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Facilities Management

Facility Effluent Monitoring Plan for the 324 Facility

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Summary

The 324 Facility in the 300 Area primarily supports the research and development of radioactive and nonradioactive waste vitrification technologies (i.e., ceramic melters, in situ vitrification [ISV], Hanford Waste Vitrification Program design support), biological waste remediation technologies, spent nuclear fuel studies, waste mixing and transport studies, and tritium development programs. All of the above-mentioned programs deal with, and have the potential to, release hazardous and/or radioactive material. The potential for discharge would primarily result from 1) conducting research activities using the hazardous materials, 2) storing radionuclides and hazardous chemicals, and 3) waste accumulation and storage. The following summarizes the airborne and liquid effluents, and the results of the Facility Effluent Monitoring Plan (FEMP) determination for the facility. The complete monitoring plan includes characterizing effluent streams, monitoring/sampling design criteria, a description of the monitoring systems and sample analysis, and quality assurance requirements.

Airborne Effluents

Potential radioactive airborne effluents in the 324 Facility have been characterized and all airborne release pathways have been verified. Stack monitors (samplers) were upgraded to meet 40 CFR 61 criteria. The primary stack at the 324 Facility (EP-324-01-S) is currently registered with the Washington State Department of Health as required by WAC 246-247. Nonradioactive airborne effluents have not been characterized, but characterization efforts are planned and will proceed in the course of compliance with state air toxics regulations and as the Clean Air Act Amendments are fully implemented.

Liquid Effluents

The 324 Facility discharges to four sewer systems: the radioactive liquid waste system (RLWS), the retention process sewer (RPS), the process sewer (PS), and the sanitary sewer (SNS). Liquid effluent releases in the 324 Facility are either administratively or physically controlled. Most connections to the process sewer that have the potential to release regulated effluent have been plugged. Unplugged connections include floor and sump drains that have been modified with stand pipes to prevent uncontrolled discharge, and other (primarily laboratory sink and hood) drains that have been posted with labels stating the type of drain and liquid effluent disposal controls. Selected floor drains in facility service tunnels that must remain open in case of main service line leaks or ruptures, are also posted to control liquid effluent disposal. Verifying RLWS, RPS, and PS liquid effluent lines in the 324 Facility proceeds as part of an ongoing program and is estimated to be completed in 1995.

Liquid effluent lines from the facility enter into the 300 Area liquid effluent system operated by Westinghouse Hanford Company (WHC). Effluent from the RPS, PS, and SNS is monitored by WHC at the end-of-pipe before being released to the environment. The RLWS effluent is transferred to the 340 Building, operated by WHC, and shipped to the 200 Area tank farms. RLWS streams are not released to the environment.

A program to monitor liquid effluents from the 324 Facility is underway. Liquid effluent monitoring equipment is being installed and includes a flow proportional liquid sampler, online pH meter, and conductivity meter. Sampling of the liquid effluents will begin when the samplers are installed.

FEMP Determination

An inventory-based method was used to estimate the maximum potential offsite dose if airborne releases from the building were unmitigated. The projected potential unmitigated dose met criteria (> 0.1 mrem) for preparing a FEMP. A list of chemicals in the building was also obtained and chemicals in greater than reportable quantity were identified to characterize the potential for emissions of nonradioactive hazardous materials. A method to determine the potential emissions of nonradioactive hazardous materials is under development.

Glossary

AABC	Associated Air Balance Council
ABPD	alpha-beta-pseudocoincidence-difference method
ACV	administrative control values
AED	aerodynamic equivalent diameter
AGL	above ground level
AKART	all known, available, and reasonable technologies
AMAD	activity median aerodynamic diameters
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASILs	Acceptable Source Impact Levels
BACT	best available control technology
BARCT	best available radionuclide control technology
BDT	best demonstrated technology
BPA	Bonneville Power Administration
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAM	continuous air monitor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DCGs	derived concentration guides
DOE	U.S. Department of Energy
DOH	Washington State Department of Health
EC	Environmental Compliance Section of PNL
Ecology	Washington State Department of Ecology
EDE	effective dose equivalent
EDL	Engineering Development Laboratory
EMP	Environmental Monitoring Plans
EP	Extraction Procedure
EPA	U.S. Environmental Protection Agency
ESP	exhaust sample point
FEMP	Facility Effluent Monitoring Plan
FWPCA	Federal Water Pollution Control Act
HBEL	High-Bay Engineering Laboratory
HEPA	high-efficiency particulate air
HLV	high-level vault
HPS	Hanford Plant Standard
HT	noncondensable tritium; tritium gas
HTO	condensable tritium; tritiated water
HVAC	heating, ventilation, and air conditioning
HWVP	Hanford Waste Vitrification Project
ITAS	International Technology Analytical Services
ISV	in situ vitrification

