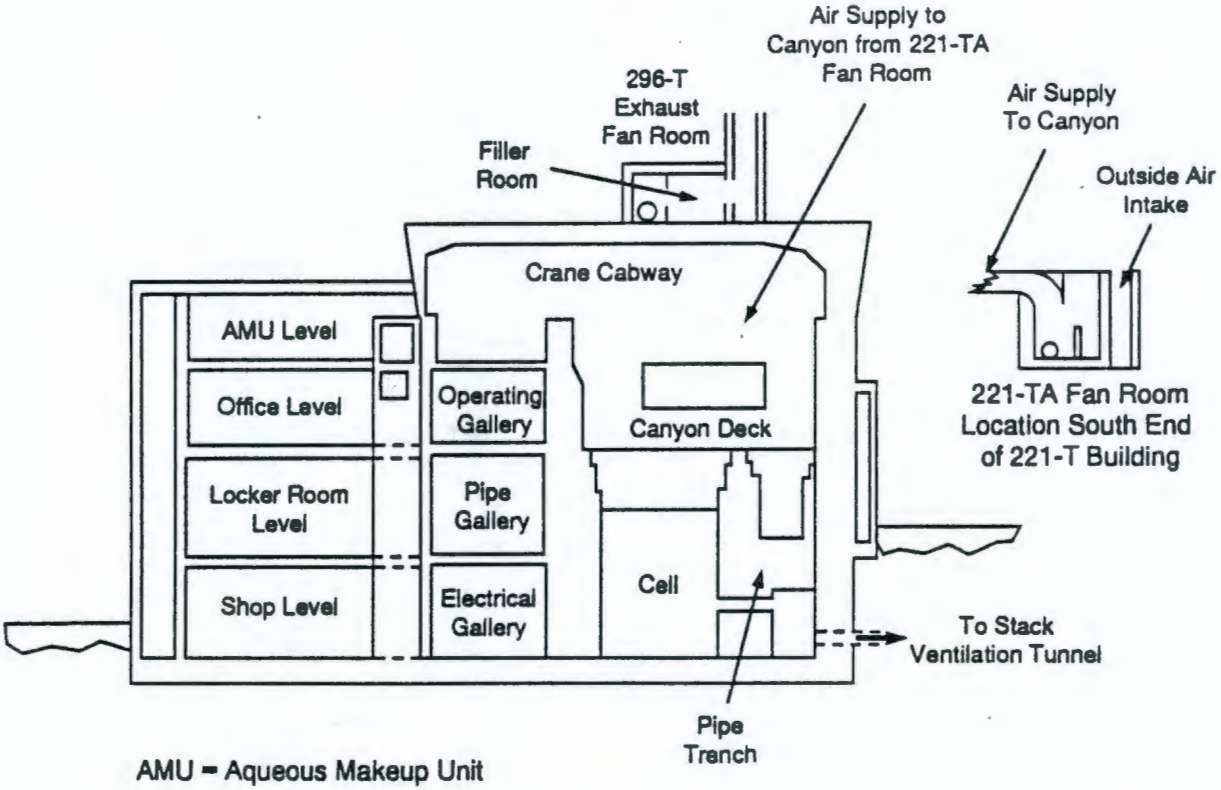
Figure 2-2. Building 221-T, Cutaway View Including Canyon Ventilation.



covered by four 6-ft-thick reinforced-concrete blocks. Cover blocks for Cells 11R, 13R, and 15R are 2-ft-thick and are covered with a 3/8-in.-thick stainless steel decontamination pad. Each cover block is equipped with a lifting bail to allow the bridge crane to lift it for access to the cells. The railroad tunnel, used for transporting equipment into and out of the canyon as well as for some decontamination, enters the plant at Cell 2L. A 16-ft-wide by 22-ft-high opening, covered by a motor-driven rolling steel door, provides railroad canyon access.

The standard canyon cells are 17 ft 8 in. long, 13 ft wide and 28 ft deep. The cells are separated from each other by 7-ft-thick reinforced-concrete walls. All service lines to the cells are encased in concrete and terminate in a row of connector flanges on the cell wall 9 ft below canyon deck level. In some instances, process lines go directly through-the-wall to the adjacent cell in the same section. Since there are expansion joints between sections of the building, there are no direct through-the-wall connections from section to section. However, all intracell liquid transfers are made through jumpers within the cells. Intersection liquid transfers are made through an 8-ft wide by 10-ft 6-in.-deep pipe trench that runs parallel to the canyon. The trench is covered by a series of 4-ft 6-in.-thick reinforced-concrete blocks. All pipes are sloped to permit proper drainage. Any leakage into the trench area is carried via trench drains to the building's 24-in. sewer line.

Each cell slopes to a corner drain that drops into a 24-in. tile sewer line running the length of the building. The sewer line is an integral part of the building structure and empties into TK 5-7 Tank in Cell 5R. Cell 5R also contains the 5-8 Sump (14 ft by 16 ft by 10 ft) which is the lowest point in the 221-T Building liquid waste system. Liquid wastes generated in the railroad tunnel are collected in a trench and pass via the french drain into the 24-in. sewer line and gravity drain into the TK 5-7 Tank. Liquid wastes from the 211-T Sump are discharged to Nozzle No. 3 of Cell 6L where they flow into the open top of TK 6-1 Tank and overflow onto the cell floor. Planned changes to the system configuration will reroute the 211-T Sump discharge to bypass Cell 6L and the TK 6-1 Tank.

From the cell floor, the wastes pass through the 6-in. floor drain into the 24-in. sewer line and flow by gravity into the TK 5-7 Tank. Liquid wastes generated within Cell 12L, Cell 12R, and on the decontamination pad of Cell 13R pass via the floor drains into the 24-in. sewer line and on to TK 5-7 Tank. The 5-8 Sump serves as secondary containment for the TK 5-7 Tank and for all other cells connected to the 24-in. sewer line. In the past, it was common operating practice to overflow the TK 5-7 Tank and use the 5-8 Sump as additional storage. This practice has been discontinued and is no longer allowed by procedure. Currently, any liquid collected in the 5-8 Sump is steam jetted into the TK 5-7 Tank. Liquid collected in the TK 5-7 Tank is steam jetted to the TK 5-9 and TK 5-6 Tanks in Cell 5L. From the TK 5-9 Tank, the waste is then jetted to the TK 15-1 Tank in Cell 15L. TK 15-1 Tank also receives liquid waste from the decontamination pad over Cell 15R. Guidance for obtaining samples from the TK 5-7 and TK 15-1 Tanks and 2706-T Sump is addressed in Appendix A.

Liquid wastes in the TK 15-1 Tank can be transferred to Tank Farms using a railcar or via cross-site underground transfer lines. The wastes trans-

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ferred by railcar are not treated in TK 15-1 Tank before transfer to 200 Area Tank Farms. However, for the wastes to meet the transfer requirements to the Tank Farms via cross-site transfer line, three conditions must be met:

- The pH must be greater than 12
- The level of nitrites must be greater than 600 ppm
- The waste cannot contain organics.

To adjust the pH and nitrite levels, sodium hydroxide and sodium nitrite are added in appropriate quantities.

Leakage or overflow from any part of the system within the 221-T Building is routed via drains and the 24-in. sewer line into the TK 5-7 Tank, and the overflow from the TK 5-7 Tank is contained within the 5-8 Sump. For this reason, the 5-8 Sump is considered secondary containment for the system within the 221-T Building. Planned changes to this system will eliminate all process flow via the cell drains and 24-in. sewer line (e.g., railroad tunnel drain and 211-T sump discharge). Therefore, no postulated routine or upset condition occurring within the 221-T Building could result in a release of liquid waste to the environment.

Liquid waste from the TK-15-1 Tank can be transferred to Tank Farms via a cross-site transfer system. The transfer lines and junction boxes are located underground and are under the operational control of the Tank Farms organization. The monitoring requirements for the cross-site transfer system are addressed in the FEMP for the Tank Farms. The underground transfer line connecting T Plant with the initial junction box is a double-walled stainless steel pipe. A release to the environment from this transfer line would require the failure of more than one engineering control. Therefore, no routine or upset condition releases to the environment from the Aqueous Waste Discharge System are postulated.

2.1.2.2 221-T Building Galleries. The electrical gallery is 760 ft long and 14 ft wide. A corridor extends along the full length of the gallery and can be entered via any of nine stairwells. The electrical gallery contains the main electrical lines, motor control centers, and the electrical distribution centers for the building. The main steam lines and water lines also enter the building through this gallery. Electrical and instrument shops are located in Sections 17 through 20.

The pipe gallery is 760 ft long and 14 ft wide. It also can be entered through nine stairwells. The pipe gallery contains most of the nonradioactive chemical, process, and utility piping. The pipe gallery is divided into four areas to meet requirements for present operations. Section 2 is the location of two compressor/condenser units for the Pressurized Water Reactor (PWR) Core II storage pool, and also the main power supply for the compressor/condenser units and the ion-exchange column. Sections 2 through 15 are used for chemical storage. The maintenance dock is located adjacent to the Section 17 stairwell.

The operating gallery is approximately 760 ft long and 14 ft wide. Nine stairwells provide access into the operating gallery. This gallery is the control center for remote operation of the canyon equipment. Section 2 is the PWR Core II operating station. Various panel control boards are located in

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Sections 5 through 15. However, only the control panels in Sections 5, 11, and 15 are in use. The other control panels have been out of service since the shutdown of the bismuth phosphate process. Sections 16 through 19 contain the lunchroom and offices of the decontamination and decommissioning operations personnel. The office adjacent to Section 19 contains panel controls for canyon air, water, steam, and lights along with power controls for the centrifuge run-in station. The office adjacent to Section 18 contains controls for the pump run-in station. The canyon entry area and decontamination shower are located in Section 20.

The 221-T Building stairwells also allow access to a 760-ft-long, 11-ft-wide craneway. The craneway is designated a Radiological Area. Only the stairwells in Sections 11 and 13 are used for access into the craneway from Building 221-T. The other stairwell entrances are barricaded at the third floor to prevent unauthorized entry.

The air supply ventilation for the galleries consists of seven air-handling units each rated at 4,500 ft^3/min. Each unit is located in stairwell fan rooms at the operating gallery level. Normally, only fans located in stairwells 3, 15, 17, and 19 are in use. Each fan is manually controlled from the fan rooms. Outside air is pulled through separate louvered openings for each unit; the air then goes through washing and air filter units before being distributed into the operating gallery. Air is also supplied from the adjoining 271-T Building through entry doors at Sections 11 and 13. From the operating gallery, the air flows through gratings in the floor and down into the pipe gallery. The air is then exhausted out of the pipe gallery directly into the atmosphere by five fans rated at approximately 3,000 ft^3/min each. Supply air also is provided for the maintenance shops (Section 12 through 17) by two cooler/heater units located in Sections 14 and 16.

The electrical gallery receives about 5,000 ft^3 of air from the 271-T Building through a duct located in Section 11. No exhaust system is in use in the electrical gallery; out-leakages through stairwells exhausts air into the pipe gallery.

2.1.2.3 221-T Building Crane Operations. The 75-ton-capacity canyon crane is remotely operated using periscopes located in a crane cab that is shielded by a parapet and 4-in.-thick lead walls. A 10-ton-capacity crane and rotary hook provide adaptability for handling, positioning, and maneuvering functions. The 10-ton-capacity crane is normally operated from the canyon deck by use of a suspended control box that hangs from the crane assembly. This crane also can be operated from the crane cab on the crane bridge.

2.1.2.4 221-T Building--Head-End Operations. The 221-T Building Head-End consists of a canyon area that extends from the basement floor to the roof and includes a four-story test vessel. This canyon area has several deck levels and a parapet wall. Four floor levels adjacent to the canyon house an electrical switchgear room, a chemistry laboratory, office areas, a change room, a lunch room, a control room, an instrument shop, a maintenance shop, and storage areas. Flow from eight process sewer lines originating in the Head-End is discharged to the 216-T-1 Ditch.

Two stacks are present in the Head-End which exhaust nonradioactive and nonhazardous air from localized areas. One stack exhausts air from the bay area and near the test vessel. Air is drawn from the room through a HEPA filter bank by a fan with a capacity of 8,000 ft^3/min, although the recent flow rate has averaged approximately 6,300 ft^3/min. The 16-gauge galvanized steel stack is rectangular in shape and measures 19.1 in. by 26.6 in., and extends approximately 8 ft above the ground. This stack is not equipped with a record sampler and there is no potential for release of radioactive or hazardous material as evidenced by the fact that the nearby bay area roll-up door is often open. Consequently, this stack will not be discussed further in this document.

The second stack, the West Exhauster Head-End Stack, previously exhausted air at a rate of 3,500 ft^3/min from the Maypack lab in the Head-End basement. The stack, which has a diameter of approximately 14 in., extends 3 ft above the nearby stairwell roof. The stack terminates with a 135° turndown elbow. This stack is no longer operated and is not equipped with a record sampler. Therefore, it will not be discussed further.

2.1.2.5 221-T Building--PWR Fuel Assembly Storage. Canyon Cell 2R has been modified to store approximately 76 PWR Core 2 blanket fuel assemblies which were used to power DOE's Shippingport Reactor located in Shippingport, Pennsylvania. Provisions were made to store the assemblies at the Hanford Site for up to 20 yr. Cell 2R consists of a cotton/asbestos layer between 2.5-ft and 3.5-ft layers of concrete. The 13-ft by 27.5-ft by 28-ft deep pool holds approximately 50,000 gal of water when filled to a depth of 19 ft. The assemblies are stored in racks at one end of the pool. That end is covered by concrete cover blocks and the remainder of the pool is open to the canyon. This opening, plus a small ventilation flow exhausted to the ventilation tunnel, vents the surface of the pool.

Pool water cooling is performed by a closed-loop refrigeration system. Waste cooling water from the secondary coolant system is discarded to the 216-T-4 Pond. The PWR Core 2 modules have been out of the reactor for a number of years. Consequently, the heat load is relatively low. As a result, complete loss of cooling results in only a gradual increase in the pool temperature. To release the contents of the pool, more than one engineering barrier would have to fail; that is, both concrete layers would have to leak. This occurrence is beyond an upset condition. Therefore, no conceivable upset conditions from this activity would result in a release to the environment.

2.1.2.6 221-T Building Ventilation. As described briefly above, there are several separate ventilation systems for the 221-T Building:

- The canyon supply and exhaust system, which is composed of two systems
- The supply and exhaust system for the galleries.

The 221-T Building galleries are maintained at atmospheric pressure while the 221-T Building canyon area is maintained at a negative pressure with respect to atmosphere and other systems. A primary design feature of these systems is to ensure that potentially contaminated canyon air is not drawn

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into the 221-T Building galleries and the 271-T Building. Because of these design features, only the 221-T Building canyon ventilation system will be discussed further.

Air from the 221-T Building canyon is emitted through two discharge points. These are the 291-T-1 Main Stack and the 296-T-13 Roof Stack (Figure 2-3). The original system for the 221-T Building canyon was designed to provide downdraft ventilation from the craneway supply fans downward through the individual canyon cells and then out the 291-T-1 Stack. To improve the habitability of the canyon, the craneway supply system was replaced by the 221-TA Building supply system. Shortly thereafter, a rooftop exhaust system, discharging out the 296-T-13 Roof Stack, was added to increase the canyon airflow (from approximately 0.8 changes/h to 1.2 changes/h) and to improve ventilation near the roof. The capacity of the original 291-T ventilation system was sufficient to ensure that the advantages of downdraft ventilation for contamination control were not significantly compromised by the addition of the roof exhauster. However, subsequent degradation of the 291-T sand filter has required that the downdraft airflow be reduced. Because of this, the updraft produced by the roof exhaust could cause excessive spread of contamination in the canyon. Therefore, the roof exhauster is normally shut off when decontamination is being performed on highly-contaminated equipment. During the most radiologically hazardous decontamination work, the only ventilation normally available in the 221-T Building canyon is a slight downdraft through the 291-T ventilation system. Even under these conditions, ventilation capacity has been considered large enough to provide airflow from areas outside the 221-T Building canyon into the canyon.

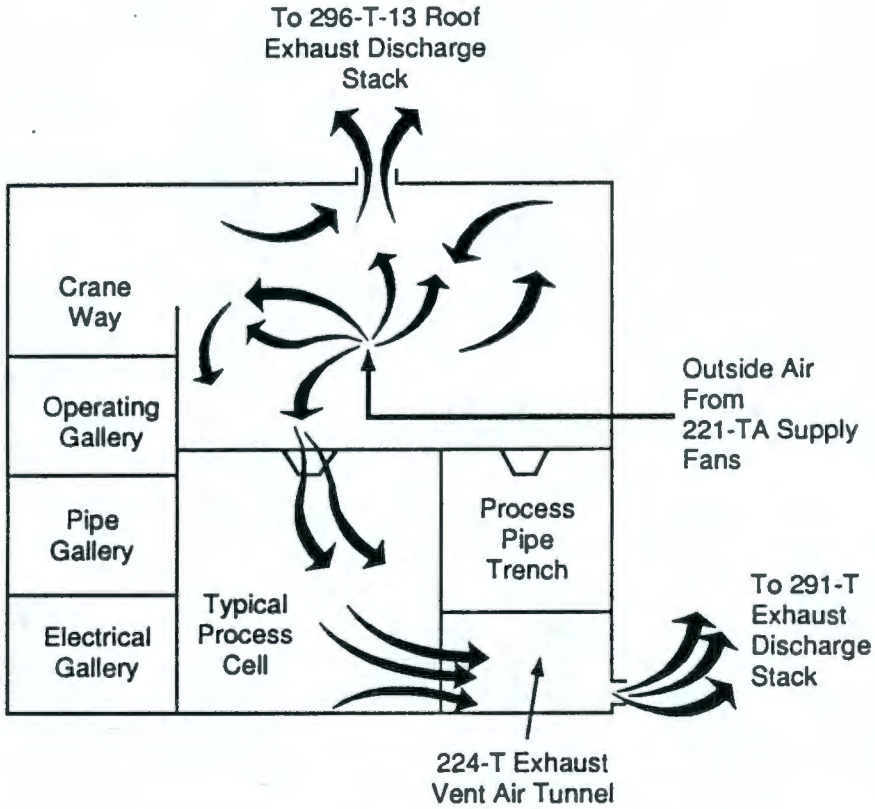
The control system for the canyon ventilation consists of the pressure switches. These switches ensure that canyon pressure remains negative with respect to atmosphere by cycling a supply fan or the roof exhauster as necessary. If signal pressure is lost, the roof exhaust switch fails "on" and the supply fans switches fail "off." The canyon air pressure alarm is set at -0.03 in. w.g.

Airborne contamination levels in the canyon during decontamination operations typically range from less than 1×10^{-9} to 5×10^{-8} μCi/mL and from less than detectable to 1×10^{-10} μCi/mL gross alpha activity. The upper limits on canyon air activity are the maximum allowed for respirator use. If high airborne contamination occurs during decontamination activities, work in the canyon is stopped and the canyon is evacuated until the canyon air contamination is reduced and the source is located and mitigated. Abnormal air quality could result from:

- Partial loss of ventilation fans
- Complete loss of offsite power
- Degraded filter performance.

However, the 221-T Building is equipped so that either of its two exhaust systems could maintain proper canyon air flow if the other failed. The 221-TA Building supply system also has two fans, even though only one operates at a time.

Figure 2-3. 221-T Canyon Ventilation Flow Diagram.



221-T Cross Section

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If offsite power is completely lost, T Plant ventilation systems are inoperable. However, the T Plant electrical system allows for manually cross-connecting the roof exhauster and the 221-TA Building systems into either of two incoming lines. This ability to cross-connect ensures that partial loss of offsite power would result in only a temporary loss of canyon ventilation.

While a ventilation system can fail because of plugged or leaking filters, administrative controls at T Plant reduce the likelihood of a release of airborne contamination to the environment. To prevent plugged filters, dust-causing operations, such as dry sandblasting, are severely restricted in the 221-T canyon. The other potential cause of clogging would be soot from a fire. If the canyon were occupied, a fire would normally be extinguished before enough soot were generated to clog exhaust filters. If a fire burned unnoticed in the unoccupied canyon overnight or during a weekend or holiday, it might create enough soot to clog the filtering system. However, this potential filter failure would not necessarily result in a contaminated release to the environment since the source of contamination (the decontamination activity itself) would not be in process. If filters leaked, any contamination would be detected by high airborne levels in the exhaust systems. The respective stack monitors would alarm, notifying T Plant staff to immediately begin corrective actions.

The 221-T Building canyon exhaust systems are large enough to ensure proper airflow even when only one system is running. The system is not large enough, however, to provide adequate canyon negative pressure to conduct operations for more than a few minutes when the railroad tunnel door is open. As a result, decontamination activities in the canyon are suspended when the tunnel door is open, and the door is not allowed to remain open any longer than necessary. Opening the cell cover blocks does not adversely affect the overall canyon pressure, but does disrupt airflow patterns within the canyon.

In both exhaust systems, the fans are placed downstream of the HEPA filters, thus ensuring that the fans and associated ductwork are exposed only to normally filtered air. In addition, the inlet ducting for the roof exhauster is as short as possible. The inlet ducting for the 291-T Building exhaust systems is longer and is radiologically contaminated. With the exception of the filter inlet plenum, however, the most highly contaminated sections of the 291-T Building inlet duct are either embedded into the structure of the 221-T Building or are buried underground.

Each of the 221-TA Building's two supply fans have manual dampers that can be adjusted to regulate flow. In addition, there are also eight supply units distributed along the craneway that are capable of supplying 25,500 ft^3/min of additional air. The eight units are currently not in service and are blanked off.

The canyon supply air can be exhausted through either of two systems: the roof exhaust system to the 15-ft-high 296-T-13 Stack or the 291-T exhaust system through the 200-ft-high 291-T-1 Stack.

The roof exhaust system consists of an exhaust fan rated at 70,000 ft^3/min that pulls canyon air through a roof stack at Section 2. The fan operates at 13,000 ft^3/min and the stack opening is 2-ft square. The air is pulled through one bank of prefilters and two banks of HEPA filters before

being exhausted out of 296-T-13 Roof Stack. The HEPA or dustop filters are replaced when the pressure drop across the filter is in excess of 4 in. w.g. The system exhausts air from approximately 5 ft above the canyon deck.

The main stack exhaust system consists of two fans (each rated 20,000 ft^3/min) that pull canyon air past the cell cover blocks down into the cells and pipe trench. The fans operate at a normal flow rate of 36,000 ft^3/min. The air then travels through 10-in-dia. ceramic ducts from each cell or section of the pipe trench into a 10-ft 6-in.-square exhaust tunnel. The air is pulled through the exhaust tunnel into a 4-ft-wide by 7-ft-high concrete duct where it flows to the 291-T Building exhaust system. The air is then pulled through four type FI-2 HEPA filter banks and is released out the 291-T Stack. The inner diameter of the stack at its base is approximately 16 ft. The system exhausts air from within approximately 5 ft of the canyon deck.

The air balance for the 221-T Building has normal canyon pressure ranging from -0.025 to -0.5 in. w.g. Usually the 221-TA Building Supply Fan No. 1, the roof exhaust fan, and both of the 291-T Building exhaust fans are operating to ensure that negative pressure is maintained in the canyon. An interlock system is provided between the 221-TA Building supply fans and the roof exhaust to prevent operation of a supply fan unless the roof exhaust is operating. Pressure switches located in Room 220 of the operating gallery are set at -0.09 in. w.g. for Supply Fan No. 1 and -0.15 in. w.g. for Supply Fan No. 2. The switches energize or de-energize the fan in use as needed. If canyon pressure becomes negative while supply air is off, the supply fans will start at -0.09 or -0.15 in. w.g. depending on which fan is in service. If canyon pressure becomes more positive when the supply is on, the supply fans will stop at -0.09 or -0.15 in. w.g. to prevent an excessive buildup of pressure. The roof exhaust pressure switch will open at -0.5 in. w.g. to prevent excess negative pressure (the fan will restart automatically when pressure increases). A control panel in the operating gallery allows operation of either supply fan.

2.1.3 211-T Chemical Storage Area

The 211-T Chemical Storage Area, located north of the 271-T Building and adjacent to the 221-T Building, was a chemical receiving area. Bulk liquid chemicals were received in tank cars (or trucks) and stored in above-ground storage tanks until needed. Originally, there were six horizontal tanks in this area; four of these tanks remain. These four tanks have capacities between 16,000 and 17,000 gal and were used to store nitric acid, sodium hydroxide, and low-level radioactive waste. All of the horizontal tanks in the 211-T Chemical Storage Area are scheduled to be removed. Three tanks are currently empty. The fourth contains a heel of low-level radioactive waste.

A new sodium hydroxide distribution system has been installed in the 211-T Chemical Storage Area. The new system includes a vertical 8,000 gal storage tank and a facility for unloading tank trucks into the storage tank. The storage tank is located in a concrete area bermed to collect all 8,000 gal. The concrete is lined with a chemical-resistant coating. The unloading area is a concrete pad with a partial berm which is sloped to a drain connected to the 214-T-4 Chemical Sewer and Pond.

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The chemical storage area also contains a cement pad (<90 d) with a berm, coated with a chemically resistant material, for storage of hazardous nonradioactive waste in drums. The pad is sloped to drain to a blind sump. This area is surrounded by a chain-link fence, covered with a metal roof, secured with a locked gate, and marked with appropriate warning signs.

No routine operations or upset conditions were identified for the 211-T Chemical Storage Area which would result in a release to the environment above final RQ values.

2.1.4 214-T Storage Building

The 214-T Building, located on the north side of the 221-T Building, is used to store liquid detergents, dry chemicals, and liquid chemicals such as solvents, emulsifiers, paint strippers, and paint. The building is divided into two areas. Liquids are stored in appropriate areas according to their characteristics. The floor is covered with a chemical-resistant coating and the two floor areas are sloped to prevent the mixing of the incompatible materials and to direct any spills to the two floor sumps. The two sumps are blind sumps that are not connected to any liquid discharge stream. Ventilation is provided by a single roof exhaust fan.

No routine operations or upset conditions were identified for the 214-T Storage Building which would result in a release to the environment above final RQ values.

2.1.5 271-T Building (Office Annex)

The 271-T Building is adjacent to the 221-T Operating Gallery. While most of this building is used for office space, portions are used by T Plant Operations. The compressor room and rigger's loft are located in the basement on the same level as the Electrical Gallery in the 271-T Building. The chemical makeup room is located on the first floor of the 271-T Building. Flammable liquids are stored in flammable storage cabinets in the lean-to on the 271-T loading dock.

No routine operations or upset conditions were identified for the 271-T Building which would result in a release to the environment above final RQ values.

2.1.6 Remaining Ancillary Buildings

Several structures included in the T Plant Buildings and Ancillary Systems shown in Figure 1-2 do not have the potential for effluent releases. These structures are the MO-739, 2716-T, 277-T, 2712-T, 292-T, MO-909, MO-306, 222-T, MO-371, and 2715-T Buildings. The MO-739 structure is a trailer that serves as a change room before entry to the 2706-T Building. The 2716-T Building is a small metal shack that serves as a change room at the railroad tunnel entrance. The 277-T Building is a metal-framed building used to store equipment. The 2712-T Building contains the compressor used by the

Tank Farms organization to supply compressed air to the diversion box near the 221-T Building. The 292-T Building is currently vacant and not in use. The MO-909 and MO-306 Buildings are trailers used for office space for Westinghouse Hanford staff. The 222-T Building is being remodeled as office space to house Westinghouse Hanford staff. The MO-371 Building is a trailer that serves as a change room for women employees. The 2715-T Building is a metal-framed structure that is currently being used as a paint shop.

2.2 BRIEF PROCESS DESCRIPTION

The purpose of this section is to describe the processes, operations and activities that are performed for decontamination at the 221-T and 2706-T Buildings and at the Head-End of the 221-T Building. Until recently, very little documentation has been maintained on the wastes generated at the T Plant Decontamination Facility. During the assessment, an effort will be made to determine the maximum concentrations of hazardous and radioactive materials expected in the T Plant Facility. The following discussion of waste characteristics has been compiled from sample analysis data, the T Plant SAR, T Plant *Superfund Amendments and Reauthorization Act of 1986* (SARA) reports, and discussions with plant personnel.

2.2.1 Decontamination Processes

The 2706-T Building was built specifically as a low-level decontamination facility and has been used as such since it was completed in 1960. The T Plant Facility fulfills its mission as a decontamination and repair facility primarily through the use of chemical decontamination performed by either immersion or spray application. In addition to chemical decontamination, abrasive methods such as wet sandblasting are used occasionally. Decontamination is currently performed with water, steam, and detergents. No acids or caustics are used in the decontamination process. In the past, some cleaning solvents were used. However, discussions with personnel indicate that no concentrated acids or caustics were used in this portion of the system. Operations personnel perform work in direct contact with the contaminated item, but typically wear two pairs of protective clothing and a full-face respirator.

The 221-T Building was built originally as a processing plant to extract plutonium from production reactor fuel using the bismuth phosphate process. The plant's original tanks, process piping, 5-8 Cell Sump, 24-in. sewer line and canyon cells were subjected to the chemicals used in this process until 1956 when the plant was deactivated. Non-original tanks were installed either from B Plant or U Plant before its reopening as a decontamination facility in 1957. B Plant also used the bismuth phosphate process. Therefore, tanks from this facility would have been subjected to the same types of chemicals as the original T Plant tanks. Chemicals used in the original T and B Plant process include bismuth phosphate, lanthanum fluoride, sodium hydroxide, nitric acid, and sodium nitrate. U Plant was a uranium recovery facility and probably used a different chemical process.

Since 1957, when the facility was reopened as a decontamination facility, all tanks and associated equipment have been subjected to the chemicals used

in the decontamination activities. High-radioactivity decontamination activities have been carried out in the 221-T Building canyon and railroad tunnel. Decontamination efforts include the use of relatively dilute acidic and caustic solutions, steam, water, chemical solvents, and abrasive methods. Wastes generated are generally composed of water slurries containing sandblast sands, dirt, oils, and soaps that are moderately radioactive. The waste generated in the facility is currently listed as dangerous waste in accordance with Washington State regulations because of past use of acetone and methylene chloride in the system.

2.2.2 Head-End Process

The processes at 221-T Building Head-End have varied during the history of T Plant. Initially the Head-End was used to process spent fuel from production reactors. The wastes discharged to the 216-T-1 Ditch from this process are reported by Anderson (1976). These wastes were cooling water and steam condensate from the spent fuel dissolution process. They were discharged from 1945 (the start of facility operations) to 1956. When the dissolution equipment was removed from the 221-T Building Head-End in 1956, the efforts were made to remove and/or stabilize the radioactive contamination in the facility. A testing program was then established for testing with iodine and radioactive cesium in a new containment vessel fabricated in place in the old dissolver cells and canyon. This modified facility also was referred to as the Containment System Test Facility (CSTF). This work was started in 1964 and completed in 1969 by the PNL. A test was conducted with radioactive cobalt during this time. In 1972, a vacuum fractionator was built and testing began. In 1976, testing was completed and the vacuum fractionator was removed. This work was performed by the Atlantic Richfield Hanford Company (ARCO). Between 1976 and 1985, Westinghouse Hanford conducted liquid-metal reactor safety tests in the CSTF with nonradioactive sodium, lithium, and sodium iodide. These tests* consisted of sodium and lithium pool reaction, spray reaction, and aerosol behavior tests. Between 1985 and 1990, Westinghouse Hanford conducted light water reactor (LWR) tests using nonradioactive cesium, manganese, zinc, lithium sulfate, iodine, and hydrogen iodide. Several related tests** were conducted using nonradioactive lithium and lithium-lead alloy in support of the fusion safety program during this same time period.

2.3 IDENTIFICATION AND CHARACTERIZATION OF POTENTIAL SOURCE TERMS

This section provides information on the potential process source terms present in the T Plant Facility. Tables 2-1 and 2-2 summarize the source term information for both radioactive and hazardous materials.

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*The test series included in this time period were AB-1 through AB-8, NT-1, NAI-1 and NAI-2, AC-1 through AC-10 SA-1, and LA-4 and LA-5.

**The test series designations include tests LA-1 through LA-6, A-1 through A-22, B-123, WIL-1, WIA-1, LPS-1, and LSS-1.

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Table 2-1. Radioactive Material Potential Source Terms for Upset Conditions in the T Plant Facility.[a]

Radionuclide	Form	Facility	Discharge point	Potential quantity released (Ci)[b] under upset conditions	Projected dose (mrem/yr)	
					GENII	CAP-88
Gross Alpha[a]	Particulate	221-T	291-T-1	1.2	1.8	1.9
$^{239,240}Pu$	Particulate	221-T	291-T-1	0.096	0.14	0.15
^{241}Am	Particulate	221-T	291-T-1	0.084	0.19	0.20
Gross Beta[b]	Particulate	221-T	291-T-1	0.14	0.0011	0.0011
Gross Alpha[a]	Particulate	221-T	296-T-13	0.012	0.043	0.062
Gross Beta[b]	Particulate	221-T	296-T-13	1.2	0.024	0.031
Gross Alpha[a]	Particulate	2706-T	296-T-7	0.0014	0.0053	0.0072
Gross Beta[b]	Particulate	2706-T	296-T-7	0.27	0.0021	0.0021

[a] WHC-EP-0141-1 (Brown 1989).
[b] Upset condition.

Table 2-2. Hazardous Material Potential Source Terms in the T Plant Facility.[a]

Chemical	Facility	Discharge point	Available quantity (lb)[b]	Reportable quantity (lb)
Acetone	T Plant	216-T-4	14	5,000
Acetic Acid	T Plant	216-T-4	6	5,000
Ammonium Citrate	T Plant	216-T-4	1	5,000
Ammonium Hydroxide	T Plant	216-T-4	1	1,000
Mercury	T Plant	216-T-4	3	1
Methanol	T Plant	216-T-4	5	5,000
Nitric Acid	T Plant	216-T-4	61	1,000
Phosphoric Acid	T Plant	216-T-4	5	5,000
Potassium Permanganate	T Plant	216-T-4	1	100
Sodium	T Plant	216-T-4	1,800	10
Sodium Hydroxide	T Plant	216-T-4	520	1,000
Sodium Nitrite	T Plant	216-T-4	1,900	100
Zinc	T Plant	216-T-4	22	1,000
Acetone	T Plant	291-T-1	14	5,000
Methanol	T Plant	291-T-1	5	5,000
Acetone	T Plant	296-T-13	14	5,000
Methanol	T Plant	296-T-13	5	5,000

[a]Jeppsen 1990.
[b]Maximum inventory potentially available during upset condition.

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2.3.1 Liquid Effluents

Most chemicals at T Plant are used in the 221-T Building canyon and the 2706-T Building, where they are collected and disposed in the radioactive liquid waste system. This liquid is transferred via railroad tank cars or cross-line transfers to the Tank Farms. This waste is considered to be the T Plant Aqueous Waste Transfer Stream.

The liquid generated during decontamination activities in the 221-T and 2706-T Buildings is generally radioactively contaminated. Chemicals which have been used at various locations within the facility and still have the potential to be introduced into the waste-handling system include: nitric acid, sodium hydroxide, potassium permanganate, sodium nitrate, phosphoric acid, citric acid, acetone, acetic acid, hydrochloric acid, oxalic acid, methylene chloride, Turco* solvents (e.g., Decon 4502), 1,1,1 trichloroethane, xylene, and soaps. Not all of these chemicals were necessarily used in the decontamination process. However, because they were reported as present in the facility, it is possible that they could have entered the waste-handling system at some time. Most of these chemicals are no longer used at the facility. Sodium hydroxide and sodium nitrite are still used to adjust the pH. A small amount of chemical waste also is produced in other locations, such as the 271-T Building chemical makeup room. This waste also is discharged into the T Plant Aqueous Waste Transfer Stream.

Liquid waste from the various floor drains and sumps in the 271-T Building, the 221-T Building galleries (excepting the Section 20 gallery floor drain and the personnel decontamination station drains, which drain into the canyon), and 211-T Chemical Storage Area are collected by chemical sewers. The chemical sewer for the 211-T Chemical Storage Area drains to the 216-T-4 Pond. The rest of the chemical sewers drain to the 207-T Retention Basin and from there can be transferred to the 216-T-4 Pond.

Between 1978 and 1985, liquid-metal reactor safety tests were conducted in the head-end with nonradioactive sodium, lithium, and sodium iodide. At the conclusion of the tests, the reacted sodium, lithium, and sodium iodide were dissolved in water and discharged to the 216-T-1 Ditch. If radioactive as a result of residual contamination from previous activities, the wastewater was transferred to the 221-T Building, Cell 5, for sampling and pH adjustment, then transferred to tank farm double-shell tanks for waste storage and eventual processing through waste evaporators. Unreacted metals were transferred to the 105-DR Reactor Facility for disposal. The determining conditions for routing the solutions were: the solution pH, the 221-T Building need for caustic solution to neutralize decontamination solutions, and/or the presence of radioactivity. If radioactivity was detected, the pH was in excess of 12.5, or the caustic solution was needed for neutralization, the procedure allowed for the solution to be transferred to the 221-T Building Head-End. Otherwise, it was discharged to the 216-T-1 Ditch. No solutions accumulated that had a pH of less than 2. Quantities of alkali metals also were discharged to the 216-T-1 Ditch.

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*Turco is a trademark of TP Industrial, Inc.

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Between 1985 and 1990, the LWR tests were conducted using nonradioactive cesium, manganese, zinc, lithium sulfate, iodine, and hydrogen. Several related tests were conducted using nonradioactive lithium and lithium-lead alloy in support of the fusion safety program during this same period. The process wastewater discharged to the 216-T-1 Ditch during these test programs consisted of cooling water, steam condensate, and some of the 221-T Building Head-End waste solutions. Head-end wastewater to the 216-T-1 Ditch was divided into two parts for the purpose of wastewater characterization (Jeppson 1990). These parts are Wastewater 1 Stream for plasma torch operation and Wastewater 2 Stream for plasma torch standby. The used lithium-lead alloy was packaged after completion of the tests and shipped offsite as solid waste.

The used process chemicals from the tests were routed to the 216-T-1 Ditch as part of the Wastewater 2 Stream. No process chemicals were discharged intentionally in the Wastewater 1 Stream with the plasma torch operating; however, some process chemicals were discharged accidentally. The liquid volume discharge for Wastewater 1 Stream was about 250 L/min or a total of 11 x 10^6 L for tests conducted between 1985 and 1990. The Wastewater 1 Stream flows were estimated to extend for one to two days for each set of LWR tests. The process concentration of constituents was expected to be the same as for sanitary water because the Wastewater 1 Stream was made up mostly of cooling water with some steam condensate. Variability of the Wastewater 1 Stream was considered very minor.

Recent test activities include two sets of LWR experiments that were conducted from October 1989 through March 1990. Cooling water, steam condensate, process solutions, and roof and floor wastewater drains associated with these tests and the building operating functions were discharged to the 216-T-1 Ditch during these 6 mo.

No testing has been conducted in the 221-T Building Head-End since March 1990. The 221-T Building Head-End may continue to be used for office space, and the heating and ventilation systems are expected to remain in operation. Steam condensate and cooling water associated with the building heating and air conditioning, along with floor wash water, are the only regular liquid effluents expected to be generated and discharged to the 216-T-1 Ditch after fiscal year (FY) 1990. About 2,000 L of lithium hydroxide solution with a pH of less than 12.5 were scheduled to be discharged in the latter part of FY 1990. The containers of solution are located in a catch pan designed to retain any solution that might leak.

There is no intention to discard chemical inventory other than the lithium hydroxide solution to the wastewater stream for disposal. Any future test or equipment-washing solutions will be evaluated using process information and chemical analyses. The decision to discharge the solution to the 216-T-1 Ditch or ship the solution to hazardous waste disposal will be made based upon the results of these analyses. The Head-End waste stream has been identified as one of 33 non-hazardous streams being discharged to the ground. It will be included in a Sample Analysis Plan (SAP) for T Plant.

Specific contributors to the 216-T-4 Chemical Sewer stream include the 221-T Building Pipe Gallery and Operating Gallery floor drains and condensate, the 271-T Building basin sump, 221-TA Building steam condensate, 291-T Building heating coils' effluents, 221-T Building PWR spent fuel storage cooling water, and heel of trucks carrying caustic. In addition, the stream receives steam condensate cooling water from the Transuranic Waste Storage and Assay Facility (TRUSAF) 224-T Building.

Effluents to the 216-T-4 Chemical Sewer Stream are generally not contaminated with either radioactive or hazardous materials. If the effluents were to be contaminated, the material would likely be hazardous rather than radioactive in nature. Based on potential contributors, the effluent stream could include: acetone, acetic acid, ammonium citrate, ammonium hydroxide, mercury, methanol, nitric acid, phosphoric acid, potassium permanganate, sodium, sodium hydroxide, sodium nitrite, and zinc.

The liquid waste-handling system for the 221-T Building canyon, called the T Plant Aqueous Waste Transfer Stream, consists of an arrangement of tanks and piping. Ultimately, all liquid that drains into this system is transferred to the 200 Area Tank Farms. Prior to transfer by pipeline, the waste is sampled and analyzed to ensure that it meets the chemical specifications of the receiving tank and that the concentration of fissionable materials is within specification.

Equipment within the canyon is drained directly into open-topped waste tanks located in Cells 5R (Tank 5-7), 11-R (Tank 11-R), and 15-R (Tank 15-1). Other active waste tanks include Tanks 5-6 and 5-9 in Cell 5L. Liquid waste is transferred by jet pump between Tanks 5-6, 5-7, 5-9, and 11-R as needed to allow use of the various decontamination stations. Ultimately, wastes from Tanks 5-6, 5-7, 5-9, and 11-R are pumped into Tank 15-1 for sampling and transfer to the tank farm. The individual cells drain into a common drain header that terminates at Tank 5-7 in the deep Cell 5-R. Liquid waste from Building 2706-T is discharged into Cell 6-R, from which it also drains into Tank 5-7. Currently, the tank system is being evaluated to assess potential modification for the waste-handling system. A schematic of the current system is illustrated in Figure 2-4.

All liquid waste produced in the 2706-T Building is collected by floor drains in the automotive and railroad pits. From these pits, the waste drains into a waste collection sump located outside of the building and eventually pumped to the 221-T Building canyon.

2.3.2 Airborne Effluents

The only sources of potential airborne radioactive waste are the 221-T Building canyon and the 2706-T Building. Stack emissions from the 2706-T Building have been monitored using a record particulate sampler only since the mid-1970s. This record particulate sample data indicate uniformly low stack emissions. In addition, restrictions on the amount and type of radioactive materials allowed into the building minimize the potential for airborne contamination.

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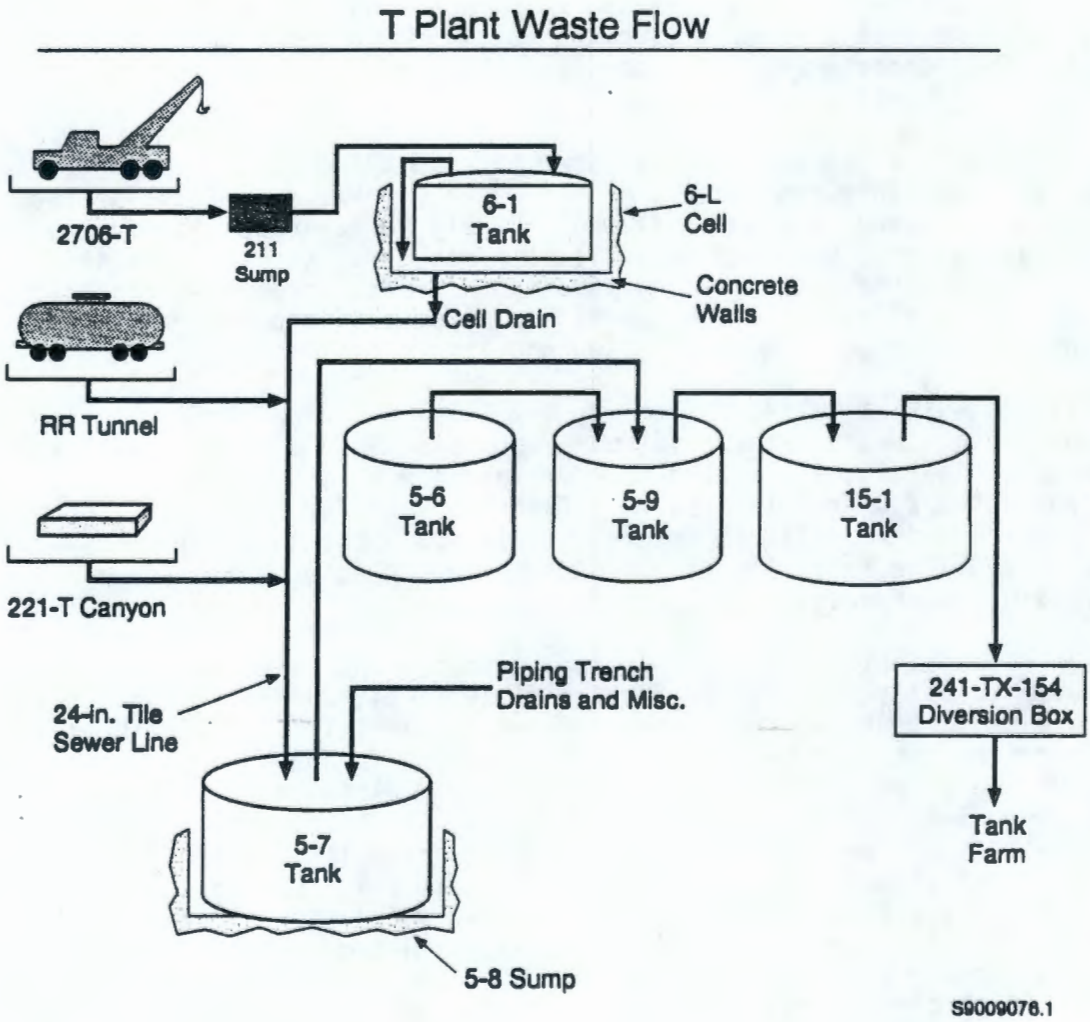
Figure 2-4. Schematic of the T Plant Aqueous Waste Transfer System.



Emissions of concern from the 221-T Building result from decontamination operations inside the canyon. Because operations are not allowed in the canyon unless the air activity is below 5×10^{-8} μCi/mL for beta-gamma emitters and 1×10^{-10} μCi/mL for alpha emitters, the records of the monitored stack emissions have been negligible for the 296-T-13 (Roof) Stack and the 291-T-1 (Main) Stack.

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3.0 APPLICABLE REGULATIONS AND STANDARDS

The purpose of this section is to present information on the regulations governing effluent monitoring requirements for radioactive, nonradioactive hazardous, and mixed waste materials in effluents. It also focuses on applicable environmental standards and statutes, including Westinghouse Hanford effluent monitoring requirements. Westinghouse Hanford is currently reviewing this FEMP for compliance to applicable regulations, and comments will be incorporated in future revisions. This review will be complete by January 1, 1992.

3.1 REGULATIONS

Regulations pertaining to effluent releases at Hanford have been developed by several regulatory agencies including the U.S. Environmental Protection Agency (EPA), DOE, Washington State and the Benton-Franklin-Walla Walla Counties Air Pollution Control Authority (APCA). A summary of applicable regulations and standards is presented in Table 3-1. Because the regulations enforced by these agencies are sometimes inconsistent and Westinghouse Hanford may enforce more restrictive requirements as a matter of policy, Westinghouse Hanford has documented the policies for compliance in the Environmental Compliance Manual (ECM): WHC-CM-7-5 (WHC 1989a). This document, when kept current, is the controlling reference for Westinghouse Hanford environmental protection criteria.

3.1.1 Protection of the Public and the Environment

To ensure the public's health and safety, DOE-controlled facilities are required to monitor effluents that have the potential of containing regulated materials. Regulations pertaining to the monitoring and environmental surveillance of effluents are typically based on effluent release limits for specific materials which are associated with their risks to the public. Monitoring requirements and associated limitations also may be based on best available technology ([BAT] for liquid control technology, best available airborne control technology [BACT] for airborne control technology), best practical control technology (BPT) currently available, or other technology-based criteria. In addition, some monitoring requirements and associated limitations are based on environmental protection criteria, such as water-quality-based discharge standards. The effluent release limits for nonradioactive and radioactive materials are designed to ensure that the risk to the public and the environment posed by these facilities is reduced to an acceptable level.

As documented in 40 CFR Part 61, "National Emission Standards for Hazardous Air Pollutants", (EPA 1989c) effluent release limits for benzene and radioactive materials are based on limiting risk to the public by limiting the potential dose to the maximally exposed member of the public. Similarly, for most nonradioactive materials, the risk to the public and the environment is controlled by limiting the quantities of materials released.