LLV	low-level vault
LOS	load out stall
MACT	maximum achievable control technology
MASR	Missing Air Sample Report
MBA	material balance area
MDA	minimum detectable activity
MDL	minimum detection levels
MFP	mixed fission product
MOTA	Materials Open Test Assembly
MPCs	maximum permissible concentrations
MPD	maximum permissible dose
NAAQS	national ambient air quality standards
NEPA	National Environmental Policy Act
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NPDES	national pollutant discharge elimination system
NRC	U.S. Nuclear Regulatory Commission
OED	offsite emission dose
ONE	off-normal event
OSR	Operational Safety Requirement
PASR	Positive Air Sample Report
PCM	personnel contamination monitor
PM-10	particulate matter > 10 microns
POG	process off-gas
PS	process sewer
PSD	prevention of significant deterioration
QC	quality control
RAM	radiation area monitor
RCRA	Resource Conservation and Recovery Act
RE	Radiochemical Engineering
RLWS	Radioactive Liquid Waste System
RQ	reportable quantity
RPS	retention process sewer
RPT	radiation protection technician
R&D	research and development
SAR	Safety Analysis Report
SDC	Standard Design Criteria
SED	Safety Evaluation Document
SMF	Shielded Material Facility
SNM	special nuclear material
SNS	Sanitary Sewer
SOP	safe (or standard) operating procedure
SPC	single point contact (375-2400)
SVLA	storage vault and laboratory area

TAPs	toxic air pollutants
TSDFs	treatment, storage, or disposal facilities
TT	molecule with two tritium atoms
UBC	Uniform Building Code
VV	vessel vent
WAC	Washington Administrative Code
WCAA	Washington State Clean Air Act
WDOH	Washington State Department of Health (see DOH)
WHC	Westinghouse Hanford Company
WL	working level
WM	Waste Management

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1.0 Introduction

It is the policy of the U.S. Department of Energy (DOE) and the Pacific Northwest Laboratory (PNL) to conduct effluent monitoring to determine if the public and environment are adequately protected during DOE operations and whether operations are in compliance with DOE and other applicable federal, state, and local standards and requirements. It is also DOE and DOE-contractor policy that effluent monitoring programs meet high standards of quality and credibility.

1.1 Purpose

DOE Order 5400.1 on General Environmental Protection Programs states the objective for environmental monitoring programs as to "demonstrate compliance with legal and regulatory requirements imposed by applicable federal, state and local agencies; confirm adherence to DOE environmental protection policies; and support environmental management decisions" (DOE Order 5400.1, IV-1). Plans must be prepared for each site, facility, or process that uses "significant pollutants or hazardous materials" (DOE Order 5400.1, IV-2). These requirements are being met through the environmental monitoring program conducted for the Hanford Site and are described in the Hanford Site Environmental Monitoring Plan (EMP).

The EMP identifies and discusses two major activities as specified by DOE Order 5400.1: a) effluent monitoring, and b) environmental surveillance. Because the Hanford Site contains a number of facilities with effluent monitoring needs, individual effluent monitoring plans are prepared for those facilities to support the discussion of effluent monitoring in the EMP. This report supplies information on effluent monitoring at the 324 Facility.

1.2 Background

The 324 Facility was determined to need a Facility Effluent Monitoring Plan (FEMP) because of the quantity and type of radionuclides in the building. The FEMP includes action plans and schedules that will be completed in FY 1995. This includes updating and verifying the effluent lines, characterizing liquid effluent streams, upgrading sampling systems (liquid), upgrading monitoring systems (air), and characterizing nonradioactive airborne effluent.

1.3 Discussion

Characterizing the radioactive and nonradioactive constituents present in inventory and in waste streams provides the underlying rationale for sampling and monitoring programs. Currently, sampling and monitoring efforts are confined to radioactive air. Compliance assessments of the existing radioactive air monitoring equipment are included in this FEMP. Compliance sampling for liquid streams is conducted by Westinghouse Hanford Company (WHC).

A major activity of the FEMP effort is to verify all the liquid and air release pathways (e.g., verify all access points to the various sewers and all radioactive emission release pathways under normal operations and during process upset conditions). This plan also identifies effluent monitoring deficiencies and action plans for installing additional effluent monitoring equipment so that sampling/monitoring information can be obtained.

The method of characterization discussed in this plan identifies potential pollutants at the point of generation and potential upset conditions that are likely to occur, and evaluates the potential for those materials to enter an effluent stream.

2.0 Facility Mission and Description

2.1 Facility Mission

The Waste Technology Engineering Laboratory (324 Facility) provides office and laboratory space for PNL scientific and engineering staff conducting multidisciplinary research in the areas of waste characterization and immobilization, waste remediation and clean-up development, biomass research, spent fuel characterization, tritium development, and cesium chloride encapsulation. The 324 Facility was designed with the necessary safety features and facilities to allow radioactive and hazardous material use in support of these activities. The facility is currently occupied by staff from the Engineering Technology Center and the Safeguards and Security Department.

2.2 Geographical and Physical Description

The 324 Facility is located in the 300 Area of the Hanford Site, which is located in the south-central region of Washington State. The 324 Facility is situated directly east of the 308 Building, and west of the 336 Building with the front facing south (see Figure 2.1).

The 324 Facility is 62.5 m x 71.6 m (205 ft x 235 ft) in plan, and 13.7 m (45 ft) in height above ground level. The foundation structure is reinforced concrete that was poured in place. The superstructure is constructed from fluted steel insulated industrial panels supported on a structural steel frame. The parapeted roof has a slightly sloped steel deck with gravel-finished, built-up roofing. The 324 Facility, constructed in 1965, was designed to the requirements of the Uniform Building Code (UBC) and Hanford Plant Standard (HPS) Standard Design Criteria (SDC) 4.1 Revision 2.

The building comprises four levels (a basement and three floors) and has five distinct operating areas: radioactive hot cells with associated operating galleries and radioactive liquid storage tanks in concrete vaults, radiological engineering development laboratories, special nuclear material (SNM) storage and assay, nonradiological engineering development laboratories, and administrative offices. The basic floor plan of the facility is depicted in Figure 2.2.

Facility safety systems include fire, criticality, radioactive airborne emission stack monitoring, radioactive liquid effluent monitoring, crash and evacuation alarms, and high-efficiency particulate air (HEPA)-filtered ventilation systems. Facility effluent drawings are included as Appendix E.

The 324 Facility ventilation system (shown in Figure 2.3 and Appendix E) is designed to ensure safe confinement of airborne radioactive materials under all normal and credible failure modes. The ventilation system is divided into four zones (Zones I, II, III, and IV) using cascading zone pressure levels to maintain proper air flow balance and direction. The system has interlocks, redundancy, failure-to-open control dampers, and backflow prevention dampers to ensure desired zone pressure and air flow control in the event of partial equipment or power failure.

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Figure 2.1. Location of the 324 Facility in the 300 Area

The Zone I and II exhaust streams are joined downstream of the final (second-stage) filters and exhaust fans, in a common tunnel, and exhaust to the atmosphere via the 46-m (150-ft)-high stack located outside the northeast corner of the building. Zone I exhausts the high-level radioactive areas such as the

Figure 2.2. 324 Facility Floor Plans

Radiochemistry and Shielded Material Facility (SMF) cells, their accompanying liquid vault tanks, and some gloveboxes and fume hoods. The Zone I exhaust is filtered through at least two testable stages of HEPA filtration and exhausted by three fans (one on standby) out to the atmosphere via the northeast stack.

Zone II exhaust serves potentially contaminated areas in which low-level radioactive materials are handled, such as shielded cell operating galleries, basement laboratories, and the storage vault. All Zone II air is exhausted through at least one testable stage of HEPA filtration. The Zone II system is serviced by two fans running continuously. The Zone II fans discharge to the atmosphere via the northeast stack.

39410048.13

Figure 2.2. (contd)

The Zone III exhaust serves normally "clean" areas such as the Engineering Development Laboratory 102 (EDL-102 is the area north of 101 containing Mods 1-18) and nonradioactive laboratories. All air exhausted from Zone III is filtered through at least one testable stage of HEPA filtration by two continuously-operating fans without any standby fan capability. The Zone III fans discharge directly to the atmosphere through a stack that penetrates the roof.

Zone IV exhaust serves areas that do not contain any radioactive materials such as offices, change rooms, and administration areas. The Zone IV air is discharged to the atmosphere through various powered or convective roof exhausters or is recirculated, depending on the location.

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Figure 2.2. (contd)

Electrical power service at 480/277 V, 3 phase, 4 wire, is provided to the facility from two substations, on the north and south sides. Normal power is supplied from the Bonneville Power Administration (BPA) grid with two separate sources of standby power.

Facility and personnel radiation monitoring is done using personnel contamination monitors (PCMs), radiation area monitors (RAMs), continuous air monitors (CAMs), and portable survey instrumentation. The 324 Facility stack emissions are continuously monitored for gross alpha and beta-gamma. (The monitors trigger alarms at the main 324 Facility annunciator panel and the 325 Facility power operator control room.) Particulate samples of stack air emissions are continuously collected, sampled bi-weekly, and subjected to radiological analyses.

Figure 2.3. 324 Facility Exhaust Ventilation Flow Diagram

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Liquid effluent, with the potential for radioactive contamination is continuously monitored by gamma detectors before being discharged from the facility.

2.3 Brief Process Description The 324 Facility primarily supports the research and development (R&D) of radioactive and nonradioactive waste vitrification technologies (i.e., ceramic melters, in situ vitrification [ISV], Hanford Waste Vitrification Program [HWVP] design support), spent nuclear fuel studies, biological waste remediation technologies, and waste mixing and transport studies. All of the above-mentioned programs have the potential to release hazardous and/or radioactive material. The following is a brief description of each activity and the potential types of radioactive and/or hazardous material each program uses to conduct research. The potential for discharge would primarily result from 1) conducting research activities using the hazardous material, 2) storing radionuclides and hazardous chemicals, and 3) waste accumulation and storage.

2.3.1 Waste Vitrification Technologies

The HWVP feed preparation program and other waste vitrification technologies work with potentially large volumes (up to 15,000 L) of nonradioactive, simulated, high-level defense waste. These feed slurries comprise various nitrates, oxides, hydroxides, salts, and heavy metal compounds. The slurries are mixed in designated chemical make-up areas and pumped to holding/feed tanks for subsequent R&D processing within the 324 Facility. Ceramic melter and ISV technologies will demonstrate their capabilities by processing all types of waste streams, such as simulated and actual radioactive waste, municipal incinerator ash, and inorganically and organically contaminated soils.

2.3.2 Spent Nuclear Fuel Studies Spent nuclear fuel is evaluated using destructive and nondestructive techniques. Gamma scanning, fission gas sampling with lasers, and thermal oxidation of fuel rod sections are some of the methods used.