Table 3-1. Applicable Regulations and Standards. (2 sheets)

Agency/originator	Regulation No.	HA[a]	HL[a]	RA[a]	RL[a]	Summary/application
DOE	DOE Order 5400.1	X	X	X	X	Outlines effluent monitoring requirements
	DOE Order 5400.5			X	X	Protects public/environment from radiation associated with DOE operations
	DOE Order 5480.4	X	X	X	X	Sets requirements for the application of the mandatory environmental protection, safety, and health (ES&H) standards; lists reference ES&H standards
	DOE Order 5484.1	X	X	X	X	Sets requirements for reporting information having environmental protection, safety and health protection significance
	DOE Order 5820.2A	X	X	X	X	Sets radioactive waste management requirements
EPA	40 CFR 61	X		X		Sets national emission standards for hazardous air pollutants (NESHAP)
	Subpart A	X				Regulates hazardous pollutants
	Subpart H			X		Sets emissions standards/monitoring requirements for radionuclides
	40 CFR 122		X			Governs release of nonradioactive liquids
	40 CFR 141.16				X	Sets maximum contaminant levels in public water systems
	40 CFR 191				X	Regulates radioactive waste disposal
	40 CFR 261		X			Identifies and lists hazardous wastes
	40 CFR 302.4	X	X	X	X	Designates hazardous materials, reportable quantities, notification process

Table 3-1. Applicable Regulations and Standards. (2 sheets)

Agency/originator	Regulation No.	HA[a]	HL[a]	RA[a]	RL[a]	Summary/application
EPA (Continued)	40 CFR 355	X	X			Identifies threshold planning quantities for extremely hazardous substances
	40 CFR 403-471		X			Sets pretreatment standards for wastewater discharged to POTW
ANSI	N 13.1-1969[b]			X		Sets standards for effluent monitoring systems
	N 42.18[b]			X	X	Recommendations for the selection of instrumentation for the monitoring of radioactive effluents
Washington State	WAC 173-216		X			Governs discharges to ground and surface waters
	WAC 173-220		X		X	Governs wastewater discharges to navigable waterways; controls NPDES permit process
	WAC 173-240		X			Controls release of nonradioactive liquids
	WAC 173-303		X			Regulates dangerous wastes; prohibits direct release to soil columns
	WAC 173-400	X				Sets emissions standards for hazardous air pollutants
Benton-Franklin Walla-Walla Counties APCA	General Regulation 80-7	X				Regulates air quality

[a] HA = Hazardous Airborne; HL = Hazardous Liquid; RA = Radioactive Airborne; RL = Radioactive Liquid.

[b] Refers to standards that are referenced in the DOE and EPA regulations.

In the case of nonradioactive effluents, monitoring requirements also may exist to protect the worker. To provide a safe workplace environment, monitoring of nonradioactive effluents is based on the level or quantity of material present at the point of generation within the facility. Currently, an accurate method does not exist for projecting from the inventory at risk to the estimated release source term at the discharge point. However, limited guidance on estimating an appropriate release fraction for some airborne materials is provided in 40 CFR Part 61, Appendix D, "Methods for Estimating Radionuclide Emissions" (EPA 1989c). Although this guidance applies specifically to radionuclide emissions in select circumstances, the release fractions for gases and particulates also can be applied to nonradioactive effluents. Any alternative method or procedure must receive prior approval of the EPA.

It is important to review the dose limits to the public from operations at DOE-controlled facilities. The EPA is promulgating a NESHAP mandating that radionuclide emissions from each DOE site shall not cause any individual (maximally exposed individual) to receive a dose of greater than 10 mrem/yr EDE. A single site or facility, as used here, means all the buildings, structures and operations within one contiguous site. For example, the entire DOE facility at the Hanford Site rather than each building must meet the 10 mrem/yr EDE standard. The date for mandatory compliance with the proposed revision to the NESHAP is set for December 15, 1991 for DOE. Westinghouse Hanford has set an internal compliance date of November 9, 1991.

Until the proposed revision to the NESHAP is adopted, the current dose limits to the public are in effect. DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1990a), provides dose limits from all DOE sources of radiation and all exposure modes of 100 mrem/yr EDE and 5 rem/yr dose equivalent limit for any tissue (including the skin and lens of the eye) to the public from operations at DOE facilities. These limits apply to both doses originating from exposures to radiation sources during routine activities as well as from remedial actions that are in progress on the same site. Although the current limit is 100 mrem/yr, it is recommended that a FEMP be prepared as if the proposed NESHAP will be instituted with the 10 mrem/yr EDE limit. Effluent monitoring and the associated plan would be required at a level of 1% of the 10 mrem/yr EDE standards; that is, at 0.1 mrem/yr EDE.

The requirements for effluent monitoring are affected by the method used to assess radiation dose. The limit of 100 mrem/yr EDE is the sum of the EDE (or deep dose equivalent, if dosimeter data are used) from exposures during the year to radiation sources external to the body plus the committed EDE from radionuclides taken into the body. The calculation of doses from routine DOE activities should be based upon a "reference man," as defined by the International Commission on Radiation Protection (ICRP), and the dosimetry models and parameters presented in ICRP Publication 30 and subsequent ICRP publications. The weighing factors and time periods for integrating doses endorsed by the ICRP are to be used for dose commitment calculations. Other requirements are presented including how doses from other man-made or enhanced natural radionuclide sources must be addressed.

The DOE Order 5400.5, Chapter II, Paragraph 1.b. (DOE 1990a) limits exposure of the public to radioactive materials from all DOE sources of radiation. The order states that DOE activities shall not cause any member of the public to receive, in a year, a dose equivalent greater than 100 mrem to the whole body. The order also stipulates that DOE must comply with legally applicable requirements, including 40 CFR 61 (NESHAP) (EPA 1989c) for airborne emissions. Doses attributed to ^{220}Rn, ^{222}Rn, and their respective decay products are specifically excluded from the NESHAP dose standard. However, they are regulated by DOE Order 5400.5.

To demonstrate compliance with the dose limit requirements using analytical techniques, evaluations of potential doses to individuals through the air pathway shall be evaluated using only AIRDOSE/RADRISK or other computer codes or models specifically approved by EPA, as specified in NESHAP. Compliance also may be demonstrated through environmental measurements taken using approved techniques. When using this method to determine compliance, estimated doses are for individuals who are assumed to reside in an unrestricted area at the point of maximum annual air concentration.

3.2 REGULATIONS PERTAINING TO MONITORING REQUIREMENTS AT U.S. DEPARTMENT OF ENERGY FACILITIES

The monitoring requirements for effluents resulting from the operation of DOE-controlled sites can be presented in two categories related to the effluent release pathway: airborne or liquid. In addition, information on monitoring requirements is presented whether the effluent is radioactive or nonradioactive material. Before presenting this material, however, it is useful to review in detail the requirements outlined by DOE for FEMPs.

3.2.1 U.S. Department of Energy Facility Effluent Monitoring Plan

Requirements for a FEMP are provided in DOE Order 5400.1, "General Environmental Protection Program" (DOE 1988). The order provides specific information in Chapter IV on the requirements for effluent monitoring systems and programs at the Hanford Site. Environmental monitoring requirements are different for new and existing facilities.

For a new facility with the potential for adverse impact on the environment, an environmental survey must be conducted before actual start-up. This survey shall establish background levels of radioactive and toxic pollutants, characterize pertinent environmental and ecological parameters, and identify potential pathways for human exposure or environmental impact as a basis for determining the nature and extent of the subsequent routine operational effluent and environmental monitoring program.

For existing facilities, radioactive and nonradioactive pollutant effluents released at the Hanford Site shall be monitored to determine compliance with the DOE 5400 series of orders. Their monitoring is performed to: evaluate the effectiveness of effluent treatment and control, inventory radioactive material, and determine compliance with all DOE, EPA, state, and

local requirements pertaining to effluents and pollutant impact on the environment. Radioactive material released to onsite waste treatment or disposal systems shall be monitored to assess the effectiveness of treatment and control and to provide both a qualitative and quantitative annual summary of the radioactive material released onsite.

DOE Order 5400.1 (DOE 1988) also provides guidance on effluent monitoring. As a general rule, monitoring should be conducted in a manner that provides accurate measurements of the quantity and/or concentration of liquid and airborne pollutants in effluents as a basis for:

- Determining compliance with applicable discharge and effluent control limits, including self-imposed administrative limits designed to ensure compliance with in-plant operating limits, effluent standards or guides, and with environmental standards and guides

- Evaluating the adequacy and effectiveness of containment and waste treatment and control, as well as of efforts toward achieving levels of radioactivity that are as low as reasonably achievable (ALARA) considering technical and economical constraints

- Compiling an annual inventory of the radioactive material released in effluents and onsite discharges.

Because the requirements in DOE Order 5400.1 (DOE 1988) are relatively general, interpretation of the requirements is necessary in order to determine the effluent monitoring practices required to meet the intent of the Order and associated regulations. In the case of airborne releases, 40 CFR 61 (EPA 1989c), ANSI N13.1-1969 (ANSI 1969), and associated documents provide specific requirements and guidelines for effluent monitoring. In the case of liquid releases, however, no currently accepted guidance exists that provides consolidated, detailed requirements. Therefore, required practices are based on industry-accepted standards and good practices that are sufficient to meet the intent of the regulations, including the primary requirement that all effluent samples obtained be representative of the effluent released. The following discussion summarizes the primary monitoring and sampling practices that are necessary to comply with DOE Order 5400.1 (DOE 1988) and associated regulations.

Effluent monitoring data collected as close as possible to the point of discharge should include volume, rate of discharge, and content. Effluent monitoring data pertaining to the release of nonradioactive pollutant material should include the total quantity (amount). Effluent monitoring data pertaining to the release of radioactive material is to include the total activity (number of curies) released in airborne and liquid effluents and the specific radionuclides comprising a significant portion (>10%) of the radiation dose. Although exceptions exist, this requirement indicates that the measurement should be made at the point of discharge. When a portion of the effluent stream is close to the point of generation, measurement then could provide a more accurate estimate of the hazardous material being released from the facility, and an exception may be allowed.

Effluents should be monitored at the point at which the applicable standards apply. For example, onsite discharges may be monitored at the waste treatment and disposal system. Effluents may be monitored at the point after all treatment and control, including retention and decay, has occurred. In many cases, the monitoring location is specified in the discharge or operating permit.

The sampling method and frequency should be determined by considering the purpose or need for the data collected. Data are collected to:

- Evaluate the effectiveness of waste treatment and control
- Demonstrate compliance with operating limits of applicable effluent or performance standards
- Compile and trend effluent characteristics.

Continuous or proportional sampling is recommended and may be required where there is significant variation in the concentrations and mixtures of potential pollutants in the effluent stream. Periodic sampling may be adequate when the concentrations and mixtures are reasonably constant and there is minimal 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. The method of sampling is usually specified in the applicable regulation or permit.

In reporting radiological data, gross radioactivity measurements are generally inadequate. However, they can be appropriate when:

- Gross radioactivity releases are a small fraction of the offsite Radioactivity Concentration Guides (RCG) for "unidentified mixtures" and are of no health or environmental significance
- The relative concentrations of specific radionuclides are so well known by other means that gross radioactivity measurements are truly indicative of the activity being released
- The activity of waste streams is so low as to preclude specific nuclide measurements.

For radioactive effluents, onsite discharge monitoring and reporting must be adequate to provide an annual average concentration and an annual summary of the quantities of radioactive materials released. The summary should include all significant or reportable releases. It is required, therefore, that the annual average flow and pollutant concentration be determined for each waste stream.

The EPA regulations pertaining to the release of hazardous substances from DOE facilities are presented in 40 CFR 302, "Designation, Reportable Quantities, and Notification" (EPA 1989a). This regulation, in accordance with Sections 101(14) and 102(a) of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), designates those substances in the statutes of CERCLA, identifies reportable quantities of those substances, and sets forth the notification requirements for releases of these

substances. This regulation also sets forth reportable quantities for hazardous substances designated under Section 311(b)(2)(A) of the *Clean Water Act of 1977*.

3.2.2 Airborne Effluents

Airborne emissions of radioactive materials from DOE-controlled facilities at the Hanford Site are subject to EPA regulations. The primary regulation is 40 CFR Part 61 (NESHAP) (EPA 1989c). The list of hazardous air pollutants regulated under the NESHAP is provided in Subpart A, "General Provisions." The specific emissions standards and monitoring requirements for radionuclides are contained in Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities," of the proposed 40 CFR Part 61. Subpart H standards cover all DOE operations that emit radionuclides other than radon to the air, except for facilities subject to 40 CFR Part 191 (EPA 1985), Subpart B (disposal of spent nuclear fuel, high-level and transuranic radioactive wastes) and 40 CFR Part 192 (EPA 1983b) (uranium and thorium mill tailings).

Subpart H of the proposed NESHAP presents detailed requirements for emissions monitoring and test procedures (61.93), compliance and reporting (61.94), record-keeping requirements (61.95) and exemptions from the reporting and testing requirements of 40 CFR Part 61.10 (61.97). Radionuclide emission rates from stacks and vents must be measured at all release points that have the potential to release radionuclides into the air in quantities which could cause an EDE in excess of 1% of the standard. The potential to release radionuclides must be based on the emissions from the effluent stream that would result if all pollution control equipment did not exist, but facility operation(s) was otherwise normal [40 CFR part 61.93 (b)(4)(ii)]. For release points that have a potential to release radionuclides into the air, but have effluents below the continuous monitoring standard, periodic confirmatory measurements must be made to verify low emissions. Also, all radionuclides which could contribute greater than 10% of the potential EDE for each release point must be measured. With prior EPA approval, alternative methods to the one described, including process knowledge, can be substituted for measurement to determine the emission levels of individual radionuclides.

Subpart H, Section 61.93, of the proposed NESHAP specifies the monitoring requirements determining radionuclide emission rates. These requirements include sampling points, appropriate sampling methods, flow rate determinations, sampling frequency, analytical methods, and quality assurance procedures. Direct measurement of air concentrations of radionuclides at the receptor point is acceptable if the criteria in Section 61.93(b)(5) are met. These criteria include continuous monitoring of released radionuclides, satisfactory detection limits, quality assurance, and prior EPA approval.

The proposed NESHAP would require that plants monitor their operations continuously and keep records of the results of their onsite monitoring for 5 yr. Westinghouse Hanford would have to certify semiannually that there have been no changes in operations that would require new testing. Although the report is based on the calendar year, the emission limit applies to any period of 12 consecutive months.

Additional EPA requirements on hazardous substances are contained in 40 CFR Part 302.4 (EPA 1989b). This regulation provides information on reportable quantities of nonradioactive hazardous substances. Unlisted hazardous substances designated by 40 CFR Part 302.4 are regulated in accordance with the EPA toxicity of the contaminant.

Several DOE orders provide requirements for monitoring of radioactive and nonradioactive emissions from DOE facilities at Hanford. These orders state that DOE-controlled facilities must comply with 40 CFR Part 61 (NESHAP) (EPA 1989c). The three principal orders are DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1990a), and DOE Order 5400.1, Chapter IV, "Environmental Monitoring Requirements" (DOE 1988).

Emissions from DOE-controlled facilities that have the potential for radioactive contamination must be monitored in accordance with the requirements of DOE Order 5400.1 (DOE 1988) and DOE Order 5400.5 (DOE 1990a).

In Washington State, airborne emissions are regulated by the *Clean Air Act of 1977*. General regulations for air-pollution sources are presented in WAC 173-400, including emission standards for sources emitting hazardous air pollutants in WAC 173-400-075 (Ecology 1987).

The U.S. Department of Energy, Field Office, Richland, (DOE Field Office, Richland), contractor policies for radioactive airborne releases are discussed in WHC-CM-7-5 (WHC 1989a). This environmental compliance manual refers to the applicable regulations governing the monitoring of radioactive emissions in NESHAP. Other regulations, including DOE orders, state that DOE facilities must comply with the requirements set forth in the NESHAP. Other regulations include: 40 CFR Part 52, "Approval and Promulgation of Implementation Plans" (EPA 1988a); and DOE Orders 5400.1 (DOE 1988), 5400.5 (DOE 1990a), and 5484.1 (DOE 1981).

3.2.3 Liquid Effluents

Requirements limiting the exposure of the public to radioactive materials from DOE-controlled activities through the drinking water pathway are presented in DOE Order 5400.5, Chapter II, paragraph 1.d (DOE 1990a). Although the radiological criteria of the public community drinking water standards of 40 CFR Part 141 (EPA 1986a) are not applicable to DOE-operated drinking water systems, it is DOE's policy to provide an equivalent level of protection for all persons consuming the water from a drinking water supply operated by, or for, DOE. These systems shall not cause any person consuming the water to receive an EDE greater than 4 mrem/yr, excluding naturally occurring radionuclides. In addition, DOE facility operators shall ensure that the liquid effluents from DOE activities shall not cause private or public drinking water systems downstream of the facility discharge to exceed the drinking water radiological limits of 40 CFR Part 141.

The dose limit is consistent with the drinking water criteria in 40 CFR 141, "National Interim Primary Drinking Water Regulations" (Safe Drinking Water Act) (EPA 1986a). The dose limit is the EDE to an individual whose exclusive source of drinking water contains a radionuclide, or a mixture

of radionuclides, at a level of 4% of the appropriate derived concentration guide (DCG) value. The maximum contaminant levels in public water systems are found in 40 CFR 141.15 (EPA 1986a) (generally radium and alpha emitters) and in 40 CFR 141.16 (beta and gamma emitters).

Liquid effluents from DOE-controlled facilities that have the potential for radioactive contamination must be monitored in accordance with the requirements of DOE Orders 5400.1 (DOE 1988) and 5400.5 (DOE 1990a). Facility operators must provide monitoring of liquid waste streams adequate to:

- Demonstrate compliance with the applicable requirements of DOE 5400.5, Chapter II
- Quantify radionuclide released from each discharge point
- Alert affected process supervisors of upsets in processes and emissions controls.

Depending on where a liquid effluent (wastewater) is discharged, certain regulations apply. These regulations are implemented through issuance of permits by federal, state, and/or local agencies. It is the responsibility of the facility, through DOE Field Office, Richland, to apply for the permit appropriate to the effluent being discharged. Before applying for any permits, the applicant must know the sources of its wastewater discharges and where the wastewater is being discharged. The following regulations apply based on where the wastewater is discharged:

- Wastewater discharged to a Publicly-Owned Treatment Works (POTW) is subject to federal regulations found in 40 CFR Parts 403 to 471 (EPA 1988b) and may also be subject to local regulations and limitations. Permits for such discharges are obtained from the local sewerage agency into which the effluent is discharged, or in some cases, from the state
- Wastewater discharged into a navigable waterway is subject to Washington State regulations (Chapter 173-220 WAC) (WAC 1988) under the National Pollution Discharge Elimination System (NPDES). The state issues NPDES permits for such discharges
- Washington State controls discharges to ground and surface waters of the state, under Chapter 173-216 WAC (Ecology 1986). The state issues permits for such discharges. A permit of this type would be necessary for any discharges to land which could infiltrate to groundwater.

Each type of discharge permit identified above will typically contain discharge limitations and monitoring requirements. However, the limitations and monitoring requirements will vary depending on the source and type of wastewater being discharged. For those processes which have been categorized by EPA, discharges to a POTW will be subject to pretreatment standards which are based on the production process which generates the wastewater. Categorical processes are identified in 40 CFR Parts 403-471 (EPA 1988c). Specific limitations, monitoring, and reporting requirements have been issued for each categorical process. In addition to EPA's requirements, the state

and local sewerage agency may impose additional limitations, monitoring, and reporting requirements. Discharges to a navigable waterway also will be subject to certain standards based on the industrial process which generated the wastewater; certain additional limitations also are imposed in the NPDES permit. In all cases, the specific pollutants to be monitored and the frequency of monitoring and reporting will be based on the applicable regulations and the language of the permit.

The DOE Field Office, Richland, contractor policies for nonradioactive and radioactive liquid effluents are discussed in WHC-CM-7-5 (WHC 1989a). This environmental compliance manual describes current contractor requirements for monitoring and restricting liquid effluents. Applicable requirements are discussed in Section 3.4 of this document.

3.2.4 Hazardous Mixed Wastes

There are currently no regulations pertaining to "mixed waste" in effluents. Radioactive and Dangerous/Extremely Hazardous contaminants in effluent streams are handled as individual components in effluent regulations and in effluent monitoring.

The DOE Field Office, Richland, contractor policies on mixed waste are presented in Section J of WHC-CM-7-5 (WHC 1989a).

3.3 STANDARDS/REFERENCES

DOE Order 5480.4, "Environmental Protection, Safety, and Health Protection Standards" (DOE 1984), presents a listing of mandatory and good practice environmental standards.

3.4 WESTINGHOUSE HANFORD COMPANY EFFLUENT MONITORING REQUIREMENTS

Westinghouse Hanford policy for monitoring effluents is presented in WHC-CM-7-5 (WHC 1989a). Although the Westinghouse Hanford environmental compliance manual contains some requirements that are more restrictive than those found in the regulations, this FEMP is only documenting Westinghouse Hanford compliance with the requirements of the regulations. The sole purpose of reviewing and referencing the Westinghouse Hanford manual is to indicate Westinghouse Hanford policy.

The purpose of the Westinghouse Hanford Environmental Compliance Manual is to establish guidelines to be used by Westinghouse Hanford that:

- Protect the environment from radioactive materials and other dangerous substances under Westinghouse Hanford jurisdiction
- Protect people from radionuclides and other dangerous substances in the environment

- Provide a tool to be used in conjunction with applicable DOE orders and other pertinent federal, state, and local laws, rules, and regulations issued for Environmental Protection in accordance with the policy defined in WHC-CM-1-1, Management Policies, MP 5.1, "Environmental Assurance" (WHC 1990a).

3.5 FACILITY REQUIREMENTS FOR ORGANIC EMISSION STANDARDS

Facilities that operate under a Subtitle C Permit [refer to 40 CFR Part 261.3 (EPA 1989b)] are required to meet specific organic emission standards as part of an EPA regulatory requirement. These would include hazardous waste treatment, storage, and disposal (TSD) facilities. Included in the final rule are organic emissions from recycling units which do not require a RCRA permit, but are part of a TSD facility that is required to have a Subtitle C Permit. If hazardous waste management facilities which manage wastes have an annual average total organic concentration of 10 ppmw or greater, then the facility is required to reduce the total organic emissions from all processes to below 3 lb/h or 3.1 tons/yr, or install and operate a control device that reduces the total organic emissions by 95%. Facilities that are in compliance are not required to install control devices or to monitor their emissions if it can be shown that organic emissions will never exceed the established limits. The effective date of the final rulemaking was December 21, 1990.

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4.0 IDENTIFICATION AND CHARACTERIZATION OF EFFLUENT STREAMS

To assess the effluent monitoring systems needed at the T Plant Facility, an identification and evaluation of the liquid and airborne effluent streams is required. The purpose of reviewing the effluent streams is to quantify the radioactive and hazardous materials in the effluent streams. The potential for radioactive and hazardous materials to be discharged or emitted to the effluent streams during upset operating conditions also will be determined.

The major liquid effluent streams that discharge to the environment from the T Plant Facility are:

- **216-T-4 Chemical Sewer Pond**--Liquid discharge to this effluent stream originates from eight sources in the 221-T, 271-T, 221-TA, 291-T and 224-T Buildings, and 211-T Chemical Storage Area. The effluent contributors include steam condensate, cooling water, flushing water, storm water runoff, and other chemical streams known not to have radioactive materials. Effluents from the 211-T Chemical Storage Area drain to several blind sumps (with no outflow). Liquid in the sumps can be manually pumped to the chemical neutralization system where the liquid is treated for pH and then sent to the 216-T-4 Pond. The other effluents drain to the 207-T Retention Basin and from there drain to the 216-T-4 Pond. The effluent stream is not currently monitored. Samples are taken for analysis of some constituents on a monthly basis and for other constituents on a quarterly basis

- **216-T-1 Ditch**--The flow from eight process sewer lines from the 221-T Building Head-End, which is not operating at this time, are discharged to the 216-T-1 Ditch. There are no effluent monitors* for flowrate or constituents for this waste stream. The effluent is sampled at the point where the 90-m underground feed pipe discharges to the 216-T-1 Ditch. When experimental operations involve process batch solutions, the effluents are collected in holding tanks, sampled for pH and routed to the 216-T-1 Ditch when the pH has been verified as acceptable.

A third major liquid effluent stream exists at the T Plant Facility. This stream is not, however, discharged to the environment. The third stream from the T Plant Facility is:

- **T Plant Aqueous Waste Transfer System**--Liquid effluents contributing to this effluent stream are generated during decontamination operations in the 221-T and 2706-T Buildings and drain to the TK 15-1 Tank. If the liquid waste is sent by cross-site underground transfer lines, it is sampled and analyzed to determine whether it meets the pH requirements for receipt at the Tank Farms.