2.3.3 Biological Waste Remediation Biological waste remediation uses microorganisms to destroy or separate various groundwater contaminants. Contaminants include inorganics such as nitrates, chromium, and various radionuclides; and organics such as carbon tetrachloride, chloroform, and trichloroethylene, at low (ppb) concentrations.

2.3.4 Waste Mixing and Transport Studies

Waste mixing and transport studies address the concerns associated with removing high-level waste from the double-shell storage tanks at Hanford. Clays and other nonhazardous materials are used to simulate the actual waste.

2.4 Identification and Characterization of Potential Source Terms

For the purposes of this section, a source term is the amount, activity, or concentration 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. A brief description of each laboratory and the research conducted in that area is provided in Appendix A.

2.4.1 Radioactive Material Inventory

Appendix B provides a summary of the nature and form of potential radioactive source terms, associated with the conduct of research in the 324 Facility, that

could lead to unplanned releases to the environment. Potential source terms involving radionuclides are mostly contained within the east half of the facility (radiochemistry hot cells and operating galleries, Rooms 145, 146, and 147, basement material balance area [MBA], and the SMF hot cells and galleries).

2.4.2 Hazardous Material Inventory

The nonradioactive hazardous materials are discussed in Appendix C. An ongoing inventory of the materials in the 324 and 3718G Buildings is mentioned.

The 3718G Building is a dedicated chemical and waste storage facility, located approximately 30 m (100 ft) directly north of the 324 Facility. The chemicals are normally inventoried in the 3718G Building until a particular activity, such as feed make-up, would warrant their transfer to a location in the 324 Facility. Only chemicals in gram quantities are generally stored in the 324 Facility. When chemicals are transferred to the 324 Facility, they are normally, taken into the High Bay, EDL-102, the aqueous makeup room, or other approved areas only. Chemical inventories are maintained for the 3718G Building and each storage area in the 324 Facility. The inventories are updated using a PNL-developed database program on a monthly or bimonthly basis. Chemical use log sheets are located at each designated storage area to record daily activities, and to facilitate the routine updating process. Staff members must record their name, the date, chemical, quantity, and shelf number for all chemicals removed or stored in the approved area. The 3718G Facility is used for storage only; chemical handling/transfer is not conducted.

Environmental release pathways for the 3718G Building are very limited. Liquid products are stored in a regulatory-designed berm area. No floor drain exists. Two manually-controlled roof fans are used to remove warm summer air only. Two large, recirculating, forced-air heaters maintain the temperature above the freezing point during winter months. Chemical products in original or equivalent containers are stored on pallet racks according to compatibility guidelines. Direct handling of chemical products in this facility is usually done in emergency situations only, where a breach of container integrity forces repackaging.

Liquid effluent release pathways in the 324 Facility are either administratively or physically controlled. Most connections to the process sewer (PS) that have the potential to release regulated effluent have been capped. Floor and sump drains have been modified with stand pipes to prevent uncontrolled discharge. The remaining drains, that cannot be physically locked by design, have been posted with liquid effluent warning signs. These are, primarily, laboratory sink and hood drains. Selective floor drains in facility service tunnels that must remain open in case of main service line leaks or ruptures are also posted.

National Environmental Policy Act (NEPA) documentation and technical operating procedures address the potential environmental impacts from conducting research activities. The Laboratory Safety Department reviews these documents to ensure that air emissions standards are addressed. PNL-MA-8, *Waste Management and Environmental Compliance*, describes the procedures and requirements related to the handling, storing, and discharging radioactive, hazardous, and objectionable waste materials in PNL-managed facilities.

2.4.3 Wastewater Discharge Points Four distinct wastewater discharge points are in operation for the 324 Facility. Wastewater flows for these systems are listed in Table 2.1. A normal operating range is shown, along with a maximum anticipated flow. Each system normally operates near the minimum value in the flow range.

The Sanitary Sewer (SNS) receives effluent from the restrooms, lunchrooms, and change rooms, which have a low probability of contamination. The sanitary waste is discharged into the 300 Area SNS system, operated by WHC under contract with DOE. The SNS is depicted in Figure 2.4.

The PS receives cooling water, process water, and other nonsanitary liquid waste that does not contain radioactive or hazardous materials that exceed regulatory requirements. In the 324 Facility, wastewater from EDL-102, the chemical make-up area, wet chemistry laboratories, the High-Bay Engineering Laboratory (HBEL), and heating, ventilation, and air conditioning (HVAC) equipment in Room 317 are discharged to the 300 Area PS system, operated by WHC under contract to DOE. Three PS discharge points exit the 324 Facility. The lines tie into a common header outside the 324 Facility, which flows to the PS trenches.

Administrative and physical controls discussed in Section 2.2 prevent the unauthorized discharge of hazardous or regulated material via this system. PNL-MA-8 discusses the procedures and regulations concerning disposal of material via the PS.