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*However, SAP will address the monitoring and sampling required on liquid streams. The SAP is beyond the scope of the FEMP requirements and will be added to the Appendix section of this FEMP.

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A calculation is performed to evaluate the quantity of enriched Pu present. Liquid waste is treated upon receipt at the Tank Farms if it is sent by railcar.

Although the constituents of the stream are described in significant detail in this FEMP, release of this waste to the environment once it has left the 221-T Building is the responsibility of the Tank Farms. An evaluation of the monitoring capabilities for waste releases to the environment are addressed in the appropriate sections of the Tank Farms FEMP.

The major emissions from the T Plant Facility are:

- **291-T-1 Main Stack**--This stack exhausts filtered air from the 221-T Building canyon and process ventilation. Four banks of HEPA filters became operational in FY 91, and an isokinetic probe and sampling consists of a record sampler, a beta-gamma continuous air monitor (CAM) unit, and an alpha CAM unit. The 291-T-1 Stack is 200 ft high and has an inner diameter at its base of 16 ft

- **296-T-13 Roof Stack**--This stack exhausts HEPA-filtered air from the roof of the 221-T Building. The exhaust is pulled through a prefilter and two banks of HEPA filters. The effluent exhausted is from approximately 5 ft above the 221-T Building canyon deck to the roof. The sampling-and-monitoring system consists of a record sampler and a beta-gamma CAM unit. The 296-T-13 stack is 15 ft high and has a 2 ft square opening

- **296-T-7 Stack**--This stack exhausts unfiltered air from the 2706-T Building. The stack exhausts approximately 10 ft above the building roof level. Air is drawn from the 2706-T Building through one exhaust system for the railroad and automotive pits and three evaporative coolers located on the south wall of the building. The 296-T-7 Stack is 26 in. in dia. and 28 ft high

- **2706-T Roof Ventilation**--This ventilator is near the middle of the 2706-T Building roof. The ventilator exhausts unfiltered and unmonitored air from near the ceiling of the building.

4.1 IDENTIFICATION AND CHARACTERIZATION OF SOURCE TERMS CONTRIBUTING TO EACH EFFLUENT STREAM

4.1.1 Routine Operating Conditions

4.1.1.1 Liquid Effluents. The 216-T-4 Chemical Sewer Pond, which is essentially a ditch, receives liquid effluents from T Plant. A small amount of routinely produced chemical waste in the 221-T Building galleries and 211-T Chemical Storage Area are collected by chemical sewers. The chemical sewers for the 211-T Chemical Storage Area drain to the 216-T-4 Pond. The rest of the chemical sewers drain to the 207-T Retention Basin and from there to the 216-T-4 Pond. Liquid effluent releases from either routine operations or upset conditions are possible through this release route. Storage facilities for handling NaOH in bulk quantities are presently in the

211-T Chemical Storage Area. An 8,000-gal NaOH storage tank, which is surrounded by a concrete berm, and sloped concrete unloading pad, which drains to the 216-T-4 Stream, comprise the bulk chemical handling facilities. The facility is designed to minimize releases during routine operations and isolate from the environment any potential release because of an upset condition. The approximate annual flow to the pond is 1.28 x 10^6 gal. The corresponding daily flow is estimated to be 35,000 gal. Specific contributors to the stream include 221-T Building Pipe Gallery and Operating Gallery floor drains and condensate, the 271-T Building basement sump, 221-TA Building steam condensate, 291-T Building Heating coils effluents, 221-T Building PWR spent fuel storage cooling water and heel of trucks carrying caustic. In addition, the stream receives steam condensate cooling water from the 224-T Building. The volume contribution from selected contributors is approximately 75 gal/d from the galleries, 2,050 gal/d from the basement sump, 10 gal/d from steam condensate, 2,400 gal/d effluent from heating coils used only during cold weather, and 21,600 gal/d from PWR spent fuel storage cooling water. The steam condensate cooling water from the 224-T Building contributes approximately 250 gal/d while the heel of trucks carrying caustic is variable.

Effluents to the 216-T-4 Chemical Sewer Pond are generally not contaminated with either radioactive or hazardous materials. If the effluents were to be contaminated, the material would likely be hazardous and not radioactive in nature. Based on potential contributors, the effluent stream could include: acetone, acetic acid, ammonium nitrate, ammonium hydroxide, mercury, methanol, nitric acid, phosphoric acid, potassium permanganate, sodium, sodium hydroxide, sodium nitrite, and zinc.

Information provided above on potential radioactive liquid effluents to the 216-T-4 Stream during routine facility operating conditions indicates that the EDE to the maximally exposed member of the general public consuming the water would be less than 4 mrem/yr. This represents a dose limit from a radionuclide or mixture of radionuclides at a level of 4% of the DCG Value.

Information on the potential hazardous liquid effluent releases during routine facility operating conditions indicates that the quantities of hazardous materials at the point of discharge to the environment may exceed applicable reportable quantities for regulated substances. Information on radioactive and hazardous materials was obtained from Westinghouse Hanford reports (Brown 1989, Jeppson 1990).

The flow from eight process sewer lines at the 221-T Building Head-End connects to the 6-in.-dia. main header for discharge to the 216-T-1 Ditch. Of the 38 potential contributors, 7 contributed routinely and 31 contributed infrequently. Routine contributors were three process water flows, two steam condensate flows, and flows from two drains. Infrequent contributors included flows from nine process tanks, five floor or safety shower drains, four cooling systems, four steam condensate traps, two sinks, two hoods, two process water lines, one compressed air line condensate trap, one vacuum pump seal water, and one large containment vessel drain. There are no effluent monitors for flowrate or constituents for this wastestream. Process batch solutions from experimental operations in the 221-T Building Head-End were collected in holding tanks, sampled for pH. They are routed to the effluent

wastewater stream when the pH was verified to be acceptable. The 216-T-1 Ditch is located just north of the 221-T Building Head-End. The wastewater line extends underground about 290 ft from the 221-T Building Head-End to the 216-T-1 Ditch. The effluent samples were obtained at the point of the wastewater stream outfall from the underground pipe to the 216-T-1 Ditch.

The wastewater stream consisted of two configurations: Wastewater 1 Stream, plasma torch operation, and Wastewater 2 Stream, plasma torch standby. The Wastewater 1 Stream time period was defined as the time it took cooling water to flow around the plasma torch tip. This cooling-water flow period was about 24 h for each of two sets of experiments conducted during the 6-mo designation period. The plasma torch was operated to generate manganese aerosol in the aerosol-mixing vessel. The torch generated aerosol for about 1 h for each set of experiments conducted. Other cooling water and steam condensate flows contributed to the Wastewater 1 Stream.

The Wastewater 2 Stream consisted of process cooling water and steam condensate flows for the time during which there was no cooling-water flow to the plasma torch. Process wash solutions were also discharged on a batch basis as part of the Wastewater 2 Stream. The Wastewater 2 Stream duration consisted of the 6-mo designation time period minus the 48 h for plasma torch cooling water flow (Wastewater 1 Stream).

The total process chemicals discharged as Wastewater 2 Stream from the Head-End for disposal in the 216-T-1 Ditch between 1985 and 1990 were cesium (33.5 kg), manganese (less than 24.0 kg), iodine (3.6 kg), potassium (7.0 kg), zinc (less than 18.5 kg), lithium (47.0 kg), sulfate (325.0 kg), phosphate (33.6 kg), sodium (120.0 kg), borate (124 kg), and ethylenediaminetetraacetic acetate (600.0 kg). The Wastewater 2 Stream consists mainly of the heating-and-ventilation cooling water flow with some steam condensate and process solution flow. Between December 1985 and March 1990, the total Wastewater 2 Stream volume during this time was estimated to be an average of about 20 L/min for a total of 5.4×10^7 L. This process evaluation resulted in an average concentration of cesium (620 ppb), manganese (33 ppb), iodine (67 ppb), potassium (130 ppb), zinc (19 ppb), sodium (2.2 ppm), borate (2.3 ppm), and ethylenediaminetetraacetic acetate (11.1 ppm). At present, no new discharges are planned for the 216-T-1 Ditch. If future activities result in effluents to the 216-T-1 Ditch, a review of monitoring requirements would be required.

Variability of the Wastewater 2 Stream concentrations of process chemicals has been significant in the past. The solutions containing the process chemicals were pumped within 1 h to the stream on a batch basis. The process batches accumulated and were discharged after each test. An average of one test every two months was typical. The maximum process evaluation concentrations of the process chemicals were estimated to be cesium (400 ppm), manganese (33 ppb), iodine (60 ppm), potassium (1,400 ppm), zinc (710 ppb), lithium (2,300 ppm), sulfate (16,000 ppm), phosphate (1,700 ppm), sodium (775 ppm), borate (4,800 ppm), and ethylenediaminetetraacetic acetate (5,200 ppm). These values were obtained by determining the concentration of a chemical constituent in the process solution and assuming that it was pumped quickly to the 216-T-1 Ditch, so no dilution credit was taken. Some of these materials were used for only one or two tests and were not routinely

materials were used for only one or two tests and were not routinely discharged. No process solution batches were identified for discharge to Wastewater 2 Stream after FY 1990.

Potentially radioactive and hazardous waste liquid effluents also are present in the T Plant Aqueous Waste Transfer System. The liquid waste is generated during decontamination activities in the 221-T and 2706-T Buildings and drains to the TK 15-1 Tank. If the liquid waste is transported via underground cross-site transfer lines, it is sampled and analyzed to determine whether it meets the pH requirements for shipment and receipt at the Tank Farms. Sodium hydroxide and sodium nitrite are used to adjust the pH. A calculation is performed to evaluate the quantity of enriched plutonium present. If the liquid waste is transferred to railroad tank cars for shipment, it is tested upon receipt at the Tank Farms.

4.1.1.2 Airborne Effluents. An evaluation of the potential radioactive airborne effluent releases during routine operating conditions has been performed. The 221-T Building canyon exhaust released 3.2×10^{-5} and 2.8×10^{-6} of ^{239}Pu, ^{240}Pu, and ^{241}Am, respectively out of the 291-T-1 main stack during 1989 (Unit Dose). Releases from this stack for this time period were filtered by four banks of HEPA filters. If a release fraction of 1/3,000 is assumed as the reduction attributable to the filter banks, the potential offsite dose would be 1.49×10^{-1} and 1.97×10^{-2} mrem/yr of $^{239,240}Pu$ and ^{241}Am, respectively for a total of 1.69×10^{-1} mrem/yr. Therefore the 0.1 mrem/yr dose has been exceeded.

The 221-T Building canyon exhaust also released 4.11×10^{-6} and 3.84×10^{-4} Ci of gross alpha and gross beta radionuclides out the 296-T-13 Roof Stack during 1989 (Ref. 1). For calculational purposes, the gross alpha and beta radionuclides are considered to be ^{239}Pu and $^{90}Sr/^{90}Y$, respectively. Releases from this stack are pulled through one bank of prefilters and two banks of HEPA filters before being exhausted. If a release fraction of 1/3,000 is assumed as the reduction attributable to the filter banks, the potential uncontrolled release would be 0.012 and 1.2 Ci of ^{239}Pu and $^{90}Sr/^{90}Y$, respectively. Using the CAP-88 unit dose calculations for the 200 West Area (Ref. 6), this release would result in a 0.093 mrem/yr dose, which is essentially equal to the 0.1 mrem/yr evaluation criteria. Information on the potential radioactive emissions during routine facility operating conditions indicates an EDE to the maximally exposed member of the general public would be approximately 0.1 mrem/yr, which represents 1% of the 10 mrem/yr radioactive emissions limit standard.

Information (presented in Section 16.2) indicates the potential hazardous emissions during routine facility operating conditions. It shows that the quantities of hazardous materials at the point of emission to the environment will exceed applicable reportable quantities for specific regulated substances.

4.1.2 Upset Operating Conditions

4.1.2.1 Potential Liquid Discharges. An evaluation of the potential radioactive liquid effluent releases during upset conditions considered the failure of one engineered barrier. Most of the liquid waste system outside of

the 221-T Building canyon is either double-wall pipe or encased in concrete. The exception is the waste transfer pipe from the 211-T Sump with liquid from the 2706-T Building to the 221-T Building canyon. This is a single-wall pipe, part of which is underground. Proposed facility upgrades to this line will provide for either secondary containment or daily inspections. Although a failure of the pipe from the 211-T Sump to the 221-T Building could result in a release to the environment, the magnitude of the release would not require monitoring. For other parts of the liquid waste system, a rupture of one engineered barrier would not cause a release to the environment.

4.1.2.2 Potential Emissions. Specific upset conditions for the facility that have the potential to generate radioactive emissions are not evaluated because the magnitude of routine releases, without mitigative engineering controls, is estimated to result in a radioactive dose equivalent to the maximally exposed member of the general public of greater than 0.1 mrem/yr.

The upset condition for the facility to generate hazardous emissions can be described as a spill of a volatile material that becomes entrained in the building exhaust. The Washington State's Dangerous Waste Regulations mandate that any discharge to the environment of a dangerous waste or hazardous substance be reported [WAC 173-303-145 (Ecology 1989)]. Washington State rules do not specify a deminimus quantity.

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5.0 EFFLUENT POINT OF DISCHARGE DESCRIPTION

The purpose of this section is to describe and characterize the liquid and airborne effluent discharge points for the T Plant Facility. Information on one liquid and three airborne effluent streams is presented. The liquid stream described is the 216-T-4 Chemical Sewer and the airborne effluent streams are the 291-T-1 Main Stack and 296-T-13 Roof Stack for the 221-T Building and the 296-T-7 Stack for the 2706-T Building.

5.1 LIQUID EFFLUENT DISCHARGE POINTS

5.1.1 216-T-4 Chemical Sewer

Liquid effluents discharged to the 216-T-4 Pond originate in the 216-T-4 Chemical Sewer. Liquid waste from the 221-T, 271-T, 221-TA, 291-T, and 224-T Buildings flow to the effluent stream. Liquid originating in the 211-T Chemical Storage Area drains directly to the 216-T-4 Pond. Liquid waste from the other sources drains to the 207-T Retention Basin and from there drains to the 216-T-4 Pond.

5.2 AIRBORNE EFFLUENT DISCHARGE POINTS

5.2.1 291-T-1 Main Stack

The 291-T-1 Main Stack exhausts emissions from the 221-T Building canyon. The air flow is drawn from within approximately 5 ft above the canyon deck drawn through the process cells, pipe trench and exhaust tunnel. The air is drawn by 2 fans rated at 20,000 ft^3/min each. Air drawn from the 221-T Building canyon by this exhaust system is pulled past the cell cover blocks down into the cells and pipe trench. The air then travels through 10-in.-dia. ceramic ducts from each cell or section of the pipe trench in a 10-ft 6-in. square exhaust tunnel. The tunnel exits the 221-T Building at Section 3, 22 ft below the deck level of the canyon, where it narrows to a 4-ft wide by 7-ft high concrete duct. This duct runs 214 ft underground to the 291-T Building, which is located just southeast of the 221-T Building. The air is then pulled through two type FI-2 HEPA filter banks and is released out the 291-T-1 Main Stack. The maximum allowable pressure drop across the primary filter bank is 4 in. w.g. The stack height is 200 ft. The inside and outside diameters of the stack at its base are 16 ft and 18 ft, respectively. The stack is constructed of 9-in.-thick reinforced concrete and is lined with stainless steel. The annual volume of the stack is 1.89 x 10^{10} ft^3/yr. The normal flow rate is 36,000 ft^3/min. Specific radionuclides contributing to this stream are ^{239}Pu, ^{241}Am, ^{90}Sr, ^{137}Cs, ^{106}Ru, ^{103}Ru, ^{113}Sn, and ^{125}Sb.

5.2.2 296-T-13 Roof Stack

The 296-T-13 Roof Stack exhausts emissions from the 221-T Building canyon. The air flow is from approximately 5 ft above the canyon deck up through the 296-T-13 Roof Stack, which is located on the roof of the 221-T Building. Air drawn from the 221-T Building canyon by this exhaust system is pulled through one bank of prefilters and two banks of HEPA filters before being exhausted out the 296-T-13 Stack. The HEPA filters are replaced when the pressure drop across the filter is in excess of 4 in. w.g. The stack exhausts approximately 15 ft above the building roof level through a square 2-ft by 2-ft duct. The annual volume of the stack is 1.89×10^{10} ft^3/yr. The normal flow rate is 13,000 ft^3/min. Specific radionuclides contributing to this stream are ^{239}Pu, ^{241}Am, ^{90}Sr, ^{137}Cs, ^{106}Ru, ^{103}Ru, ^{113}Sn, and ^{125}Sb.

5.2.3 296-T-7 Stack

Airborne emissions from the 2706-T Building can be exhausted through two discharge points. These are the 296-T-7 Stack and a building roof exhauster. Proposed facility upgrades will eliminate the roof exhauster and both increase the discharge volume and add continuous monitoring to the 296-T-7 Stack. The 296-T-7 Stack exhausts emissions from the 2706-T Building, which is a low-level decontamination facility at the T Plant Facility. The stack exhausts approximately 10 ft above the building roof level. Air is drawn from the 2706-T Building from one exhaust system for the railroad and automotive pits and three evaporative coolers located on the south wall of the building. The exhaust is not filtered. The air is drawn from the pits into four 15-in.-dia. vitrified clay ducts that flow into a common 2-ft-dia. clay duct. The air is then exhausted out the 296-T-7 Stack, which is 26 in. in dia. and 28 ft in height. The annual volume of the stack is 1.58×10^9 ft^3/yr. The normal flow rate is 5,000 ft^3/min. Radioactive constituents of this stream are categorized only as gross alpha and gross beta.

6.0 EFFLUENT MONITORING SYSTEM DESIGN CRITERIA

This section presents design criteria for both liquid and airborne effluent monitoring systems. These include criteria contained in federal regulations and contractor's design criteria to ensure compliance with the regulation. Because of the age of some monitoring systems, contractor design criteria may not be compatible with existing regulations. Therefore, design criteria for actual or planned monitoring system upgrades also are described.

6.1 LIQUID EFFLUENTS

The DOE has maintained that the release of radioactive materials is governed by the Atomic Energy Act and that the release limits set by DOE correspond to federally Permitted Releases and are thus exempt from other federal and state regulations. At the same time, DOE has committed to complying with all "applicable" limits of EPA and state regulations.

DOE 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1990a), provides guidance on the acceptable levels of radioactivity that are allowed in liquid waste and effluents. The purpose of the DOE standards is to both assure that the dose to the public remains below 100 mrem/yr (Chapter I.3) and to protect the natural resources.

Demonstration of compliance with 5400.5 will generally be based on data from monitoring and surveillance programs (Chapter I, 8.a; Chapter II, 6). It is stated in the DOE order (Chapter II, 4.d) that liquid effluents from DOE activities shall not cause private or public drinking water systems downstream of the facility discharge to exceed the drinking water limits in 40 CFR Part 141 (EPA 1986a), which are, in general, numerically equivalent to 4% of the DOE DCG values. There is no guidance given on how to achieve that goal with regard to allowable concentrations in the facility liquid effluent.

Some guidance is provided in Chapter II, Section 3, for surface discharges:

- Discharges greater than DCG values on an annual average would require the BAT to be applied
- Discharges at less than DCG do not require implementation of BAT
- The settleable solids in any liquid effluent stream may not exceed 5 pCi/g alpha or 50 pCi/g beta
- Interim dose limits for native aquatic animal organisms may not exceed 1 rad/d.

Guidance on discharges of liquid waste to aquifers and phase out of soil columns is found in DOE 5400.5, Chapter II, 3.b. The guidance is limited to a reaffirmation of DOEs commitment to phase out soil column use (i.e., trenches, cribs, ponds, and drain fields) at the earliest practicable time. DOE also will develop a plan and schedule for implementing alternate acceptable disposal at the earliest practical time for those liquid discharges not first

treated by BAT. In addition, new or increased discharges of radionuclides in liquid waste to soil columns is prohibited [Chapter II, 3.b(2)] unless the DOE activity cannot comply or the release is tritium [Chapter II, 3.e(1)]. Westinghouse Hanford is in the process of preparing a plan and schedule which addresses soil column use.

Compliance with the dose limits of DOE Order 5400.5 (DOE 1990a) shall be demonstrated by documentation of an appropriate combination of measurements and calculation (Chapter II, 6.a). The ALARA concept in 5400.1 (DOE 1988) calls for attaining dose levels as low as possible. Compliance with these two objectives could be met by monitoring any stream with the potential for containing measurable radioactivity.

For nonradioactive liquid effluents discharged to cribs, the basic criteria is that the facilities may not discharge any effluent that is a hazardous waste per WAC 173-303 (Ecology 1989). The WAC 173-303 is the state's implementation of RCRA and incorporates by reference 40 CFR 261 (EPA 1989b) and 264 (EPA 1989d). The required monitoring must demonstrate a continuing knowledge of the waste composition and compliance with the prohibition on discharging hazardous waste to the ground. It is specified in DOE Order 5400.1, Sections 5 and 8 of Chapter IV (DOE 1988).

A second area that impacts liquid releases to ponds, cribs, ditches, etc. is the "Land Ban" regulations embodied in 40 CFR 268 (EPA 1988d) and WAC 173-303-140 (Ecology 1989). The 40 CFR 268 is incorporated by reference into WAC 173-303. Again, monitoring will be conducted to confirm the identity of the waste and demonstrate compliance.

While these regulations generally apply only to wastes designated as dangerous or expected to be dangerous, the applicable DOE Regulations (5400.1, 5a.1-4) require monitoring to demonstrate verification of compliance, evaluate effectiveness of effluent treatment and control, and determine if a waste is hazardous.

Westinghouse Hanford design and performance criteria for monitoring liquid effluent streams are presented in some SAR for DOE facilities operated by Westinghouse Hanford. An example is the Plutonium Finishing Plant (PFP) SAR, Section 7.1.2 (WHC-SD-CP-SAR-021, Rev. 0) (WHC 1991e). Although the following information is not presented in the T Plant SAR, it is applicable.

The following criteria are applicable to all T Plant radioactive liquid effluent streams, except the T Plant Aqueous Waste Disposal Stream discharges that are transferred to the Tank Farms via railcar:

- Record sampling systems are for effluents that normally or potentially exceed 4% of the DCG values
- Continuous monitoring is performed on effluents that have the potential to exceed 1 DCG equivalent averaged over 1 yr
- Monitoring systems must have audible alarms.

The following criteria are applicable to all T Plant's nonradioactive liquid effluent streams:

- Sampling is performed when a regulated chemical exceeds 10% of the equivalent concentration
- Corrosive streams are monitored for pH.

The following criteria are applicable to T Plant's radioactive and nonradioactive liquid effluent streams:

- Monitoring systems must maintain backup systems; be located downstream of the process but before the point of release; be calibrated in accordance with the manufacturer's recommendations; and have adequate written records
- Samples must provide representative measures of volume and concentration and calibrated flow rates must be recorded.

6.2 AIRBORNE EFFLUENTS

The DOE prescribes criteria for effluent monitoring systems in DOE Order 6430.1A, "General Design Criteria" (DOE 1989b). Listed below are those criteria that are relevant to the 291-T-1 Main Stack, the 296-T-13 Roof Stack, and the 2706-T Roof Ventilation:

- (Section 1305-6.4.1) All exhaust outlets that may contain plutonium contaminants shall be provided with two monitoring systems. These monitoring systems shall comply with DOE 6430.1A, Section 1589-99.0.1
- (Section 1589-99.0.1) All exhaust ducts (or stacks) that may contain radioactive airborne effluents shall be provided with effluent monitoring systems that are designed in accordance with the applicable requirements contained in the directive on Radiation Protection of the Public and the Environment in the DOE 5400 series and the directive on Radiological Effluent Monitoring and Environmental Surveillance in the DOE 5400 series. Backup capability for monitoring systems shall be considered in the design of each system (e.g., redundant detectors, additional sample line ports, additional sampler trains, etc.). Continuous stack sampling and continuous radiation detection shall be considered. Sampling systems shall be designed in accordance with ANSI N13.1 (ANSI 1969) and associated appendices to ensure representative sampling of the effluent stream. Isokinetic sampling shall be provided for effluent streams that are expected to contain particulate radionuclides. The range of capability of continuous monitors shall cover from routine to potential DBA releases of radionuclides
- (Section 1589-99.0.2) Nonradioactive emissions shall not exceed the guidelines contained in DOE 5400.1 (DOE 1988) and shall comply with all other applicable federal, state, and local requirements.

The above criteria essentially state that effluent monitoring systems must be designed to meet applicable federal, state, and local regulations. In general, the design criteria specified by the contractor are more specific because these criteria are developed to ensure compliance with the regulations. Because the original 291-T-1 Main Stack effluent-monitoring system was designed many years ago, the relevant design criteria are inadequate for determining compliance with existing regulations.

Specific contractor design criteria for upgrading the 200 Area stacks to meet recent regulations were documented by Cammann (see Section 16.3). These criteria were intended to be used for upgrading selected 200 Area stack sampler-monitor systems. Although the 291-T-1 Main Stack has not been upgraded to meet these criteria, the criteria are summarized here to document the criteria necessary to conform to applicable standards. The primary criteria that may be applicable to the 291-T-1 Main Stack and 296-T-13 Roof Stack are:

Stack Flow Totalizing:

- Stack flow totalizing is recommended, and shall be provided, whenever stack flowrates vary routinely by more than 20%.

Sample Extraction Probes:

- Sample probe designs shall follow guidelines presented in ANSI N13.1 (ANSI 1969)
- Sample probes shall be designed for representative/isokinetic sample extraction based on the average stack velocity
- Sample probes shall be located a minimum of 5 duct diameters downstream and two duct diameters upstream of major flow disturbance points, unless the suitability of an alternate location can be demonstrated through repeatable flow profile measurements
- Independent sample extraction probes shall be provided for the record sample loop and the continuous air-monitor loop
- Sample extraction probes shall be flange mounted to the stack to facilitate periodic removal, inspection and cleaning activities.

Sample Transport Lines:

- Sample transport lines shall be selected and installed to minimize particle loss attributed to gravity settling, turbulent impaction, and electrostatic effects
- Sample transport line runs, bends, and tube transitions shall be minimized to the extent practical

- Sample transport line bend radii shall be at least 10 times the inside diameter of the transport line

- Provisions shall be made to inhibit condensation of moisture in sample transport lines.

Record Sampling:

- The record sample airstream shall be routed through a 47-mm filter to obtain a buildup sample for laboratory analysis

- The record sampling system shall have sample flowrate indicating and totalizing capabilities

- A flowrate regulator shall be provided to maintain a constant flowrate to compensate for filter loading effects

- Variable sample flow control may be required for exhaust streams having a flow that varies by more than 20%

- The product of the sample flowrate and the sample collection time shall be at least 370 ft^3/min/h

- Sample flowrates shall not exceed 4 ft^3/min.

Continuous Air Monitoring:

- The CAM system shall have flowrate indicating and regulating capabilities

- The CAM system shall have local readout countrate meters with stripchart recording capability

- Monitoring system alarm setpoints shall be adjusted to alarm at release concentrations as low as possible without resulting in an excessive number of alarms due to normal fluctuations in either background radiation or release quantities.

Alarm System:

- Separate remote instrument failure alarms, high airborne radiation alarms, and real time airborne radiation measurement indication shall be provided when feasible.

Power Coordination and Backup:

- The stack sampler-monitor system shall operate continuously using the same emergency electrical power backup capabilities as the stack blower fan(s).

Reliability:

- The CAM failure annunciation shall be provided and the CAM system will be checked periodically to verify system response
- Independent vacuum pumps or house vacuum shall be provided for each leg of the record sampling system and the CAM system
- Vacuum system failure annunciation shall be provided and checked periodically to demonstrate operability.

These criteria are generally consistent with, and in some cases more restrictive than, ANSI N13.1-1969, which continues to serve as the primary source of detailed requirements for effluent monitoring systems. Therefore, comparison of the existing stack monitoring system to these design criteria will help determine compliance with the applicable regulations. This comparison is made in Section 14.0 of this report.

Westinghouse Hanford design and performance criteria for monitoring airborne emissions are presented in some SARs for DOE facilities operated by Westinghouse Hanford. Although not presented in the T Plant SAR, the following information from the PFP SAR, Section 7.1.1 (WHC-SD-CP-SAR-021, Rev. 0) (WHC 1991e) is applicable. In addition, there are various engineering documents and correspondence letters that pertain to the design criteria for specific monitoring system components. In the discussion that follows, general contractor design and performance criteria for airborne effluent sampling and monitoring as well as specific criteria for individual monitoring systems are presented.

The following criteria are applicable to all T Plant's radioactive emissions:

- Sampling is provided for all effluents that have the potential to exceed 10% (annual average) of any DCG-Public value
- Continuous monitoring and alarm systems are provided for all systems that have the potential at any time to exceed 10 times any DCG-Public value
- Audible and visible alarm indications are easily discernible to responsible personnel in continuously or frequently occupied (at least once every half hour) areas
- Monitoring system alarms are set at release concentrations as low as possible without resulting in an excessive number of false alarms resulting from fluctuations in releases or background radiation levels

- Air-monitoring systems are calibrated according to ANSI N323 (ANSI 1978) and ANSI N42.18 (ANSI 1980) when installed and anytime they are subject to maintenance or modification

- Air-monitoring systems are powered from a source that has the same or equivalent back-up capability as the air mover for the effluent stream being monitored

- Air-monitoring systems are inspected daily and source-checked monthly.

The following criterion is specific to the 291-T-1 Stack for radioactive emissions:

- The annual average concentration of radionuclides released from the stack is not to exceed 10 times the DCG for alpha emitters and 10 times the DCG for beta emitters.

Although specific criteria for other stacks also are provided in the SAR, they pertain to stacks that were determined to not require a FEMP and, therefore, are not discussed here.

The following criteria are applicable to all T Plant's nonradioactive emissions:

- Continuous effluent monitoring systems with alarm capabilities are used for airborne effluents that have the credible potential to exceed 50% of any quantifiable release standard specified in the ECM

- Analytical methods for continuous monitoring of effluents are in accordance with applicable EPA methods for the contaminants specified by EPA. Alternate methods are used where approved EPA methods are not specified.

The only criteria identified above that is difficult to meet from a technical standpoint is sampling alpha emitters at 10% of the DCG-Public value. This difficulty exists because the minimum detectable level (MDL) of alpha emitters through sampling is relatively high compared to the DCG. Consequently, as will be discussed in Sections 7.0 and 14.0, demonstrating compliance with this criterion is difficult.

The criteria outlined previously may be used to demonstrate compliance with applicable regulations provided that two conditions are met. First, it must be demonstrated that these criteria are consistent with the applicable regulations. Second, the actual operation of the systems must be consistent with the criteria. In Section 7.0, the effluent monitoring system instrumentation is described in detail. This information will be used to demonstrate compliance with the criteria and applicable regulations in Section 14.0.

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7.0 CHARACTERIZATION OF CURRENT EFFLUENT MONITORING SYSTEM

7.1 EFFLUENT MONITORING SYSTEM AND SAMPLING PRACTICES

This section contains descriptions of the effluent monitoring instrumentation for each effluent discharge point. Detailed descriptions are provided for those effluent discharge points previously determined to require a FEMP. These effluent discharge points are the 216-T-4 Chemical Sewer Pond, 291-T-1 Main Stack and 296-T-4 Roof Stack. These detailed descriptions and the design criteria presented in Section 6.0 are used later in this report to determine compliance with applicable regulations. Only brief descriptions of the effluent monitoring instrumentation or sampling procedures are provided for those discharge points determined to not require a FEMP. These effluent discharge points are the T Plant Aqueous Waste Disposal Stream, which is transferred to 200 West Area Tank Farms, the 216-T-1 Ditch, and the 296-T-7 Stack.

Detection apparatus capable of detecting alpha- and beta-gamma-emitting radionuclides must be used on any contaminated or potentially contaminated emissions to ensure that radioactivity concentrations are maintained below the Table I guidelines of DOE Order 5480.1A, Chapter XI (DOE 1982). All T Plant's potentially contaminated airborne release points, except those from the 2706-T Building, are equipped with sampling and continuous monitoring devices to measure radionuclide concentration and ensure accurate measurement of routine and nonroutine releases. The beta-gamma emitters are detected by effluent CAMs. Alpha emitters are detected with record air samplers.

7.2 MONITORING AND SAMPLING REQUIRED

7.2.1 216-T-4 Chemical Sewer Pond

The 216-T-4 Chemical Sewer stream is not monitored. The stream is sampled monthly and quarterly for analysis of constituents. Samples are analyzed monthly for gross alpha, gross beta, total organic carbon, and pH. Samples are analyzed quarterly for aluminum, silver, mercury, uranium, ammonia, anions, total organic halides, volatile organic analytes, extractable organics, direct injection organics, total cyanide, sulfides, temperature, organo chlorine pesticides, organo phosphorus pesticides, chlorinate herbicides, and dioxin.

The effluent sample is drawn and discharged into a 5-gal receiver container. A 4-L sample is removed from the container and delivered to the 222-S Laboratory for analytical processing.

7.2.2 291-T-1 Main Stack

This stack is equipped with an isokinetic air sampling probe feeding a record particulate sampler, an alpha CAM, and a beta CAM both with alarms. The stack is also equipped with a flow velocity recorder. Details on the stack-monitoring equipment are provided below.

Air is extracted from the stack through a penetration at the 50-ft level. Its air-sampling probe has 10 nozzles located along sample line. The sample line is 0.5 in. 300-Series stainless steel. The flow rate through the sampling probe and line is approximately 6 ft^3/min.

A cabinet containing the monitoring instrumentation is located near the base of the stack. This arrangement requires the sample line to extend from the 50-ft probe level to the cabinet. Although the heated sample line bends at each end to accommodate entries into the stack and sample cabinet, most of the line is straight. Depending upon the size of the emission particulates, the arrangement may result in potentially significant losses along the sampling line. The cabinet is heated as appropriate. Upon entering the cabinet, the sample stream is split using a knife-edge "vee" type flow splitter. One line exiting the splitter goes to a record sampler, and the other line is split again using a second knife-edge "vee" type flow splitter. The resulting two lines go to an alpha CAM and to a beta CAM.

The record sampler is a Hanford-type 47-mm fixed head sampler and is located within a foot of the splitter. The sampler is equipped with a filter which is removed weekly for analysis. Air is drawn through the sampler at a flow rate of approximately 2 ft^3/min.

Air travels from the record sampler via a flexible line to a flow totalizer. The totalizer is a Rockwell Model MR-9 and measures total flow in increments of tenths of cubic meters. The totalizer is calibrated quarterly by Westinghouse Hanford personnel. The air then travels through a vacuum gauge, a pump, and is released. The line also includes a pressure switch which monitors the vacuum in the line and triggers an alarm whenever a pressure drop indicates a loss of flow. Both the gauge and pressure switch are calibrated annually by Westinghouse Hanford personnel.

One of the two lines exiting the second splitter leads to an Eberline Alpha 5-A CAM. The other line leads to an Eberline Beta AMS-3 CAM. The CAMs are calibrated yearly by PNL per the PNL-MA-563 Eberline Alpha 4, 5, and 5A Air Monitors Calibration Procedure.

7.2.3 296-T-13 Roof Stack

This stack is equipped with an isokinetic air sampling probe feeding a record particulate sampler and a beta CAM with an alarm. The stack also is equipped with a flow velocity recorder. Details on the stack-monitoring equipment are provided below.

Air is extracted from the stack through a penetration 2 ft from the exhaust fan and 8 ft from the release point. The duct is 2 ft^2. An air-sampling probe with one nozzle is located in the center of the duct

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where it samples the effluent. The sample line is 0.5 in. 300 Series stainless steel. The flow rate through the sampling probe and line is approximately 4 ft^3/min.

A cabinet containing the effluent-monitoring instrumentation is located near the stack on the roof. The cabinet is heated as appropriate. This arrangement requires the sample line to extend approximately 15 ft from the probe to the cabinet. The sample line is relatively straight and also is heated. Before entering the cabinet, the sample stream was split. One incoming line to the cabinet goes to a record sampler and the other goes to a beta CAM.

The record sampler is a Hanford-type 47-mm fixed head sampler. The sampler is equipped with a filter, which is removed weekly for analysis. Air is drawn through the sampler at a flow rate of approximately 2 ft^3/min.

Air travels from the record sampler via a flexible line to a flow totalizer. The totalizer is a Rockwell Model MR-9 and measures total flow in increments of tenths of cubic meters. The totalizer is calibrated quarterly by Westinghouse Hanford personnel. The air then travels through a vacuum gauge, a pump, and then released. The line also includes a pressure switch which monitors the vacuum in the line and triggers an alarm when a pressure drop occurs indicating a loss of flow. Both the gauge and pressure switch are calibrated annually by Westinghouse Hanford personnel.

The second incoming line leads to an Eberline Beta AMS-3 CAM. The CAM is calibrated yearly by PNL per the PNL-MA-563 Eberline Alpha 4, 5, and 5A Air Monitors Calibration Procedure.

7.3 MONITORING AND SAMPLING NOT REQUIRED

7.3.1 216-T-1 Ditch

The future content of liquid effluents that would be discharged to the 216-T-1 Ditch is uncertain. As documented previously, the nature of the experiments in the 221-T Building Head-End determines the constituents of the waste stream. Currently, there are no effluent monitors for flowrate or constituents for this effluent stream since there are no experimental activities conducted there. In the past, process batch solutions from experimental operations in the Head-End were collected in holding tanks and sampled for pH. If they met discharge criteria, they were discharged into the 216-T-1 Ditch. As previously stated, no new discharges are planned for the 216-T-1 Ditch. If future activities result in effluents to the 216-T-1 Ditch, a review of monitoring requirements would be required.

7.3.2 T Plant Aqueous Waste Discharge Stream

There are no identifiable sources of routine releases of hazardous or radioactive material to the environment from this stream. If upset conditions were to occur, the material would be contained within the facility sumps. Because there is no effluent stream, effluent monitoring is not provided. As

documented previously, the effluent is sampled from the TK 15-1 Tank and analyzed to determine whether it meets the pH requirements for cross-site transfer line shipment and receipt at 200 West Tank Farms. A calculation is performed to evaluate the quantity of enriched Pu present.

7.3.3 Sanitary Sewer

Information on the T Plant Sanitary Sewer is presented to document its current status. At present, no influents to the sanitary sewer system contain hazardous and/or radioactive constituents. In the past, some hazardous and/or radioactive constituents may have been released to the sanitary sewer system under past practices or upset conditions. Since characterization of the stream is not required, no monitoring or sampling of this effluent stream is performed.

7.3.4 296-T-7 Stack

The T Plant FEMP determination (WHC 1991b) presented data that indicated that the emissions from this stack do not require monitoring. Monitoring and sampling of the effluent stream consists of a record particulate sampler. It is a Hanford-type 47-mm fixed head air sampler. The sample probe is located approximately 1 ft downstream of the stack fan. The sampler is equipped with a filter that is removed weekly for analysis. Air is drawn through the sampler at a flow rate of approximately 2 ft^3/min. The air then travels through a pump and then is routed back into the stack. There is no totalizer on the system.

7.4 ALTERNATIVE MONITORING AND ASSESSMENT METHODS

An alternative assessment method has been prepared for liquid waste in the TK-15-1 Tank, which is part of the Aqueous Waste Transfer System. This method is documented in the *T Plant Decontamination Unit Waste Analysis Plan*, WHC-SD-WM-EV-062, Rev. 0 (WHC 1991f). A method for collecting a representative sample from the TK-5-7 and TK-15-1 Tanks and the 2706-T Sump, which are part of the Aqueous Waste Transfer System, is presented in the "T Plant Sampling Plan", part of WHC-SD-WM-EV-062 (WHC 1991f).

8.0 HISTORICAL MONITORING/SAMPLING DATA FOR EFFLUENT STREAMS

The historical data for normal operating conditions presented in this section have been taken from the Westinghouse Hanford Effluent Discharges and Solid Waste Management Reports (200/600 Areas) for calendar years 1987 through 1989. Data on the effluents from the 291-T-1 Main Stack and 296-T-13 Roof Stack are presented.

Table 8-1 lists radionuclide emissions data for the 291-T-1 Main Stack for calendar years 1987 through 1989. Table 8-2 lists radionuclides in total curies released from the 291-T-1 Main Stack for calendar years 1987 through 1989. Table 8-3 presents alpha and beta emissions data for the 291-T-1 and 296-T-13 Stacks for calendar years 1987 through 1989.

Historical data for upset operating conditions have been obtained from event occurrence reports, which are prepared by various organizations in accordance with Westinghouse Hanford administrative procedures.

Table 8-1. Radionuclide Emissions Data for the 291-T-1 Main Stack at the T Plant Facility.*

Year	Radionuclide Concentration (μCi/mL)							
	$^{89,90}Sr$[b]	^{137}Cs[b]	$^{239,240}Pu$	^{241}Am	^{106}Ru[b]	^{113}Sn	^{125}Sb	^{129}I
1989	c	c	7.11 E-14	6.32 E-15	c	c	c	c
1988	c	c	3.00 E-14	<5.00 E-15	c	c	c	c
1987	c	c	1.00 E-13	<1.00 E-14	c	c	c	c

[a]Refer to Section 2.0 of this report for locations and descriptions of stacks.
[b]The values do not include activity of daughter products.
[c]Analysis is not required (as determined from inventory, effluent history, and/or gross beta/alpha analyses).
*Brown 1989.

Table 8-2. Radionuclides in Total Curies Released from the 291-T-1 Main Stack[a] at the T Plant Facility.*

Year	$^{89,90}Sr$[b]	^{137}Cs[b]	$^{239,240}Pu$	^{241}Am	^{106}Ru[b]	^{113}Sn	^{125}Sb	^{129}I
1989	c	c	3.2 E-05	2.8 E-06	c	c	c	c
1988	c	c	2.0 E-05	<3.0 E-06	c	c	c	c
1987	c	c	5.0 E-05	<5.0 E-06	c	c	c	c

[a]Refer to Section 2.0 of this report for locations and descriptions of stacks.
[b]The values do not include activity of daughter products.
[c]Analysis is not required (as determined from inventory, effluent history, and/or gross beta/alpha analyses).
*Brown 1985.

Table 8-3. Alpha and Beta Emissions Data for T Plant Facility Stacks.*

Stack	Year	Curies		Concentration (μCi/mL)		Stack volume (L)
		Gross alpha	Gross beta	Gross alpha	Gross beta	
291-T-1 Main Stack	1989	4.04 E-04	<4.67 E-05	1.17 E-13	<1.35 E-14	3.46 E+12
291-T-1 Main Stack	1988	2.26 E-05	1.26 E-04	4.33 E-14	2.41 E-13	5.22 E+11
291-T-1 Main Stack	1987	5.58 E-05	4.77 E-04	1.05 E-13	8.98 E-13	5.31 E+11
296-T-13 Roof Stack	1989	4.11 E-06	3.84 E-04	8.10 E-15	7.56 E-13	5.08 E+11
296-T-13 Roof Stack	1988	<1.79 E-06	<7.41 E-06	<3.50 E-15	<1.45 E-14	5.13 E+11
296-T-13 Roof Stack	1987	<8.50 E-07	<2.92 E-06	<3.50 E-15	<1.20 E-14	2.43 E+11

*Brown 1989.

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9.0 SAMPLE ANALYSIS

Westinghouse Hanford Health Physics personnel employ a variety of methods to obtain samples (record and CAM) from effluent streams, change-out filters and cartridges, and deliver specific samples to laboratories for analysis. Westinghouse Hanford procedures include references to requirements for accuracy of measurements, methods to preserve samples for counting, sample log and data sheets, and chain of custody procedures. In general, these procedures cover the following topics:

- Air-sample envelopes
- Air-sample-counter log sheets
- Silver zeolite monitor/cartridge change-out methods
- Airborne effluent sampling and monitoring system operability inspection
- Airborne effluent sampling and monitoring systems' operations
- Potentially contaminated water sampling
- Beta CAM operational performance tests for the Eberline AMS-3.

In order to determine those liquid effluent sampling analyses appropriate for T Plant, the following methodology was used:

- Normal operations of the facility were examined to determine what processes were performed
- Various hazardous materials involved in the processes were identified and the potential for their incorporation into a liquid effluent stream was evaluated
- Based on these evaluations, the potential normal components of the liquid effluent stream were identified.

To ensure that the sample analyses also would provide the necessary data for releases under other than normal operations, potential upsets were postulated. The hazardous materials that could be introduced into the liquid effluent streams of the facility as a result of such upsets were then identified.

The potential constituents of each liquid effluent stream resulting from both normal operations and upset conditions have been examined to determine the possible quantities that could be introduced into the liquid effluent stream. These were examined in relation to analysis detection limits and regulatory release limits. Based on these examinations, the potential liquid effluent constituents requiring analyses were identified. If past and/or current data were available on liquid effluent sample analyses, these results were examined. Those hazardous material constituents identified at levels above minimum detection limits were incorporated into the list of necessary

analytical processes. If previous or current analyses indicated levels below minimum detection limits, and if no potential upset condition could result in increased levels of the hazardous material, the need for the specific analysis was eliminated. Based on the results, the appropriate analytical method for each remaining hazardous material constituent was determined and the resulting analysis and procedure list was prepared.

Sampling at T Plant identified the chemical sewers as a potential source of discharging hazardous materials. However, the levels of such materials in the effluent would only be significant in an upset condition.

The normal operating and potential upset liquid effluent streams from T Plant have been reviewed and results indicate that the following routine sample analyses should be performed on the chemical sewer's discharge:

Analysis	Procedure
pH	SW846, 9040/9045 (WHC 1986c); LA-212-102 (WHC 1991c)
TOC	SW846, 9060
Nitrates	EPA 300; LA-533-105 (WHC 1991i)
ICP Metals	SW846, 6010

A more complete listing of the analytes of interest and the analytical methods for liquid monitoring and sampling are given in Section 12.0, Table 12-2.

No significant levels of radiological material are anticipated in the liquid effluent. However, it is recommended that quarterly sampling for gross alpha and beta be performed for all of the above using a 24-h composite sampler.

9.2 U.S. DEPARTMENT OF ENERGY ANALYTICAL AND LABORATORY GUIDELINES

The analytical and laboratory procedures for the FEMP activities are identified in the *Quality Assurance Project Plan for the Facility Effluent Monitoring Plan Activities* (WHC 1991g). General requirements for laboratory procedures, data analyses, and statistical treatment are addressed in the QAPP. Detailed descriptions of these requirements are given in each FEMP.

Tables 9-1 and 9-2 show the elements identified in *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991).

Table 9-1. Laboratory Procedures.

Element	Documentation
Sample identification system	To be provided when complete
Procedures preventing crosscontamination	Contained in 222-S Laboratory Analytical Procedures (identified in QAPP WHC-EP-0446 Table 8-1) (WHC 1991c)
Documentation of methods	Contained in 222-S Laboratory Analytical Procedures (identified in QAPP WHC-EP-0446 Table 8-1)
Gamma emitting radionuclides	See QAPP Table 8-1
Calibration	See QAPP Table B-1
Handling of samples	See QAPP Table 8-1
Analysis method and capabilities	See QAPP Table 8-1
Gross alpha, beta, and gamma measurements	See QAPP Table 8-1
Direct gamma-ray spectrometry	See QAPP Table 8-1
Beta counters	See QAPP Table 8-1
Alpha-energy analysis	See QAPP Table 8-1
Radiochemical separation procedures	To be provided when available
Reporting of results	To be provided when available
Counter calibration	See Table B-1, QAPP
Intercalibration of equipment and procedures	To be provided when available
Counter background	Contained in 222-S Laboratory Analytical Procedures (QAPP, Table 8-1)
Quality assurance	To be provided when available

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Table 9-2. Data Analyses and Statistical Treatment.

Element	Documentation
Summary of data and statistical treatment requirements	To be provided when available
Variability of effluent and environmental data	To be provided when available
Summarization of data and testing for outliers	To be provided when available
Treatment of significant figures	To be provided when available
Parent-decay product relationships	To be provided when available
Comparisons to regulatory or administrative control standards and control data	To be provided when available
Quality assurance	To be provided when available

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10.0 NOTIFICATION AND REPORTING REQUIREMENTS

Notifications and reporting of specific events related to environmental releases and/or events involving effluents and/or hazardous materials shall made as per DOE Orders 5400.1 (DOE 1988) and 5000.3A (DOE 1990b). Implementation of the orders is accomplished via Management Requirements and Procedures Manual (MRP) WHC-CM-1-3, 5.14, Rev 5 (WHC 1989c). Specific implementation, where required, is included in the appropriate Facility's "Occurrence Categorization, Notification and Reporting" procedure. Implementation of environmental limits and requirements is found in the ECM, WHC-CM-7-5 (WHC 1989a).