The retention process sewer (RPS) receives waste liquids such as equipment cooling water, laboratory waste liquids, and floor drain liquids that are normally free of radioactive contamination, but have the potential for such contamination. It is a system of steel piping, within the 324 Facility (see Figure 2.5), routed to diverter stations that provide automatic diversion to the Radioactive Liquid Waste System (RLWS) in the event of radioactive contamination being detected. A diverter station consists of a counting instrument and an automatically operated, three-way valve and associated alarms for diverting liquid flow from the RPS to

Table 2.1. Wastewater Flows

System	Normal Operating Range, gpm	Maximum Anticipated Flow, gpm
Sanitary sewer	8	45
Process sewer	10-15	260
Retention process sewer	10	80
Radioactive liquid waste system	(a)	(a)

(a) Disposal by approved batch transfer only, no continuous flow.

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Figure 2.4. Schematic of Sanitary Sewer

the RLWS if radioactivity in the waste exceeds a preset level of $5 \times 10^{-5} \mu\text{Ci/mL}$ of ^{137}Cs equivalent. After passing the diverter station, the 324 Facility liquid wastes are discharged to the 307 basins operated by WHC at the 340 Complex. The effluent is then screened again at the 307 basins for radioactivity before being discharged to the 300 Area PS system; if diverted, the liquid goes to the 300 Area RLWS system, which directs the flow to the 340 Building, operated by WHC under contract with DOE. Figure 2.5 is a schematic of the major PS, RPS, and RLWS lines coming from the 324 Facility.

The RLWS within the 324 Facility is a series of piping that drains to holding tanks within the building (excluding the two diverter stations monitoring the RPS system). The tanks are housed in two subsurface, fully enclosed, steel-lined concrete vaults. These holding tanks have the capability of being jetted or pumped to the 300 Area Waste Management Facility (340 Building), operated by WHC under contract with DOE. The RLWS system receives liquid effluent from the Room 18 diverter station, radioactive wet chemistry lab sinks and hoods, hot cell sumps, radiation area safety showers, and personnel decontamination sink and shower drains. PNL-MA-8 and RLWS procedure R1-6 discuss the procedures and regulations concerning disposal of material via the RLWS. All RLWS users must receive training on procedure R1-6 and possess an approved RLWS disposal request, as outlined in R1-6, before using the system.

Figure 2.5. Schematic of Process Sewer and Retention Process Sewer

3.0 Applicable Regulations

3.1 Introduction

Among the primary concerns of PNL management and staff are compliance with federal, state, and local regulations; DOE Orders; and the protection of the environment and public health. PNL's FEMPs support overall compliance and are intended to ensure liquid effluents and air emissions produced by the Laboratory conform to all applicable standards. This chapter provides a brief description of those standards. This material is intended to help staff gain fuller understanding of those regulations that drive environmental compliance and better appreciate the significance of noncompliance. Instances of noncompliance could result in violations of the law and imposition of fines or penalties on the Laboratory and/or individual staff members, and possible criminal action against the Laboratory and/or individual staff members for willful neglect.

3.2 Environmental Regulations

This section identifies the major environmental laws (federal and state) that guide PNLs in implementing environmental protection policies with respect to air emissions and liquid effluents.

Most major federal environmental laws contain specific language defining their applicability to federal facilities, and specifying the requirements for federal facilities to comply with certain state and local pollution-control regulations. Both federal and state laws are passed by act, statute, or executive order. Regulations are then prepared by an authorized agency, federal regulations are documented in the Code of Federal Regulations (CFR) and state regulations are accumulated in the Washington Administrative Code (WAC). In addition, policy and "guidance" documents are written, many of which must be strictly followed. A regulatory program is, therefore, often composed of the act, CFR or WAC, and written guidance. Federal regulations are often incorporated, directly by reference, into programs, or states implement their own, often more stringent, regulations. DOE Orders often use federal regulations as bases, or may reference those regulations for compliance.

3.2.1 Federal Clean Air Act

The Clean Air Act (CAA) of 1970, and its 1977 amendments, established national ambient air quality standards and mechanisms for attaining and maintaining those standards. It also established standards and mechanisms for preserving air quality in areas already cleaner than the standards. The original CAA consisted of three titles. The Clean Air Act Amendments (CAAA) of 1990 greatly expanded the scope of the act, consisting of eleven titles. Some of the titles amend the three earlier titles; others are new. Regulations implementing the amendments have been, and will continue to be, promulgated for several years.

Regulations implementing the amended act that are applicable to current PNL operations and that require emission monitoring include 40 CFR 61 National Emissions Standards for Hazardous Air Pollutants, "Subpart H National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities." The requirements of this regulation are discussed below. The Washington State Department of Health (WDOH) has applied to the U.S. Environmental Protection Agency (EPA) for delegation of authority and is implementing this regulation.

Regulations being promulgated to implement Title III-Hazardous Air Pollutants, and Title V-Permits, may also apply to PNL operations and require emission monitoring. Title III lists 189 hazardous air pollutants for which emissions are to be controlled by maximum achievable control technology (MACT) for major sources. The EPA is to develop MACT standards for a list of source categories according to a schedule. The source categories have already been established and PNL operations are unlikely to fall into any category. Title III lists research laboratories as a source category for which standards are to be established, but no schedule for action has been published. Title V requires an operating permit program to ensure compliance with the CAA and to enhance enforcement. A permit is required for major sources, and thus, one will be submitted for Hanford, including the PNL facilities on the Site. The permit will be issued by the Washington State Department of Ecology (Ecology), once its program is approved by EPA, and will incorporate all federal, state, and local regulations. The permit must include sufficient monitoring (measurements or record keeping) to ensure compliance with applicable regulations and permit conditions. The impact of this requirement on emission monitoring will be determined by the final permit conditions. The permit application will be submitted in May 1995, and Ecology will have up to 18 months to approve, or disapprove, the application.