10.1 REQUIREMENTS

10.1.1 Occurrence Identification and Immediate Response

Each employee shall identify events and conditions and shall promptly notify management of such occurrences by:

- Calling 811 if immediate help such as fire, ambulance, or patrol is required
- Calling 3-3800 (the Patrol Operations Center) if assistance other than fire, ambulance, or patrol is required
- Notifying, after requesting necessary outside assistance, the supervisor, who shall notify the facility manager, the building emergency director, and the Occurrence Notification Center (ONC) (6-2900).

Operations personnel shall take appropriate immediate action to stabilize or return the facility/operation to a safe condition. The oversight organizations shall notify their DOE Field Office, Richland, counterparts of the event after receiving notifications from, and discussing the event with, the facility manager.

10.1.2 Occurrence Categorization

Occurrences (environmental) shall be categorized as soon as practical using the following specific criteria for radioactive and hazardous materials release. These categorizations should be made within 2 h of identification. Occurrences shall be categorized by their seriousness. If categorization is not clear, the occurrence initially shall be categorized at the higher level being considered. The occurrence categorization shall then be either evaluated, maintained, or lowered as information becomes available.

10.2 OCCURRENCE CATEGORIZATION

10.2.1 Radioactive Releases

10.2.1.1 Emergency.

- Any release of radioactive material to controlled or uncontrolled areas in concentrations which, if averaged over a 24-h period, would exceed 5,000 times the DCG.

- Any release of radioactive material off-site that is not a normal monitored release and could reasonably be expected to result in an annual dose or dose commitment greater than 500 mrem to any member of the general population.

10.2.1.2 Unusual Occurrence.

- Release of radionuclide material that violates environmental requirements in permits, regulations, or DOE standards as determined by Westinghouse Hanford Environmental Protection.

- Any other release below emergency levels that requires immediate reporting to regulatory agencies or triggers outside agency specific action levels as determined by Westinghouse Hanford Environmental Protection.

10.2.1.3 Off-Normal.

- Any release of radionuclides that is not a normally monitored release.

- Any discovery of radionuclides where they are not expected (e.g., storm sewers, sanitary sewers, etc.) and for which no immediate explanation is available.

- Any statistically significant increase in normally monitored releases of radionuclides to an uncontrolled area.

- Any release of radionuclides which will be reported to an outside agency (excluding normal reporting) but is not classified as an unusual occurrence.

- Any controlled and monitored gaseous radionuclide release exceeding a Westinghouse Hanford Administrative Control Value (ACV) on an annual basis or 10 times ACV on a weekly basis.

- Any controlled and monitored (instantaneous) gaseous radionuclide release exceeding 5,000 times the DCG during any 4-h period.

- Any controlled and monitored liquid radionuclide releases exceeding Westinghouse Hanford-established ACV on an annual basis or 2 times ACV on a monthly or weekly basis.

- Any controlled and monitored liquid radionuclide release exceeding 5,000 times DCG instantaneously.

10.2.2 Hazardous Substances Releases

10.2.2.1 Emergency.

- Any actual or potential release of material to the environment that results in or could result in significant offsite consequences; i.e., need to relocate people, major wildlife kills, woodland degradation, aquifer contamination, or the need to secure downstream water supply intakes, etc.

10.2.2.2 Unusual Occurrence.

- Release of a hazardous substance, regulated pollutant, or oil that exceeds a reportable quantity, federal permits, DOE standards, or levels requiring immediate reporting to outside agencies as determined by Westinghouse Hanford Environmental Protection.

10.2.2.3 Off-Normal.

- Any unmonitored release of hazardous substance or regulated pollutant as determined by Westinghouse Hanford Environmental Protection.

- Any statistically significant increase of hazardous substance in normally monitored releases.

- Any discovery of toxic or hazardous substance where it is not expected.

- Any release of hazardous substance or oil which is not classified as an unusual occurrence but will be reported to outside agencies (excluding normal reporting) as determined by Westinghouse Hanford Environmental Protection.

10.2.3 Discovery of Radioactive or Hazardous Material Contamination Due to U.S. Department of Energy Operations

10.2.3.1 Emergency.

- Discovery of contamination that could result in significant consequences (i.e., exceeding safe exposure limits to workers or public).

10.2.3.2 Unusual Occurrence.

- Discovery of offsite contamination due to DOE operations which does not represent an immediate threat to the public.
- Any discovery of groundwater contamination not previously known or suspected.

10.2.3.3 Off-Normal.

- Discovery of any onsite contamination not previously known or expected that is attributable to DOE operations.

10.2.4 Agreement/Compliance Activities

10.2.4.1 Unusual Occurrence.

- Any agreement, compliance, remediation, permit-mandated activity or notification received from a relevant regulatory agency specifying that a site plan is not satisfactory, or that a site is considered to be in noncompliance with schedules or requirements.
- Any occurrence under any agreement or compliance area that requires notification of an outside agency within 4 h or less, or triggers an outside regulatory agency action level, or otherwise indicates specific interest/concern from such agencies.

10.2.4.2 Off-Normal.

- Any occurrence under any agreement of compliance area that will be reported to outside agencies in a format other than routine monthly or quarterly reports.
- Any changes to existing agreements or permit-mandated activities.
- Development of new agreements or permit-mandated activities.

11.0 INTERFACE WITH THE OPERATIONAL ENVIRONMENTAL SURVEILLANCE PROGRAM

11.1 DESCRIPTION

The sitewide Environmental Monitoring Plan (EMP), as described in WHC-EP-0491 (WHC 1991d), consists of two distinct but related components: environmental surveillance conducted by PNL and effluent monitoring conducted by Westinghouse Hanford. Environmental surveillance, conducted by PNL, consists of surveillance of all environmental parameters to demonstrate compliance with regulations. Effluent monitoring includes both in-line and facility effluent monitoring as well as near-field (near-facility) (operational environmental) monitoring. Projected EDEs, reported in this FEMP, are the products of in-line effluent monitoring. Near-field monitoring is required by Part O, "Environmental Monitoring," *Environmental Compliance Manual* (WHC-CM-7-5) (WHC 1989a), and procedures are described in *Operational Environmental Monitoring* (WHC-CM-7-4) (WHC 1988a).

11.2 PURPOSE

The purpose of near-field (operational environmental) monitoring is to determine the effectiveness of environmental controls in preventing unplanned spread of contamination from facilities and sites operated by Westinghouse Hanford for DOE. Effluent monitoring and reporting, monitoring of surplus and waste management units, and monitoring near-field environmental media are, therefore, conducted by Westinghouse Hanford for the purposes of: controlling operations, determining the effectiveness of facility effluent controls, measuring the adequacy of containment at waste transportation and disposal units, detecting and monitoring upset conditions, and evaluating and upgrading effluent monitoring capabilities.

11.3 BASIS

Near-field environmental surveillance is conducted to (1) monitor employee protection; (2) monitor environmental protection; and (3) ensure compliance with local, state, and federal regulations. Compliance with parts of DOE Orders 5400.1, *General Environmental Protection Program* (DOE 1988); 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1990a); 5484.1, *Protection, Safety, and Health Protection Information Reporting System* (DOE 1981); 5820.2A, *Radioactive Waste Management* (DOE 1986a); and DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991), are addressed through this activity.

11.4 MEDIA SAMPLED AND ANALYSES PERFORMED

Procedure protocols for sampling, analysis, data handling, and reporting are specified in WHC-CM-7-4 (WHC 1988a). Media include ambient air, surface water, groundwater, external radiation dose, soil, sediment, vegetation, and animals at or near active and inactive facilities and/or waste sites. Parameters monitored include the following, as needed: pH, water temperature,

Parameters monitored include the following, as needed: pH, water temperature, radionuclides, radiation exposure, and hazardous constituents. Animals that are not contaminated, as determined by a field instrument survey, are released at the capture location.

11.5 LOCATIONS

Samples are collected from known or suspected effluent pathways (e.g., downwind of potential releases, liquid streams, or proximal to release points). To avoid duplication, Westinghouse Hanford relies upon existing sample locations where PNL has previously established sample sites (e.g., air samplers in the 300 Area). There are 38 air samplers (4 in the 100 Area and 34 in the 200/600 Areas), 35 surface water sample sites (22 in the 100 Area and 13 in the 200/600 Areas), 110 groundwater monitoring wells (20 in the 100 Area, 89 in the 200/600 Areas, and 1 in the 300/400 Areas), 299 external radiation monitor points (182 survey points and 41 thermoluminescent dosimeter [TLD] sites in the 100 Area, 61 TLD sites in the 200/600 Areas, and 15 TLD sites in the 300/400 Areas), 157 soil sample sites (32 in the 100 Area, 110 in the 200/600 Areas, and 15 in the 300/400 Areas), and 95 vegetation sample sites (40 in the 100 Area, 40 in the 200/600 Areas, and 15 in the 300/400 Areas). Animal samples are collected at or near facilities and/or waste sites. Specific locations of sample sites are found in WHC-CM-7-4 (WHC 1988a).

Additionally, surveys to detect surface radiological contamination, scheduled in WHC-CM-7-4 (WHC 1988a), are conducted near and on liquid waste disposal sites (e.g., cribs, trenches, drains, retention basin perimeters, pond perimeters, and ditch banks), solid waste disposal sites (e.g., burial grounds and trenches), unplanned release sites, tank farm perimeters, stabilized waste disposal sites, roads, and firebreaks in the Operations Areas. There are 391 sites in the Operations Areas (100 in the 100 Area, 273 in the 200/600 Areas, and 18 in the 300/400 Areas) where radiological surveys are conducted.

11.6 PROGRAM REVIEW

The near-field (operational environmental) monitoring program will be reviewed at least annually to determine that the appropriate effluents are being monitored and that the monitor locations are in position to best determine potential releases.

11.7 SAMPLER DESIGN

Sampler design (e.g., air monitors) will be reviewed at least biannually to determine equipment efficiency and compliance with current EPA and industry [e.g., American National Standards Institute (ANSI) and American Society for Testing and Materials (ASTM)] standards.

11.8 COMMUNICATION

The Operations and Engineering Contractor and the Research and Development Contractor will compare and communicate results of their respective monitoring programs at least quarterly and as soon as possible under upset conditions.

11.9 REPORTS

Results of the near-field (operational environmental) monitoring program are published in the document series WHC-EP-0145, *Westinghouse Hanford Company Environmental Surveillance Annual Report* (Schmidt 1990). The radionuclide values in these reports are expressed in curies, or portions thereof, for each radionuclide per unit weight of sample (e.g., picocuries per gram) or in field instrument values (e.g., counts per minute) rather than EDE, which is calculated as the summation of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighting factor.

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12.0 QUALITY ASSURANCE

12.1 PURPOSE

This Quality Assurance (QA) Plan describes the quality assurance requirements associated with implementing FEMPs. The plan identifies the FEMP activities and assigns the appropriate quality assurance requirements defined by the *Westinghouse Hanford Quality Assurance Manual*, WHC-CM-4-2 (WHC 1989d). This QA Plan shall be consistent with the requirements in DOE 5700.6B, "Quality Assurance" (DOE 1986b). In addition, QA requirements in 40 CFR 60, Appendix A, "Reference Methodologies" (EPA 1986b) shall be considered when performing monitoring calculations and establishing monitoring systems.

12.2 OBJECTIVE

The objective of this plan is to provide a documented QA plan describing QA requirements for facilities implementing the FEMPs.

12.3 REQUIREMENTS

A Quality Assurance Project Plan (QAPP) has been developed to implement the overall QA program requirements defined by WHC-CM-4-2 (WHC 1989d) and WHC-EP-0446 (WHC 1991g). The QAPP applies specifically to the field activities, laboratory analyses, and continuous monitoring performed for all FEMPs conducted by Westinghouse Hanford. Plans and procedures referenced in the QAPP are available for regulatory review upon request by the direction of the Westinghouse Hanford Environmental Assurance Manager. Table 12-1 contains selected Westinghouse Hanford supporting activities for FEMP activities as described in the QAPP.

12.4 FACILITY-SPECIFIC REQUIREMENTS

The QAPP includes a list of analytes of interest and analytical methods for RCRA groundwater monitoring at the Hanford Site. This list includes detection limits and precision and accuracy requirements for each analyte. The analytes of interest applicable to the T Plant have been identified from this table and are listed in Table 12-2.

Table 12-1. Westinghouse Hanford Supporting Procedures for Facility Effluent Monitoring Activities.

Procedure	Title or subject	Source	QAPP reference section
EII 1.2	Preparation and Revision of Environmental Investigation Instructions	WHC-CM-7-7[a]	4.3.1, 4.4
EII 1.4	Deviation from Environmental Investigation Instructions	WHC-CM-7-7[a]	4.3
EII 1.5	Field Logbooks	WHC-CM-7-7[a]	4.2
EII 1.6	Records Management	WHC-CM-7-7[a]	4.3.2, 5.0, 8.3
EII 1.7	Indoctrination, Training, and Qualification	WHC-CM-7-7[a]	4.3.2, 4.2
EII 5.1	Chain of Custody	WHC-CM-7-7[a]	5.0
EII 5.5	Decontamination of Equipment for RCRA/CERCLA Sampling	WHC-CM-7-7[a]	4.1
EII 5.11	Sample Packaging and Shipping	WHC-CM-7-7[a]	4.2
EII 3.1	User Calibration of Health and Safety Equipment	WHC-CM-7-7[a]	6.0
EII 3.2	Health and Safety Monitoring Instruments	WHC-CM-7-7[a]	6.0
[b]	Data Validation	[b]	8.2

[a]*Environmental Investigations and Site Characterization Manual* (WHC 1989b).

[b]Methods shall be developed by the Office of Sample Management or other data validation contractors as required.

Table 12-2. Analytes of Interest and Analytical Methods for Liquid Effluent Monitoring and Sampling at T Plant. (2 sheets)

Analytical category	Analyte of interest	Standard reference method	Analytical method	Contractual quantitation limit (target)[c]	Precision[c]	Accuracy[c]	Comments
Volatile Organics	1,1,1-Trichloroethane	8240[a]	b	5	±25% RPD	±25%	d
	Acetone	8240[a]	b	100	±25% RPD	±25%	d
	Methylene Chloride	8240[a]	b	5	±25% RPD	±25%	d
	Xylene	8240[a]	b	5	±25% RPD	±25%	d
Inorganics	Arsenic	6010[a]	b	300	±25% RPD	±25%	d
	Barium	6010[a]	b	20	±25% RPD	±25%	d
	Cadmium	6010[a]	b	40	±25% RPD	±25%	d
	Chromium	6010[a]	b	70	±25% RPD	±25%	d
	Lead	7420[a]	b	10	±25% RPD	±25%	d
	Mercury	7470[a]	b	2	±25% RPD	±25%	d
	Selenium	6010[a]	b	20	±25% RPD	±25%	d
	Silver	6010[a]	b	70	±25% RPD	±25%	d
Ions/Anions	Chloride	325.3[e]	b	1.0 mg/L	±25% RPD	±25%	d
	Nitrate	352.1[e]	b	0.1 mg/L	±25% RPD	±25%	d
Radionuclides[f]	alpha	9310[a]	b	0.5 pCi/L	±30% RPD	±35%	d
	beta	9310[a]	b	1.0 pCi/L	±30% RPD	±35%	d
	gamma	901.1[g]	b	10.0 pCi/L	±25% RPD	±25%	d
	^{239}Pu	00-07[h]	b	0.5 pCi/L	±25% RPD	±35%	d
Pesticides/PCBs	PCB 1016	8080[a]	b	1	±25% RPD	±25%	d
	PCB 1242	8080[a]	b	1	±25% RPD	±25%	d
	PCB 1232	8080[a]	b	1	±25% RPD	±25%	d
	PCB 1221	8080[a]	b	1	±25% RPD	±25%	d

Table 12-2. Analytes of Interest and Analytical Methods for Liquid Effluent Monitoring and Sampling at T Plant. (2 sheets)

Analytical category	Analyte of interest	Standard reference method	Analytical method	Contractual quantitation limit (target)[c]	Precision[c]	Accuracy[c]	Comments
Pesticides/PCBs	PCB 1248	8080[a]	[b]	1	±25% RPD	±25%	[d]
	PCB 1260	8080[a]	[b]	1	±25% RPD	±25%	[d]
	PCB 1254	8080[a]	[b]	1	±25% RPD	±25%	[d]
Ignitability	N/A	1010/1020[a]	[b]	80°C (140°F)	±25% RPD	±25%	[d]
Corrosivity	N/A	9040/9041 1110[a]	[b]	pH 1-14	0.1 pH unit	0.05 pH unit	[d]
Reactivity	Hydrogen Cyanide	Chapter 7.3/9010[a]	[b]	250 mg HCN/Kg	±25% RPD	±25%	[d]

[a]Standard methods are from *Test Methods for Evaluating Solid Waste* (SW 846) (EPA 1986a).

[b]Analytical methods shall be Westinghouse Hanford or Westinghouse-approved participant contractor or subcontractor procedures based on the reference methods cited in column 3 of this table. All procedure reviews and approvals shall be in compliance with applicable Westinghouse Hanford procedure control or procurement procedures. Once laboratory methods are approved, this table shall be updated to provide contractual method references as applicable.

[c]Values for quantitation limits, precision and accuracy are to be considered only as target values for initial procurement negotiations with the analytical laboratory. Target Contractual Quantitation Limits (CQL) are expressed as μg/L unless otherwise specified. Precision is expressed as Relative Percentage Difference (RPD); accuracy is expressed as percentage recovery. This table shall be updated to reflect negotiated contractual values as specified in the final procurement documents or work orders.

[d]Analyses shall be performed by an approved Westinghouse Hanford, participant contractor, or subcontractor laboratory.

[e]Standard methods are from *Methods for Chemical Analysis of Water and Waste* (EPA 1983).

[f]The radionuclides of interest ^{137}Ce, ^{238}Pu, and ^{241}Pu are not listed.

[g]Standard methods are from *Eastern Environmental Radiation Facility, Radiochemistry Procedures Manual* (EPA 1984).

[h]Standard methods are from *Prescribed Procedures for the Measurement of Radioactivity in Drinking Water* (EPA 1982).

13.0 INTERNAL AND EXTERNAL PLAN REVIEW

DOE Order 5400.1, "General Environmental Protection Program," Chapter IV.4 (DOE 1988) requires the facility effluent monitoring plan be reviewed annually and updated every 3 yr. The FEMP should be reviewed and updated as necessary after each major change or modification in the facility processes, facility structure, ventilation and liquid collection systems, monitoring equipment, waste treatment, or a significant change to the Safety Analysis Reports.*

Facility operators will have to certify on a semiannual basis that no changes have occurred in operations that would require new testing. Although the report is based on the calendar year, the emission limits apply to any period of 12 consecutive mo. Westinghouse Hanford Environmental Protection prepares an annual effluent discharges report for each area on the Hanford Site that covers both airborne and liquid release pathways (Brown et al 1990). In addition, a report on the air emissions and compliance to the *Clean Air Act of 1977* (NESHAP) is prepared by Westinghouse Hanford Environmental Protection for the DOE Field Office, Richland for submittal to EPA as well as DOE-HQ.

Facility management is to obtain approval from the Environmental Protection function for all changes to the FEMPs, including those generated in the annual review and update. In addition, the FEMP shall be reviewed by QA.

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*T Plant Facility management is responsible for ensuring that the reviews and updates are performed. Records retention shall be in accordance with the QAPP.

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14.0 COMPLIANCE ASSESSMENT

Since there are currently monitoring devices on all T Plant facility effluent streams that require them, this section assesses whether or not the existing monitoring equipment meets compliance criteria. It investigates adequacy in relation to accurate detection and measurement of radioactive and nonradioactive materials that could potentially be released. Additional information on effluent monitoring specifications is presented in Section 16.2.

Many of the effluent streams monitored at the T Plant Facility do not require monitoring according to either the Determination Report or a reassessment of the data as described previously. For these effluent streams, a brief description of the current monitoring system is provided. No compliance assessment of the associated monitoring systems is performed since it is not required. Consequently, this compliance assessment focuses on one liquid effluent and two airborne effluent streams and their associated monitoring systems. Those determined to require monitoring are: the 216-T-4 Chemical Sewer, the 291-T-1 Main Stack, and the 296-T-13 Roof Stack.

14.1 216-T-4 CHEMICAL SEWER

The 216-T-4 Chemical Sewer has the potential to be contaminated with hazardous materials. It is unlikely that the stream would be contaminated with radioactive materials. Discharges from the 211-T Chemical Storage Area are transferred to the chemical neutralization system where they are monitored before being released to the 216-T-4 Pond. The chemical neutralization system adjusts the pH of the discharge to prevent the discharge from being corrosive. The WAC 173-303-090 (Ecology 1989) states that waste is considered corrosive, and therefore a dangerous waste, if it has a pH less than or equal to 2 or greater than or equal to 12.5. Other contributors to the stream are routed to the 207-T Retention Basin. There, samples are analyzed on a monthly basis for gross alpha, gross beta, total organic carbon and pH to determine if these constituents of the liquid waste are being maintained at an acceptable level. Therefore, the effluent stream itself has no effluent-monitoring system to detect the presence of reportable quantities of hazardous and radioactive materials.

A primary consideration regarding the required monitoring capabilities for this effluent stream is whether or not the stream is considered a dangerous waste pursuant to WAC 173-303, "Dangerous Waste Regulations" (Ecology 1989). An evaluation of the stream based on process knowledge and analysis of several samples has not been performed and compared with the WAC 173-303 criteria for dangerous waste. Based on the available data, however, it is likely that the stream would not be designated a dangerous waste stream. Given this preliminary analysis, an adequate monitoring system must be capable of demonstrating that the waste does not meet the criteria. The type or frequency of monitoring for specific chemicals, radionuclides, or physical properties depends on the potential for exceeding the relevant criteria.

For discharges of radioactive liquids, the basic requirement for the 216-T-4 Pond is that the RQ values contained in 40 CFR 302 (EPA 1989b) are not exceeded. The RQ values are given in units of radioactivity and pertain to daily releases. As described previously, it has been determined that no radioactive material has the potential to be released in significant quantities to the 216-T-4 Pond. There is the potential for minor amounts of plutonium isotopes and associated radionuclides such as ^{241}Am, ^{90}Sr, and ^{137}Cs to be released. However, because significant quantities of these radionuclides are not normally released, it is sufficient to sample periodically for gross alpha and gross beta radioactivity, which would confirm that none of the above radionuclides had been released in unacceptable quantities. Isotopic analysis for specific radionuclides can be accomplished if necessary based on the gross alpha and gross beta analyses.

14.2 216-T-1 DITCH

Liquid effluents to the 216-T-1 Ditch are determined by the experimental operations being performed in the 221-T Building Head-End. Currently, there are no experimental operations being performed in the Head-End. Therefore, there are no routine sources of radioactive or hazardous material to this effluent stream, nor are there any credible upset conditions that could result in releases that approach reportable quantities. No monitoring of this stream is provided other than periodic sampling. Sampling of the stream is performed at the final discharge point to the 216-T-1 Ditch. Monitoring of this effluent stream is not required according to federal, state, or local regulations.

14.3 T PLANT AQUEOUS WASTE TRANSFER SYSTEM

This effluent stream is not discharged to the environment at T Plant Facility. The liquid waste is transferred to the Tank Farms for disposal. Before a transfer using the cross-site transfer line, the liquid waste is sampled from the TK 15-1 Tank to determine if the pH is within acceptable range for shipment and receipt by Tank Farms. A calculation is performed to determine the quantity of enriched Pu in the waste. There is no potential for a release to the environment during routine or upset operating conditions. For this reason, no monitoring of this liquid waste is required.

14.4 SANITARY SEWER SYSTEM

Current influents to this stream are characteristic of those to a normal sanitary system. Past practices resulted in contamination of the system with hazardous and/or radioactive constituents. Although it is regulated under the Benton-Franklin County Health District Department guidelines for sanitary sewers, these guidelines do not require monitoring. Consequently, no monitoring or sampling is provided.

14.5 291-T-1 MAIN STACK

The effluent monitoring system for this stack is designed to monitor the release of both alpha and beta radiation. A particulate record sampler is installed to provide a sample that is evaluated weekly for the presence and quantity of alpha and beta radiation, and is isotopically analyzed periodically to quantify specific radionuclides.

The stack also is equipped with two continuous alarm monitors that are designed to alarm when an unusual increase in alpha activity or beta activity is detected. The stack also is equipped with associated monitoring equipment including pumps, tubing, vacuum gauges, and flow-measuring devices.

The primary intent of regulations governing this system is to ensure that:

- The appropriate radioactive materials are being monitored
- The system can detect and quantify the levels of concern
- The quantification is accurate.

The basic requirements for monitoring radionuclides release to air are contained in 40 CFR 61 (NESHAP) (EPA 1989c). The requirements of Subpart H of the NESHAP were described in detail in Section 3.0 of this document. The following is an assessment of the compliance of 291-T-1 Main Stack monitoring system against these requirements.

As documented in the NESHAP and associated literature, one of the primary conditions that must be met to ensure accurate measurement is that the monitoring be performed in an acceptable location in the stack. 40 CFR 60, Appendix A, Method 1, requires that sampling be performed "at a site located at least eight stack diameters downstream and two diameters upstream from any flow disturbance . . ." This condition is not met for the 291-T-1 Main Stack sampling probes, which are located at the 50 ft level of the stack, or approximately three duct diameters from the base of the 16-ft dia. stack where major flow transitions occur. However, Method 1 also states that "if necessary, an alternative location may be necessary, at a position at least two stack diameters downstream and a half diameter upstream from any flow disturbance." Therefore, compliance with the sampling probe placement requirement depends in part on the reasons for selecting the 50-ft level for sampling. However, the stack flow at 50 ft is highly turbulent, having a Reynolds number of over two million. Consequently, the five or eight stack diameter is less important than it would be if the flow were laminar. However, as is discussed below, selection of this sampling location necessitates careful studies of flow and particle size distributions to ensure that representative samples are obtained.

Another critical consideration is proper placement and operation of the sampler probes within the stack. One concern is that the probes are placed in proper locations and sufficient quantities to ensure that the particles being sampled are representative of those being released from the stack. In cases where mixing is complete and particle size distribution is uniform over the stack cross section, a single probe may be sufficient. A second concern is

that the velocity of flow through the sampling probe(s) be approximately the same as the flow velocity surrounding the probe (i.e., isokinetic), thus assuring that particles of certain sizes are neither preferentially sampled nor excluded.

The criteria for a point or points from which a sample is to be taken are listed in ANSI N13.1-1969 (ANSI 1969), which is specifically referenced in the NESHAP. The two primary criteria are:

- The particle and gaseous composition is representative at the point in the cross section selected, or enough points in the cross section are sampled essentially simultaneously or sequentially to provide an average, representative sample

- The velocity and flow distribution in the duct at this cross section should be a known value so that the rate of sampling can be chosen to provide near-isokinetic sampling for particles larger than about two to five microns.

For very large stacks such as 291-T-1 Main Stack, ANSI N13.1 specifies a minimum of six sampling points. The 291-T-1 Main Stack is sampled using 10 nozzles. Each sampling point should be centered in an equal annular area of size equal to the cross sectional area divided by the number of probes. Fewer withdrawal points may be used if careful studies demonstrate that uniformity of composition exists throughout the cross section of the duct.

As described in Section 7.0, the sampler arrangement for the 291-T-1 Main Stack consists of 10 nozzle probes extending at various locations from a single sampling line. The probe orifice diameters are identical. The sampling line is a constant size (0.5 in. dia.). The probes would not draw an equal volume of air. The probes are not centered in an equal annular area of size equal to the cross sectional area divided by the number of probes as required by ANSI N13.1-1969 (ANSI 1969).

The requirement to draw samples isokinetically is less important for turbulent flow conditions (as exists) compared to laminar flow conditions. However, it is important. Under turbulent flow conditions, the flow velocity is roughly the same across the majority of the stack cross-section. In general, each probe is designed to draw air at approximately the same velocity and meet isokinetic conditions, provided that the sample velocity is approximately the same as the stack velocity. However, this is not true for sampling locations near the stack wall, where the stack flow velocity decreases dramatically. Because one of the 291-T-1 Main Stack sampling probes is located near a stack wall, the flow rate through this probe must be less than that through other probes. It is not evident that the sample flow velocity was considered in the design of the sampling system, as suggested by the constant sample line diameter. No documentation is available that provides measurements or calculations of both stack flow velocity profiles and sampling probe velocities to demonstrate isokinetic sampling. Calculations using the available information would be insufficient to draw defensible conclusions. Furthermore, based on historical stack flow rate sampling data, the stack flow rate is highly variable. This renders it difficult to draw samples isokinetically without a feedback system that adjusts the sample flow rate to correspond with changes in the stack flow rate. Such a system would

be unnecessary if it could be demonstrated that the particle sizes in the effluent stream are small enough that isokinetic sampling is not important. However, no documented particle studies were available.

To summarize the analysis of the stack sampling probe design: a sufficient number of nozzle probes is used to sample the stack effluent and ensure that the sample composition is representative of the composition of the effluent. However, no documentation was identified that demonstrates that the probes are located properly. Isokinetic sampling is difficult in this stack because of the highly variable flow rate. However, no documentation was available that demonstrates, preferably through measurements, that isokinetic sampling conditions exist even for average stack flow rates. These measurements should include both stack velocity profile measurements and measurements of the velocity through the sampling probe orifices. These measurements could be unnecessary if it could be demonstrated that the particle sizes in the effluent stream are substantially less than 5 μm. Such measurements are required even though the air is passed through several stages of HEPA filtration because there is a possibility of HEPA filter inoperability or a conglomeration of particles downstream of the filters. In general, it appears that the overall system may be sufficient given the effluent stream conditions, although documentation is lacking.

A point-by-point evaluation of the Clean Air Act (NESHAPs) requirements is being conducted by the facility at this time and will be incorporated in this document in the next revision.

Specific requirements on the number and location of points used to characterize particle size distributions are provided in 40 CFR 60 (EPA 1986b), Appendix A, Method 1. In cases in which the eight- and two-diameter criteria cannot be met, the minimum number of traverse points is dependent on the specific number of duct diameters both downstream and upstream of the closest flow disturbances.

The effluent monitoring equipment contained in the instrument cabinet appears to be in compliance, in general, with applicable regulations. The cabinet is heated, lit, and well-ventilated. As described in Section 7.0, the monitoring equipment includes:

- An incoming sampling line
- Two flow splitters
- A record sample holder
- An Alpha 5-A CAM
- A Beta AMS-3 CAM
- Three rotameters
- A flow totalizer
- Three vacuum gauges
- Three flow alarm switches
- Vacuum lines
- Three centrifugal type pumps
- Three flow regulators
- An alarm relay panel.

The equipment and lines appear adequate, but the method for regulating the flow rate through the sample lines is inadequate. The flow regulators serve only to maintain a constant flow rate. Adjustment of flow rate may be necessary at times when the stack flow rate is known to increase or decrease significantly. Currently, the flow rate is adjusted by clamps attached to the sample lines. Cognizant personnel have indicated that implementation of an improved method, which will include new lines and flow rate adjusters, is in progress. Another area that has not been addressed is line losses. Significant loss of radioactive material in sampling lines is possible, especially if the lines are bent dramatically or frequently. Although the organization of the sampling lines and equipment for the 291-T-1 Main Stack appears to be reasonable, a formal evaluation of line losses is specifically required in ANSI N13.1-1969 (ANSI 1969). No documentation of line loss studies for the 291-T-1 monitoring system is available. A site-wide study of sampling-line losses is currently underway.

The performance of the 291-T-1 Main Stack emissions monitoring system must be adequate in order to detect the maximum releasable quantity of radioactivity and demonstrate that the limits have not been exceeded. Considering the applicable regulations outlined in Section 3.0, the maximum allowable release mandated by the operational safety requirements (OSR) is 2×10^{-12} μCi/L alpha averaged over 1 yr or 8×10^{-12} μCi/mL alpha averaged over 1 wk. Because both the CAM and record sampler filters are changed and evaluated weekly, the units must have minimum detection limits at least as good as 8×10^{-12} μCi/mL averaged over 1 wk. According to the manufacturer's technical manual for the Alpha 5-A CAM, an air concentration of 8×10^{-12} μCi/mL can be detected over a 20-h period. This capability also complies with the WHC-CM-7-5 (WHC 1989a) requirement that an alarm go off if a release of 5,000 times the DCG-Public value (2×10^{-14} μCi/mL for ^{239}Pu) over a 4-h period. For the record sampler, a minimum detection level of 2×10^{-15} μCi/mL over a 1-wk period must be detected to comply with WHC-CM-7-5 (WHC 1989a). The current detection level is 1×10^{-14} μCi/mL, which does not meet the requirement.

Procedures for obtaining and evaluating air samples and calibrating, testing and inspecting air sampling equipment are located in WHC-IP-0692, "Health Physics Procedures." The primary procedure addressing operability of the emissions monitoring systems in the 200 Areas is Procedure 5.2.2.6, "Gaseous Effluent Sampling and Monitoring System Operability Inspection." This procedure provides Radiation Protection Technologists with specific instructions for inspecting various components either daily, weekly, or monthly. Required daily tasks include checks of the operability of the CAMs and proper air flow rates. Required weekly tasks include alarm function tests, which are performed concurrently with the changeout of the record sampler filter. Required monthly tasks include performance of routine CAM operational performance tests. Procedure 5.2.2.7 provides instructions for operation of the systems including exchanging the filters for the record samplers and CAMs. Procedures exist for counting air samples (2.1.11), recording readings of air-sampling equipment (2.1.6), testing air sampler and CAM in-leakage and airflow (5.2.6), and performing monthly alpha CAM operational performance tests (7.3.1, Rev 3).

These procedures appear to be adequate for complying with the applicable regulations requiring that a representative sample be collected. Although the procedures are sufficient to ensure a representative sample if followed, some additional information could be included. For example, it appears that procedures for inspecting and cleaning the sampling probes are not available. This is an important part of the air-sampling process because probes can become partially plugged and subsequently record inaccurate measurements. The requirement to perform these maintenance tasks is contained in ANSI N13.1-1969 (ANSI 1969) and needs to be addressed by plant management.

14.6 296-T-13 ROOF STACK

The effluent-monitoring system for this stack is designed to monitor the release of alpha and beta radiation. A particulate record sampler provides a sample that is evaluated weekly for the presence and quantity of alpha and beta radiation, and is isotopically analyzed periodically to quantify the amount of specific radionuclides.

The stack also is equipped with a CAM that is designed to alarm when an unusual increase in beta activity is detected. A similar CAM for detecting alpha radiation is not required because historical sampling data and process knowledge demonstrate that such a system is unnecessary. The stack also is equipped with associated monitoring equipment including pumps, tubing, vacuum gauges, and flow measuring devices.

The primary intent of regulations governing this system is to ensure that:

- The appropriate radioactive materials are being monitored
- The system can detect and quantify the levels of concern
- The quantification is accurate.

The basic requirements for monitoring radionuclides release to air are contained in 40 CFR 61 (NESHAP) (EPA 1989c). The requirements of Subpart H of the NESHAP were described in detail in Section 3.0 of this document. The following is an assessment of the compliance of 296-T-13 stack-monitoring system against these requirements.

As documented in the NESHAP and associated literature, one of the primary conditions that must be met to ensure accurate measurement is that the monitoring be performed in an acceptable location within the stack. The 296-T-13 Stack is 15-ft high with a cross-section 2 ft square. Regulation 40 CFR 60, Appendix A, Method 1, requires that sampling be performed "at a site located at least eight stack diameters downstream and two diameters upstream from any flow disturbance . . ." This condition is not met by the 296-T-13 Stack's single sampling probe, which is located 2 ft above the stack fan, or approximately one duct diameter from the base of the stack where major flow transitions occur. However, Method 1 also states that "if necessary, an alternative location may be necessary, at a position at least two stack diameters downstream and a half diameter upstream from any flow disturbance." The stack, therefore, does not meet either of these requirements. This issue needs to be addressed by plant management.

Another critical consideration is proper placement and operation of the sampler nozzle probes within the stack. One concern is that the probes be placed in proper locations and sufficient quantities to ensure that the particles being sampled are representative of those being released from the stack. In cases where mixing is complete and particle size distribution is uniform over the stack cross section, a single probe may be sufficient. A second concern is that the velocity of flow through the sampling nozzle probe(s) be approximately the same as the flow velocity surrounding the probe (i.e., isokinetic), thus assuring that particles of certain sizes are neither preferentially sampled nor excluded.

Specific criteria for a point or points from which a sample is to be taken are listed in ANSI N13.1-1969 (ANSI 1969), which is specifically referenced in the NESHAP. The two primary criteria are:

- The particle and gaseous composition is representative at the point in the cross section selected, or enough points in the cross section are sampled simultaneously or sequentially to provide an average, representative sample

- The velocity and flow distribution in the duct at this cross section should be known so that the rate of sampling can be chosen to provide near-isokinetic sampling for particles larger than about two to five microns.

For 2-ft-square stacks such as the 296-T-13 Roof Stack, ANSI N13.1-1969 (ANSI 1969) specifies a minimum of 6 to 12 sampling points. Each sampling point should be centered in an equal annular area of size equal to the cross sectional area divided by the number of probes. Fewer withdrawal points may be used if careful studies demonstrate that uniformity of composition exists throughout the cross section of the duct. As described in Section 7.0, the sampler arrangement for the 296-T-13 Roof Stack consists of one nozzle probe located in the center of the stack. The probe orifice diameter is 0.45 in.

The requirement to draw samples isokinetically is less important for turbulent flow conditions (as exist) compared to laminar flow conditions. However, it is important. Under turbulent flow conditions, the flow velocity is roughly the same across the majority of the stack cross-section. Therefore, in general, each probe can draw air at approximately the same velocity and meet isokinetic conditions provided that the sample velocity is approximately the same as the stack velocity. It is not evident that sample flow velocity was considered in the design of the sampling system, as suggested by the decreasing sample line diameter. No documentation was available to provide measurements or calculations of both stack flow velocity profiles and sampling nozzle probe velocities to demonstrate isokinetic sampling. Calculations using the available information would be insufficient to draw defensible conclusions. Based on historical stack flow-rate sampling data, the stack flow rate is highly variable. This variability makes it difficult to draw samples isokinetically without a feedback system that adjusts the sample flow rate to correspond with changes in the stack flow rate. Such a system would be unnecessary if it could be demonstrated that the particle sizes in the effluent stream are small enough such that isokinetic sampling is not important. However, no documented particle studies were available.

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In summarizing the analysis of the stack sampling probe design, the location of the sample point is inadequate to collect a representative sample. Furthermore, an insufficient number of nozzle probes are used to sample the stack effluent and ensure that the sample composition is representative of the composition of the effluent. No documentation was identified to demonstrate that the single nozzle probe is sufficient. Isokinetic sampling is difficult in this stack because of the highly variable flow rate. However, no documentation was available that demonstrates, preferably through measurements, that isokinetic sampling conditions exist even for average stack flow rates. These measurements should include both stack velocity profile measurements and measurements of the velocity through the sampling probe orifices. These measurements could be unnecessary if it could be demonstrated that the particle sizes in the effluent stream are substantially less than 5 μm. Such measurements are required even though the air is passed through several stages of HEPA filtration because there is a possibility of HEPA filter inoperability or a conglomeration of particles downstream of the filters. In general, it appears that the overall system may be inadequate given the effluent stream conditions.

Specific requirements on the number and location of points used to characterize particle size distributions are provided in 40 CFR 60 (EPA 1986b), Appendix A, Method 1. In cases in which the eight- and two-diameter criterion can not be met, the minimum number of traverse points is dependent on the specific number of duct diameters both downstream and upstream of the closest flow disturbances.

The effluent monitoring equipment contained in the instrument cabinet appears to be in compliance, in general, with applicable regulations. The cabinet is heated, lit, and well-ventilated. As described in Section 7.0, the monitoring equipment includes:

- An incoming sampling line
- A flow splitter
- A record sample holder
- A Beta AMS-3 CAM
- Two rotameters
- A flow totalizer
- Two vacuum gauges
- Two flow alarm switches
- Vacuum lines
- Two centrifugal type pumps
- Two flow regulators
- An alarm relay panel
- An exhaust line routed back into the stack.

The equipment and lines appear adequate, except that an adequate method for regulating the flow rate through the sample lines is not present (the flow regulators serve only to maintain a constant flow rate). Adjustment of flow rate may be necessary at times when the stack flow rate is known to increase or decrease significantly. Currently, the flow rate is adjusted by clamps attached to the sample lines. Cognizant personnel of the T Plant Operations have indicated that implementation of an improved method is in progress. Another area that has not been addressed is line losses. Significant loss of radioactive material in sampling lines is possible, especially if the lines

are bent dramatically or frequently. Although the organization of the sampling lines and equipment for the 296-T-13 Roof Stack appear to be reasonable, a formal evaluation of line losses is specifically required in ANSI N13.1-1969. No documentation of line-loss studies for the 296-T-13 Roof Stack monitoring system is available. However, a site-wide study of sampling-line losses is currently underway.

Procedures for obtaining and evaluating air samples and calibrating, testing and inspecting air sampling equipment are located in WHC-IP-0692, *Health Physics Procedures* (WHC 1990b). The primary procedure addressing operability of the emissions monitoring systems in the 200 Areas is Procedure 5.2.2.6, "Gaseous Effluent Sampling and Monitoring System Operability Inspection." This procedure provides Radiation Protection Technologists with specific instructions for inspecting various components either daily, weekly, or monthly. Required daily tasks include checks of the operability of the CAMs and proper air flow rates. Required weekly tasks include alarm function tests, which are performed concurrently with the changeout of the record sampler filter. Required monthly tasks include performance of routine CAM operational performance tests. Procedure 5.2.2.7 provides instructions for operation of the systems including exchanging the filters for the record samplers and CAMs. Procedures exist for counting air samples (2.1.11), recording readings of air-sampling equipment (2.1.6), testing air-sampler and CAM in-leakage and airflow (5.2.6), and performing monthly alpha CAM operational performance tests (7.3.1, Rev 3).

These procedures appear to be adequate for complying with the applicable regulations. However, it appears that procedures for inspecting and cleaning the sampling probes are not available. This is an important part of the air-sampling process because probes can become partially plugged, resulting in inaccurate measurements. The requirement to perform these maintenance tasks is specified in ANSI N13.1-1969 (ANSI 1969).

14.7 296-T-7 STACK

There were no routine or credible upset conditions evaluated that could result in the release of significant quantities of hazardous or radioactive materials. The maximum annual dose to an individual offsite from releases of radioactive material was calculated to be significantly less than 0.1 mrem EDE. Although monitoring of the effluents is provided, an assessment of the compliance of the system with applicable regulations is not provided in this document because the releases do not meet the criteria requiring monitoring.

15.0 SUMMARY AND CONCLUSIONS

This FEMP assessed the magnitude of routine and potential liquid and airborne effluent releases from the T Plant Facility to determine the compliance of effluent monitoring systems and sampling programs with applicable DOE, federal, and state regulations. Based on the data reviewed, three effluent streams were determined to require monitoring according to the regulations. These streams are the 216-T-4 Chemical Sewer, 291-T-1 Main Stack and the 296-T-13 Roof Stack. The adequacy and compliance of their monitoring systems and/or sampling programs is documented in this Plan. Specifics of the monitoring/sampling program that were determined not to be in compliance have been identified

Table 15-1 identifies changes recommended to achieve compliance for the three effluent streams which require monitoring.

Table 15-1. Compliance Recommendation Summary for T Plant Effluent Streams.

Effluent stream	Recommended changes to achieve compliance
216-T-4 Chemical Sewer	• Install monitoring system capable of demonstrating that effluent is not a dangerous waste as defined by WAC 173-303 (Ecology 1989). • Institute laboratory procedure to routinely measure and determine pH. (For further discussions, refer to Section 14.1.)
291-T-1 Main Stack	• Investigate probe placement to ensure accuracy of isokinetic sampling. • Upgrade flow-regulators on monitoring equipment. • Conduct formal evaluation of line losses. • Institute procedure for routine cleaning/inspection of sample probes. (For further discussion, refer to Section 14.5.)
296-T-13 Roof Stack	• Relocate stack sampling probe site to meet 40 CFR 60 (EPA 1986b) regulations. • Increase number of sampling probes. • Upgrade flow-regulators on monitoring equipment. • Conduct formal evaluation of line losses. • Institute procedure for routine cleaning/inspection of sample probes. (For further discussion, refer to Section 14.6.)

16.0 ATTACHMENTS

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16.2 EFFLUENT MONITORING SYSTEM SPECIFICATIONS

The NESHAP establishes requirements and procedures for measuring radionuclide emissions from point sources (e.g., stacks and vents). The requirements and procedures are contained in 40 CFR 61.93 (EPA 1989a). Alternative procedures are allowed if EPA has granted prior approval. The following sections present methods that the NESHAP mandates for an airborne radionuclide effluent monitoring system. Alternative methods are allowed but they must have received prior EPA approval.

The NESHAP in 40 CFR Part 61 (EPA 1989a) specifies parameters that must be sampled or measured and specific implementation methods. The methods are contained in 40 CFR 60, Appendix A and 40 CFR 61, Appendix B. The following six elements are the essential requirements for design and operation of an airborne effluent release monitoring system mandated by the NESHAP for DOE facilities.

- Effluent flow rate must be measured using EPA Method 2 in large stacks and vents or EPA Method 2A in pipes and small vents
- Radionuclides shall be directly monitored or extracted, collected and measured
- The placement of the sampling/monitoring probe or sensor must be derived using EPA Method 1
- If measurement is not performed in situ, the guidance presented in ANSI N13.1 1969 (ANSI 1969) must be followed for sample extraction

- Radionuclides must be measured according to 40 CFR 61, Appendix B, Method 114 (EPA 1989a)

- A quality assurance program must be conducted that meets the performance requirements described in 40 CFR 61, Appendix B, Method 114 (EPA 1989a).

The following sections present these requirements in more detail and discusses their importance.

16.2.1 Measurement of Effluent Flow Rate

The NESHAP (EPA 1989c) requires that flow rate measurements be made. The flow rate (volumetric) needs to be accurately quantified so that concentrations or activity levels, measured in the samples that are extracted, can be used to derive total emission rates. The volumetric flow rate is the product of the cross-sectional area of the stack and the effluent velocity. The measurement of velocity is complicated by its variation across the diameter of the stack. For stacks with a circular cross-section, the maximum velocity occurs at the center of the stack and the velocity approaches zero at the stack wall.

The NESHAP specifies EPA Reference Method 2 to determine velocity and volumetric flow rate for stacks and large vents. Reference Method 2A is specified for flow rates through pipes and small vents. Both methods are contained in 40 CFR 60, Appendix A (EPA 1986b).

Method 2 specifies the measurement of average gas velocity with a Type S pitot tube. It is applicable to any gas stream where a measurement site that meet the criteria of Method 1 is available. It cannot be used in cyclonic or swirling gas streams.

Method 2A specifies the measurement of average gas velocity directly with a gas volume meter. Temperature and pressure measurements are made to correct the volume to standard conditions. It is applicable to pipes and small ducts, either in-line or at exhaust positions, within the temperature range of 0 °C to 50 °C.

The NESHAP (EPA 1989c) does not define a specific frequency for conducting flow rate measurements. The rule states that the frequency of flow rate measurements should be dependent upon the variability of the effluent flow rate. If the flow is highly variable, continuous or frequent flow rate measurements must be made. For consistent flow rates, only periodic measurements are necessary.

16.2.2 Measurement of Radionuclides

The NESHAP (EPA 1989c) mandates that radionuclides be monitored in situ or extracted, collected, and measured. The effluent stream must be monitored continuously with an in-line (in situ) detector, or representative samples

must be extracted continuously. Periodic sampling may be used only with EPAs prior approval, and the frequency must be sufficient to provide representative sampling.

The NESHAP (EPA 1989c) requires that radionuclides be measured at the point of release so that dispersion modeling can then be used to estimate the ambient impact (dose) at critical receptors. Measurements are made on samples of the effluent. The samples must be representative of the entire effluent stream to minimize over- or under-estimation of the characteristics of the effluent and the estimated ambient impacts. The characteristics of the effluent stream can vary temporally and spatially. The procedures specified by the NESHAP are designed to ensure that samples are representative. The 40 CFR 61.93 (b)(2)(ii) (EPA 1989c) mandates that monitoring or sample extraction be performed continuously. This eliminates or at least mitigates the impact of temporal variation on the representativeness of the sample. The NESHAP also mitigates the impact of spatial variation on representativeness of the sample by mandating a method for identifying an acceptable sampling site. This method is presented in the next section.