3.2.2 NESHAPs

Under the original CAA, the EPA established emissions standards, monitoring and testing requirements, and reporting tasks for the sources of eight pollutants considered to be carcinogenic or mutagenic hazards. The substances covered by these standards, known as National Emissions Standards for Hazardous Air Pollutants (NESHAPs), are arsenic (inorganic), asbestos, beryllium, mercury, vinyl chloride, benzene, Radon-222, and radionuclides. As these standards apply only to specifically named sources, only those standards regulating radionuclides apply to PNL operations.

Under Subpart H of 40 CFR 61, "NESHAPs for Hazardous Air Pollutants for Radionuclide Emissions," the EPA has established emission standards, monitoring and testing requirements, and reporting tasks for sources known to emit radionuclides. As of October 1994, WDOH is awaiting delegation of authority from EPA to regulate emissions within the state of Washington.

3.2.3 The Washington State Clean Air Act (WCAA)

The WCAA empowers Ecology to develop, implement, and enforce state air regulations. State air regulations are contained in the Washington Administrative Code (WAC-173-400 series). WAC 173-400 "General Regulations for Air Pollution Sources," could impose monitoring and control requirements for new or modified sources. Also, WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," is applicable to NESHAP-regulated emission units and could also require the application of TBACT for new or modified sources of air toxics. WAC 173-401, "Operating Permit Regulation," when approved by the EPA as implementing CAAA Title V, may result in monitoring requirements as a permit condition, as discussed above. A related state regulation, WAC 246-247, "Regulation of Radioactive Air Emissions," requires monitoring radioactive emissions, incorporating the requirements of 40 CFR 61, Subpart H.

3.2.4 Clean Water Act

Section 313 of the Clean Water Act (PL 92-500, 33 USC 1251, *et seq.*) requires federal facilities to obtain a national pollutant discharge elimination system (NPDES) permit to ensure that all appropriate discharges into "navigable waters" are within applicable water quality standards and technology-based requirements (see Section 3.2.6). Currently, the Laboratory operates under two site-wide NPDES permits for its five outfalls in the 300 Area and one outfall in the 100 Area.

The 324 Building releases liquid effluent to 300 Area sewer and waste systems, operated by WHC. None of these systems are currently under an NPDES permit. However, future plans for the PS include treatment and discharge to the Columbia River for which an NPDES permit will be required.

3.2.5 WAC 173-220, "National Pollution Discharge Elimination System Permit Program"

WAC 173-220 implements authority delegated from the EPA to Ecology to issue NPDES permits under the Federal Water Pollution Control Act (FWPCA) amendments of 1972. Permits under this program are required for directly discharging pollutants, or other wastes or substances, from a point source into any navigable water of the state. The term "point source" includes any discrete conveyance, such as a ditch, pipe, well, container, or vessel from which pollutants may be discharged. "Pollutant" is defined broadly to include everything from sand to chemical, biological, and radioactive materials, as well as industrial, municipal, and agricultural waste. "Navigable waters" is defined very broadly to include all surface waters of the state. The term is not limited to waters that are actually navigable. "Navigable waters" does not, however, include groundwater.

Permits under this program include effluent limitations, schedules of compliance, monitoring requirements, reporting requirements (including a requirement to report any new or increased discharge of pollutants), and any conditions necessary to prevent or control pollutant discharges. Effluent limitations may be based on federal technology-based standards or on "any more stringent limitation" imposed by state law, including applicable water quality standards or methods necessary to provide all known, available, and reasonable technologies (AKART) that exceed the requirements of federal law. Section 510 of the FWPCA reserves the state's the ability to promulgate additional effluent or treatment standards so long as they are at least as stringent as the federal standards.

As stated in the previous section, future plans for the process streams from the 324 Facility and other 300 Area facilities include treatment and discharge to the Columbia River therefore, an NPDES permit will be required for these discharges.

3.3 DOE Orders

A number of DOE Orders establish the framework for environmental safety and health and environmental compliance by DOE and its contractor operations. These orders are, essentially, policy statements internal to DOE by which it commits operating contractors, such as PNL, to full compliance with all applicable federal, state, and local environmental standards. DOE Orders are essential components of PNL's environmental compliance program. The following are brief descriptions of major DOE Orders driving overall environmental compliance, including the development of FEMPs.

3.3.1 DOE 5400.1, "General Environmental Protection Program"

This order establishes environmental protection program requirements, authorities, and responsibilities for DOE operations to ensure compliance with all applicable federal, state, and local environmental protection laws and regulations, executive orders, and internal DOE policies. This order enumerates DOE's overall policy commitment to environmental compliance, as well as more specific commitments to a number of substantive objectives, including notification and reports for effluent releases, environmental protection program plans, and environmental monitoring requirements.