16.2.3 Sampling or Monitoring Site Location (U.S. Environmental Protection Agency Method 1)

In order to obtain a representative sample that considers the impact of spatial variation the NESHAP [40 CFR 61.93(b)(2)(i)] (EPA 1989a) mandates that EPA Method 1 be employed to select a monitoring or sampling site. EPA Method 1 can be found in 40 CFR 60, Appendix A (EPA 1986b). The purpose of the method is to aid in the representative measurement of contaminants and volumetric flow rate by identifying a measurement site where the effluent stream is flowing in a known direction. The method also divides the stack into cross-sections of equal areas. The method is applicable to flowing gas streams in ducts, stacks or vents. It cannot be used when (1) flow is cyclonic or swirling, (2) a stack is smaller than 12 in. in diameter, or (3) the measurement site is less than two stack diameters downstream or less than half a diameter upstream from a flow disturbance.

16.2.4 Sample Extraction (ANSI N13.1 1969)

If the sample must be extracted from the effluent stream and transported to a collection device or analyzer, precautions must be taken to ensure that the representativeness of the sample is not affected by the extraction process.

If it is necessary to extract the sample from the effluent for collection or measurement, the NESHAP [40 CFR 61.93(b)(2)(i)] (EPA 1989c) mandates that ANSI N13.1-1969 (ANSI 1969) be followed to mitigate changes in the characteristics of the sample due to extraction and transport of the sample to the collection or measurement device.

The ANSI N13.1-1969, *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities* (ANSI 1969), provides the guideline for design of an effluent monitoring system. The standard encompasses the design of the probe and the transport system for moving the sample from the probe's orifice to the sample collection device or analyzer.

The guidelines in ANSI N13.1-1969 (ANSI 1969) are designed to ensure that the sample that is collected and/or measured represents the effluent slip stream at the point of extraction. Factors that affect the representativeness of the sample during collection and transport are inertial separation, deposition, impaction, sample loss/dilution, physical changes, and/or chemical activity. ANSI N13.1 provides guidance for mitigating the impact of each of these factors.

16.2.4.1 Inertial Separation. Radioactive particulate matter is frequently a contaminant of concern in airborne effluents. Particulate matter consists of small solid and liquid particles. These particles when entrained in an airstream tend to continue to move in a straight line, because of momentum, when the air stream flow is redirected resulting from a bend, tee, change in diameter, or other flow disturbance. The greater the mass of the particle, the greater the tendency to continue to move in a straight line. This is the principal mechanism of inertial separation. It is employed in cyclonic separators to remove particles from an effluent stream, or at the inlet of an air sampling device to obtain a sample that is differentiated by size. The location of a sample probe should avoid regions where a change in the direction of the airstream flow may result in an unrepresentative particle size distribution.

The ANSI N13.1-1969 (ANSI 1969) recommends that a sampling point should be a minimum of five diameters (or five times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions. However, the NESHAP (EPA 1989c) requires that Method 1 be used to select sampling sides. Method 1 requires that the probe is eight diameters upstream and two diameters downstream from a flow disturbance. The more restrictive requirements of Method 1 should be applied.

Inertial separation can be induced in particles entrained in an airstream by suddenly changing the velocity of the airstream. In airborne effluent monitoring systems, distortion in particle size distributions may occur when the velocity of the sampled air entering the sample probe (or collector, when supported directly in the stream to be sampled) is significantly different from the velocity of the air in the stream sampled. When the air drawn through the sampler or collector in the stream is at a much lower velocity than the stream velocity, larger particles will be preferentially collected. When the air velocity through the sample probe and collector is greater than the stream velocity smaller particles will be preferentially collected. The degree to which the fractionation occurs is a function of particle size, density, the particle size distribution, and the difference between the isokinetic velocity and the an isokinetic velocity employed. Except in very unusual situations, particles smaller than an aerodynamic diameter of about five microns are able to follow the streamlines of the air, and the fractionation error is not great.

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The ANSI N13.1-1969 (ANSI 1969) recommends that in applications in which particle sizes may be expected to vary, particularly when particles larger than five microns are anticipated, the sampler arrangement be designed to permit near isokinetic flow into the sampler entry probe or through the collector when the collector is facing into the stream sampled.

16.2.4.2 Deposition Losses. The principal mechanisms by which particles are deposited are gravity settling and Brownian diffusion when the flow is laminar. Particles carried by an airstream moving in a horizontal tube will tend to settle to the bottom of the tube due to the influence of gravity. Any delivery line through which the sample is carried to the collection or measurement device will preferentially remove large particles through gravitational settling when the flow is too low. Very small particles can diffuse to the wall of a conduit by Brownian motion. Particle size is of extreme significance. Very small particles are lost to the wall rapidly when gas flow is very low.

The ANSI N13.1-1969, Appendix B (ANSI 1969) recommends that sampling lines be avoided whenever possible and always kept at a minimum length. In every case where sampling delivery lines are required, an evaluation should be made of deposition in the lines. Appendix B also provides a table that allows a determination to be made of the significance of distortion because of deposition.

16.2.4.3 Impaction Losses. Particles carried in turbulent flow will be deposited on the walls of a conduit because of the adhesive properties of the particle and the wall. The degree of deposition depends upon particle size and density, the average velocity of the air, and the diameter and length of the conduit. Deposition does not continue to increase indefinitely as the velocity and particle size increases. A velocity will be reached above which particles will be re-entrained. The onset of re-entrainment is a function of particle size, the particle density, tube diameter, and the adhesive properties of the particle and wall.

16.2.4.4 Physical Changes. A change in the physical state (e.g., liquid, gas, solid) of an airstream constituent can result in sample distortions. Such changes can be precipitated by a temperature and/or pressure change. Moisture in the sample can result in condensate on the inner surfaces of sampling lines that may form pockets and act as traps, or provide wetted surfaces to which the contaminant of interest may adhere. In extreme situations traps and pockets may act as effective scrubbers for the radioactive material transported. Excessive moisture may also destroy filter media usefulness either by blocking the air passageways through the pores, or by weakening it to a point that it tears or breaks easily. ANSI N13.1 recommends heated sampling lines when heavy moisture loadings are anticipated, to prevent condensation in the lines and to raise the collector temperature well above dewpoint.

16.2.4.5 Chemical Activity. Chemically reactive contaminants in the extracted sample can be largely absorbed on or react with materials of construction resulting in under-representation in the analysis. In addition the corrosion, clogging, and uneven surfaces that can result from chemically active constituents can result in distortion of the measurement of non-reactive contaminants. The ANSI N13.1-1969 (ANSI 1969) recommends extreme

care when extracting a sample from an airstream when the air contains chemically reactive forms of radioactive isotopes. Precautions would include having a thorough understanding of the chemical composition of the airstream and the materials of construction of the effluent monitoring/sampling system. For example, when radioiodine is a constituent, materials to be avoided in sampling systems are rubber, copper, and some plastics.

16.2.4.6 Sample Loss/Dilution. There are many mechanisms that can result in sample loss. An isokinetic sample extraction can cause the loss of larger or smaller particles. Deposition or impaction in sample transport lines can cause losses of particulate matter. Chemical reaction of the sample with the material of construction can cause sample loss resulting from absorption or it can become fixed because it reacted with a system component. The reactions can also cause physical obstructions that interfere with the transfer of nonreactive contaminants resulting in losses at the collection or measurement device.

Since sample transfer lines operate at below atmospheric pressure, system leaks will generally introduce ambient air into the sampling lines that will dilute the constituents in the sample.

The ANSI N13.1-1969 (ANSI 1969) recommends that sampling lines be avoided whenever possible and always kept at a minimum length. Guidelines to mitigate the various types of line losses were presented in the previous five sections. In addition, good operating practice would mandate identification of effluent monitoring system leakage and expedient corrective action to preclude sample dilution from this type of problem.

16.2.5 Sample Analysis (U.S. Environmental Protection Agency Method 114)

The requirements for determining the amounts of radionuclides collected by the effluent sampling system are provided in EPA Method 114, which is codified in 40 CFR 61, Appendix B (EPA 1989a). The appropriate sample analysis for a radionuclide is dependent upon a number of interrelated factors including the mixture of other radionuclides present. Therefore, a series of methods based on "principles of measurement" are described for monitoring and sample collection and analysis; these methods are applicable to the measurement of radionuclides found in effluent streams at stationary sources. The approach provides flexibility to choose the most appropriate combination of monitoring and sample collection and analysis methods.

16.2.5.1 Stack Monitoring and Sample Collection Methods. The EPA Method 114 presents monitoring and sample collection methods based on "principles of monitoring and sample collection" which are applicable to the measurement of radionuclides from effluent streams at stationary sources. The collection media (i.e., filters) for particulate radionuclides are incorporated by reference to ANSI N13.1-1969 (ANSI 1969). Collection methods for other radionuclide physical states are present in Table 16-1.

16.2.5.2 Radionuclide Analysis Methods. The EPA Method 114 presents a series of methods based on "principles of measurement," which are applicable to the analysis of radionuclides collected from airborne effluent streams at stationary sources. These methods are applicable only under the conditions stated and within the limitations described. Some methods specify that only a single radionuclide be present in the sample or the chemically separated sample. This condition should be interpreted to mean that no other radionuclides are present in quantities that would interfere with the measurement. The methods that are applicable are dependent upon the type of radiation emitted. Table 16-2 summarizes the mandated analysis methods by radiation type and applicability.

16.2.6 Quality Assurance Program for Effluent Monitoring

The EPA Method 114 presents minimum requirements for QA program. The QA program must be documented in a project plan that addresses all the QA elements prescribed in Method 114. The QAPP must contain the following critical elements:

- A description of the organizational structure that includes functional responsibilities, authority, and lines of communication for all emission measurement activities
- A description of administrative controls.

Table 16-1. Collection Methods (Contained Within U.S. Environmental Protection Agency Method 114).

Radionuclide of concern	Direct measurement method	Collection principles	Appropriate collectors
Particulate		Refers to ANSI N13.1	Refers to ANSI N13.1-1969 (ANSI 1969)
Tritium (water vapor)		Sorption, condensation, or dissolution	Silica gel, molecular sieves, ethylene glycol, or water bubblers
Tritium (gas)	B-1	Measured directly	Not applicable
		Metal catalyst oxidation to water, then same as tritium water vapor	Same as tritium water vapor
		Gas sample	Cylinder or flexible bag
Iodine		Sorption or dissolution techniques	Charcoal, impregnated charcoal, metal zeolite, and caustic solutions
Argon, krypton, and xenon	A-4, B-2, and G-4	Measured directly	Not applicable
		Low temperature sorption technique	Charcoal or metal zeolite
Oxygen, carbon, nitrogen, and radon (radionuclide gases)	A-4, B-2, and G-4	Measured directly	Not applicable
Carbon (as carbon dioxide)		Sorption	Caustic scrubber

Table 16-2. Analysis Methods (Contained within U.S. Environmental Protection Agency Method 114). (6 sheets)

Radioactivity type	Method	Techniques	Applicability
Alpha Emitting	A-1	Radiochemistry-Alpha Spectrometry	Determine the activity of any alpha-emitting radionuclide, regardless of what other radionuclides are present in the sample provided the chemical separation step produces a very thin sample and removes all other radionuclides that could interfere with the spectral region of interest.
Alpha Emitting	A-2	Radiochemistry-Alpha Counting	The measurement of any alpha-emitting radionuclide, provided no other alpha emitting radionuclide is present in the separated sample. Method A-2 may also be applicable for determining compliance when other radionuclides of the separated element are present, provided that the calculated emission rate is assigned to the radionuclide that has the highest dose conversion factor that could be present in the sample.
Alpha Emitting	A-3	Direct Alpha Spectrometry	Simple mixtures of alpha-emitting radionuclides and only when the amount of particulates collected on the filter paper are relatively small and the alpha spectrum is adequately resolved. Resolutions should be 500 keV or better.

Table 16-2. Analysis Methods (Contained within U.S. Environmental Protection Agency Method 114). (6 sheets)

Radioactivity type	Method	Techniques	Applicability
Alpha Emitting	A-4	Direct Alpha Counting (Gross Alpha Determination)	Gross alpha determinations may be used to measure emissions of specific radionuclides only (1) when it is known that the sample contains only a single radionuclide, or the identity and isotopic ratio of the radionuclides in the sample are well-known, and (2) measurements using either Method A-1, A-2, or A-5 have shown that this method provides a reasonably accurate measurement of the emission rate. Gross alpha measurements are applicable to unidentified mixtures of radionuclides only under certain conditions.
Alpha Emitting	A-5	Chemical Determination of Uranium	Emissions of uranium when the isotopic ratio of the uranium radionuclides is well-known.
Alpha Emitting	A-6	^{222}Rn Continuous Gas Monitor	Emissions of radon in effluent streams that do not contain significant quantities of ^{220}Rn.
Alpha Emitting	A-7	^{222}Rn Alpha Track Detectors (ATDs)	Effluent streams that do not contain significant quantities of ^{220}Rn, unless special detectors are used to discriminate against ^{220}Rn. ATDs must have been demonstrated to produce data comparable to data obtained with Method A-6. Prior approval from EPA is required for use of this method.

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Table 16-2. Analysis Methods (Contained within U.S. Environmental Protection Agency Method 114). (6 sheets)

Radioactivity type	Method	Techniques	Applicability
Gaseous Beta Emitting	B-1	Direct Counting in Flow-Through Ionization Chambers	Measuring the activity of a gaseous beta-emitting radionuclide in an effluent stream that is suitable as a counting gas, when no other beta-emitting nuclides are present.
Gaseous Beta Emitting	B-2	Direct Counting with In-Line or Off-Line Beta Detectors	Radionuclides with maximum beta particle energies greater than 0.2 MeV. This method may be used to measure emissions of specific radionuclides only when it is known that the sample contains only a single radionuclide or the identity and isotopic ratio of the radionuclides in the effluent stream are well known. Also applicable to unidentified mixtures of gaseous radionuclides for specific purposes and certain conditions.
Gaseous Beta Emitting	B-3	Radiochemistry-Beta Counting	Measuring the activity of any beta-emitting radionuclide with a maximum energy greater than 0.2 MeV, provided no other radionuclide is present in the separated sample.

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Table 16-2. Analysis Methods (Contained within U.S. Environmental Protection Agency Method 114). (6 sheets)

Radioactivity type	Method	Techniques	Applicability
Gaseous Beta Emitting	B-4	Direct Beta Counting (Gross Beta Determination)	Gross beta measurements are applicable only to radionuclides with maximum beta particle energies greater than 0.2 MeV. Gross beta measurements may be used to measure emissions of specific radionuclides only (1) when it is known that the sample contains only a single radionuclide, and (2) measurements made using Method B-3 show reasonable agreement with the gross beta measurement. Gross beta measurements are applicable to mixtures of radionuclides only for specific purposes and certain conditions.
Gaseous Beta Emitting	B-5	Liquid Scintillation Spectrometry	Any beta-emitting nuclide when no other radionuclide is present in the sample or the separated sample provided that it can be incorporated in the scintillation cocktail. This method is also applicable for samples that contain more than one radionuclide but only when the energies of the beta particles are sufficiently separated so that they can be resolved by the spectrometer. This method is most applicable to the measurement of low-energy beta emitters such as tritium and ^{14}C.

Table 16-2. Analysis Methods (Contained within U.S. Environmental Protection Agency Method 114). (6 sheets)

Radioactivity type	Method	Techniques	Applicability
Gamma Emitting	G-1	High Resolution Gamma Spectrometry	The measurement of any gamma-emitting radionuclide with gamma energies greater than 20 keV. Method G-1 can be applied to complex mixtures of radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids, or gases. The method may also be applied to the analysis of gaseous gamma-emitting radionuclides directly in an effluent stream by passing the stream through a chamber or cell containing the detector.
Gamma Emitting	G-2	Low Resolution Gamma Spectrometry	The measurement of gamma-emitting radionuclides with energies greater than 100 keV. Method G-2 can be applied only to relatively simple mixtures of gamma-emitting radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids, or gas. The method can be applied to the analysis of gaseous radionuclides directly in an effluent stream (see previous).
Gamma Emitting	G-3	Single Channel Gamma Spectrometry	The measurement of a single gamma-emitting radionuclide. Method G-3 is not applicable to mixtures of radionuclides. The samples counted may be in the form of particulate filters, absorbers, liquids, or gas. The method can be applied to the analysis of gaseous radionuclides directly in an effluent stream (see previous).

Table 16-2. Analysis Methods (Contained within U.S. Environmental Protection Agency Method 114). (6 sheets)

Radioactivity type	Method	Techniques	Applicability
Gamma Emitting	G-4	Gross Gamma Counting	Gross gamma measurements may be used to measure emissions of specific radionuclides only when it is known that the sample contains a single radionuclide or the identity and isotopic ratio of the radionuclides in the effluent steam are well known. When gross gamma measurements are used to determine emissions of specific radionuclides, periodic measurement using Methods G-1 or G-2 should be made to demonstrate that the gross gamma measurements provide reliable emission data. The method may be applied to analysis of gaseous radionuclides directly in an effluent stream by placing the detector directly in or adjacent to the effluent stream or by passing an extracted sample of the effluent stream through a chamber or cell containing the detector.

GLOSSARY

Administrative Control Values (ACV). Contractor-imposed radionuclide and hazardous material release limits usually based upon ALARA goals for protection of the public.

Contractor. A company or entity that has entered into a prime contract to operate a Hanford Site facility or perform a function for DOE Field Office, Richland.

Crib. A trench, ditch, or similar configuration used to discharge liquid effluents to the ground. This method of subsurface liquid waste disposal allows liquid waste to percolate into the surrounding soil.

Dangerous Waste. Washington State designation for solid wastes specified in WAC 173-303 (Ecology 1989) as dangerous or extremely hazardous waste.

Derived Concentration Guides (DCG). The concentration of a radionuclide in air or water that, under conditions of continuous exposure for 1 yr by one exposure mode, would result in an effective dose equivalent of 100 mrem. DCGs do not consider decay products when the parent radionuclide is the cause of the exposure. DCGs are listed in DOE Order 5400.5, Chapter III (DOE 1990a), and contractor safety and environmental compliance manuals.

Discharge. Liquid effluent releases.

Discharge Point or Effluent Discharge Point. The point at which an effluent or discharge enters the environment from the facility in which it was generated.

Effective Dose Equivalent (EDE). The summation of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighing factor. This sum is a risk-equivalent value and can be used to estimate the health-effects risk of the exposed individual. The tissue-specific weighing factor represents the fraction of the total health risk resulting from uniform whole-body irradiation that would be contributed by that particular tissue. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides and the effective dose equivalent because of penetrating radiation from sources external to the body. Effective dose equivalent is expressed in units of rem (or sievert).

Effluent. A collective term describing emissions and discharges.

Effluent Monitoring. Measurement of liquid and airborne effluents to characterize and quantify contaminants, assessing radiation exposures of members of the public, provide a means to monitor and/or control effluents at or near the point of discharge, and demonstrate compliance with applicable standards and permit requirements.

Effluent Sampling. The continuous or intermittent collection and analysis of effluent samples for the purpose of characterizing and quantifying contaminants, assessing radiation exposures of members of the public, providing a means to control effluents at or near the point of discharge, and demonstrating compliance with applicable standards and permit requirements.

Emissions. Airborne effluent releases (gaseous, particulates, and solids).

Environmental Control Limits. Contractor limits based on permit limits and contractor policies as derived from DOE requirements.

Environmental Occurrence. Any sudden or sustained deviation (categorized as emergencies, unusual occurrences, or off-normal occurrences) from a regulated or planned performance at a DOE operation that has environmental protection and compliance significance. Typical occurrences of interest to this document include failure of primary or secondary facility effluent monitoring equipment or a monitored/unmonitored release of regulated materials exceeding administrative control values.

Environmental Surveillance. The collection and analysis of samples, or direct measurements, of air, water, soil, foodstuffs, biota, and other media from DOE sites and their environs to determine compliance with applicable standards and permit requirements, assess radiation exposures of members of the public, and effects, if any, on the local environment.

Extremely Hazardous Waste. Washington State designation for waste specified in WAC 173-303 (Ecology 1989).

French Drain. Generally a rock-filled encasement with an open bottom to allow drainage into the soil. A French drain is used for the disposal of relatively low volume wastewater, usually runoff or steam condensate. Term may be applied to any drain system that releases directly to the soil and is not a septic system, pond, ditch, or crib.

Hazardous Substance or Material. Solid, liquid, or gaseous material as defined by the following regulations:

- Any CERCLA hazardous substance identified in 40 CFR 302.4 (EPA 1989b).
- Superfund Amendments and Reauthorization Act (SARA) extremely hazardous substance identified in Appendix A of 40 CFR 355 (EPA 1988a).
- Any dangerous waste regulated pursuant to WAC Chapter 173-303 (Ecology 1989), "Dangerous Waste Regulations."

Hazardous Waste. Solid wastes designated by 40 CFR Part 261 (EPA 1989c), and regulated as hazardous wastes by the EPA or Washington State [WAC 173-303 (Ecology 1989)]. This term includes dangerous waste, extremely hazardous wastes, and toxic dangerous waste.

In-line Monitor. A system in which a detector or other measuring device is placed in the effluent stream to perform measurements on the effluent stream.

Inventory at Risk. The quantity and/or type of radioactive and/or nonradioactive hazardous material present in a facility with the potential to enter an airborne or liquid effluent stream.

Isokinetic. A condition that exists when the velocity of air entering a sampling probe held in an airstream is identical to the velocity axis of flow of the airstream being sampled at that point.

Mixed Waste. Waste containing both radioactive and hazardous components regulated by the Atomic Energy Act and the *Resource Conservation and Recovery Act of 1976* (RCRA), respectively.

Non-complexed. Waste that does not contain the chelating agents ethylenediaminetetraacetic acid (EDTA), hydroxyethylethylenediaminetriacetic acid (HEDTA), citric acid, or hydroxyacetic acid.

Non-conformance. A non-conformance exists when any of the following have occurred, and the appropriate recovery actions are implemented.

- Exceeding an ECL
- Failure to meet an environmental surveillance requirement
- Failure to implement an environmental administrative control
- Failure of primary environmental monitoring equipment to pass a surveillance check.

Normal Operations. A plant operating condition where all processes and safety control devices are operating as designed.

Occurrence Report. A written evaluation of an event or condition that is prepared in sufficient detail to enable the reader to assess its significance, consequences, or implications and to evaluate the actions being proposed or employed to correct the condition or to avoid recurrence.

Oil. Oil of any kind or in any form, including, but not limited to petroleum, fuel oil, sludge, oil refuse and oil mixed with wastes other than dredged soil.

Onsite. Refers to the area encompassed by the Hanford Site boundaries.

Offsite. Refers to the area outside the Hanford Site boundaries.

Primary environmental monitors. Monitoring equipment legally required to monitor ongoing discharges. In general, this term applies to monitors closest to the point of discharge which are used to determine if discharges are within specified limits.

Radioactive Component. Refers only to the actual radionuclides dispersed or suspended in the waste substance.

Releases. Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or otherwise disposing of substances into the environment. This includes abandoning/discarding any type of receptacle containing substances or the stockpiling of a reportable quantity of a hazardous substance in an unenclosed containment structure.

Reportable Quantities. That quantity of hazardous substances as listed in 40 CFR 302 (EPA 1989a) which, if released, requires notification as per 40 CFR 302. These quantities also provide a criteria for requiring FEMPs with respect to nonradioactive hazardous substances.

Secondary environmental monitors. Environmental monitoring equipment or activities which, if degraded, will produce a more than minor disruption of a monitoring program. An example of a minor effect would be the failure of a unit whose place in the program is effectively duplicated by overlap between one or more components.

Shutdown Condition. A plant condition where all processes involving radioactive and/or hazardous materials are inactive and otherwise stable.

Source Term. The amount, activity, or concentration and the effective release height of a hazardous or radioactive material in a facility effluent stream at the point of discharge that is available to expose personnel either within the facility or beyond the site boundary.

Statistically significant increase. When used in reference to a continuous release of a hazardous substance listed in 40 CFR 302.4 (EPA 1989b), means the largest 5% of all continuous releases. Determination of statistical significance shall be based on any of the following:

- The non-parametric statistical test
- The control chart or student *t* test
- Other tests that have an equivalent sensitivity.

Tank Farm. An area of underground tanks designed to store high-level liquid wastes generated by nuclear fuel or decontamination processes.

Toxic Dangerous Wastes. Washington State designation for wastes meeting the criteria specified in WAC 173-303-101 (Ecology 1989).

Transuranic. Any radionuclide having an atomic number greater than 92.

Tri-Party Agreement. Agreement among U.S. Department of Energy, Washington State Department of Ecology, and the Environmental Protection Agency concerning cleanup of the Hanford Site.

Upset Condition. Any one condition that is outside the normal process operating parameters, or an unusual plant operating condition where one material confinement/containment barrier or engineered or administrative control has failed.

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