The development of FEMPs is driven by Chapter IV of this order, "Environmental Monitoring Requirements," which states:

"A written environmental monitoring plan shall be prepared for each site, facility, or process that uses, generates, releases, or manages significant pollutants or hazardous materials."

3.3.2 DOE 5400.5, "Radiation Protection of the Public and the Environment"

This DOE Order establishes standards and requirements for DOE and DOE contractor operations with respect to protecting the public and the environment against undue risk from radiation. Airborne emissions are limited to the extent required by the CAA and its amendments. Accordingly, the exposure of members of the public to radioactive materials released to the atmosphere as a consequence of routine DOE activities shall not cause members of the public to receive, in a year, an effective dose equivalent (EDE) greater than 10 mrem (0.1 mSv).

DOE makes further provision for emissions and exposure to Radon-220, Radon-222, their respective decay products. These guidelines extend beyond federal guidelines in 40 CFR 61 and state guidelines in WAC 173-480 that explicitly exclude doses caused by these radionuclides.

3.3.3 DOE EH-0173T, *Environmental Regulatory Guide for Radiological Monitoring and Environmental Surveillance*

This document is significant because it provides guidance for DOE Orders concerning environmental safety and health, and sets conditions for radiological emissions. DOE mandates that all airborne emissions be monitored and evaluated, and the potential for releasing radionuclides be assessed. Furthermore, any airborne emissions that have the potential for causing doses exceeding 0.1 mrem EDE from emissions in a year shall be monitored in accordance with requirements set forth in DOE 5400.1 and 5400.5.

3.4 PNL-MA-8, *Waste Management and Environmental Compliance*

This document is an internal PNL guide to regulatory compliance. It is intended to supplement, not replace, compliance with applicable regulations and DOE Orders. PNL-MA-8 sets forth procedures and requirements that must be met for air and liquid discharges in the 300 Area.

4.0 Effluent Stream Characterization

The airborne and liquid effluent streams leaving the 324 Facility are identified and discussed in this section. The discussion includes the types of contaminants expected to be present in effluent streams during routine (or normal) operations and process upsets.

During normal operations, the effluent streams from the 324 Facility can contain source terms from a variety of research and development activities. Shutdown operations produce a small subset of the normal operating source terms. In addition, upset conditions that are more than likely to occur must also be considered. These are situations that are nonroutine, but that would be expected to occur under normal operations. An upset could result in either an unusual source term that follows a normal effluent pathway, or a normal source term that follows an unusual pathway. Releases of contaminants to the environment from accidents (more improbable and severe events than upsets) are discussed in the 324 Facility Safety Analysis Report (SAR).

This section identifies those effluent streams that require sampling and/or monitoring and the nature of the contaminants to be monitored. The determination of the need to monitor is based on the facility inventory available for release under the conditions cited above, the pathways available for discharge of materials, and existing requirements for sampling. These have been previously discussed in Sections 2.0 and 3.0.

4.1 Identification of Effluent Pathways

The 324 Facility produces both liquid and gaseous effluent streams, all of which are generated in the building rather than being pass-through from other facilities. The effluent streams during normal and shutdown operations include three sewers and one main ventilation stack (minor vents and stub stacks also exist and are listed in Table 5.1). There is also an interbuilding pipeline between the 324 Facility and the 325 Facility, but this is currently inoperational, and there are no plans to revise its use.

The 3718G Building provides chemical storage for operations in the 324 Facility. No liquid and gaseous effluent streams are produced in this building under normal operations. Potential upset conditions for the 3718G Building operations are considered in Section 4.3.

4.1.1 Gaseous and Aerosol Effluent Pathways

Figures 4.1 through 4.4 provide a simplified summary of the 324 Facility exhaust system. Greater detail can be found in the schematics in Appendix E. These drawings were prepared and field verified in the summer of 1991, then verified again in 1994. They have been identified as "critical building drawings." Any facility modification that changes building flow paths must 1) receive prior concurrence of the manager of Waste Management and Environmental Compliance (WM&EC) (per PNL-MA-8, 1991 revision), and 2) update the appropriate drawing before project close-out.

R9103068.2

Figure 4.1. 324 Facility Ventilation Flow Diagram, Zones I and II

For Legend see Figure 4.12

R9103068.1

Figure 4.2. 324 Facility Ventilation Flow Diagram, Zones III and IV

Figure 4.3. RE Cell POG and VV System

R9103068.4

Figure 4.4. POG and VV System

R9103068.3

The 324 Facility ventilation system is divided into four zones. Confinement is also provided by conducting operations involving highly radioactive materials in hot cells. All potentially radioactively contaminated air flow passes through at least one stage of HEPA filtration before exiting the building through a single monitored and sampled stack. Air that does not have a potential for radioactive contamination may be exhausted out roof vents and be unfiltered.

The 3718G Building does not have an active forced-air ventilation system. The building does have two manually operated power roof exhausts, but these exhausts are only run periodically for temperature control. Gaseous and aerosol effluent may be released from the 3718G Building out the three doors (two walk-through doors and one large roll-up door) or through the two manual exhausts.

The following paragraphs provide descriptions of the supply air system, exhaust, process off-gas (POG), and vessel vent (VV) systems for the 324 Facility. Potential gaseous effluent pathways for the 3718G Building are also discussed. These descriptions are intended to support later descriptions (Section 4.3) of effluent release paths under normal and upset conditions.

Supply Air Systems

Supply air to almost all of the 324 Facility is provided by the process air supply system that consists of two fan units (with no standby) using 100% outside air. Some areas also have their own supply units, with varying amounts of recirculation (rooms 3C and 3D, EDL-101, HBEL, the support facilities addition, and the office and administrative areas).

Both sets of hot cells (Zone I) receive supply air from adjoining areas. The Radiochemical Engineering (RE) cells draw air primarily through 85% American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)-rated filters, but a minor amount of air is supplied unfiltered through cell penetrations. The SMF cells receive unfiltered air from the adjoining gallery.

Exhaust

During normal operation, the exhaust system provides the only effluent path followed by in-building releases. The system is divided into Zones I, II, III, and IV, which are separated by cascading pressure levels to maintain flow from areas of low potential contamination to areas with higher potential contamination. Of these zones, Zone I has the lowest pressure, and Zone IV the highest.

Zone I exhaust serves high-level radioactive areas and includes filtration of the exhaust air through at least two testable stages of HEPA filtration before discharge. The Zone I exhaust system has three fans, one of them on standby. The Zone I fans discharge to the atmosphere via the 46-m-tall stack.

Zone II exhaust serves potentially contaminated areas in which low-level radioactive materials are handled and includes filtration of all air through at least one testable stage of HEPA filtration. In addition, rooms 3E, 3F, and 3G have a separate exhaust system that can be considered Zone II. The Zone II system has two operating fans and no standby fan.

Zone III exhaust serves normally noncontaminated areas and includes filtration of all air through one testable stage of HEPA filters. The Zone III system has two operating fans and no standby fan. The Zone III fans discharge directly to the atmosphere through stub stacks that penetrate the roof. This zone does not serve areas containing radioactivity and monitoring of the stub stacks is not required.

The EDL-101 is served by a separate exhaust system that consists of one fan that exhausts the room through two testable stages of HEPA filtration to the atmosphere through a 12-m-tall stack located on the west side of the building. This system is not interlocked with any of the other building exhaust systems.

Zone IV exhaust serves areas that do not contain any radioactive materials. The air from Zone IV is either exhausted outdoors through various powered or gravity roof exhausters, or is recirculated, depending on the location.

A summary of the description of the zone designations is listed in Table 4.1.

Interlocks between the supply and exhaust fans are as follows: for normal operation, two exhaust fans in each of the three zones (Zone I, Zone II, and Zone III) and the two supply fans are operated. An additional Zone I fan is normally on standby and starts automatically if one of the two operating Zone I exhaust fans stop. Interlocks are in place that require both Zone I fans to operate before the second Zone II exhaust fan can be started, and one

Zone II fan to operate before one Zone III fan can be started. Two Zone II fans must be running to start the second Zone III fan. Both supply fans are electrically interlocked with the exhaust fans to require the sequenced starting of one of the exhaust fans in each of the three zones before a supply fan can be started. The second supply fan can be started only when two exhaust fans in each of the three zones are running. If any of the running exhaust fans stop, one supply fan stops. If two exhaust fans in one zone stop, both supply fans are stopped by open relay interlocks.

Table 4.1. Ventilation Zone Descriptions

Zone	Description	Areas
I	High-level radioactive	RE cells, SMF, high-level vault (HLV), low-level vault (LLV), storage vault and laboratory area (SVLA) (except Rooms 3-A and the Safeguard Vault), hoods and a glovebox in the manipulator shop, load out stall (LOS), and sample room
II	Potentially contaminated	low-level canyon, basement laboratories, Room 3A, Safeguard Vault, cell operating galleries, manipulator shop, and cask handling area
III	Normally non-contaminated	EDL-102, the second floor laboratories, portions of the basement (tank pit, Rooms 22, 22A, and 22B), a laboratory in Room 115, and the chemical make-up area on the third floor
IV	Areas that do not contain radioactive material	office areas, change rooms, HBEL, and the support facilities addition

As with the main exhaust system, the vent and off-gas systems are important as release pathways. Two POG/VV systems (Figures 4.3 and 4.4) are located in the 324 Facility. The first system serves the processes in the RE cells and the HLV and LLV tanks. The second system serves processes in the EDL-101, EDL-102, HBEL, and the Tank Pit.

The POG/VV system serving the RE cells and the HLV and LLV has two common exhaust fans and two stages of testable HEPA filtration. The fans discharge into the Zone I exhaust system downstream of the final stage of Zone I HEPA filters. Both fans are connected to standby power. The air streams typically undergo a process treatment (such as scrubbing, evaporating, or demisting) before the first stage of HEPA filtration.

The POG/VV system that serves EDL-101, EDL-102, HBEL, and the Tank Pit has two exhaust fans (with no standby) that discharge through the Zone II exhaust tunnel. Both fans are connected to normal power only. Depending on the process or equipment being served, the exhaust air from each system is process treated (such as scrubbing or demisting) and/or filtered upstream of the respective exhaust fan.

Other potential pathways for gaseous effluent releases are through the elevator shaft and open drain lines. The elevator shaft is on the north side of the 324 Facility and is surrounded and exhausted by Zone III areas. More than one failure would have to occur (loss of confinement of both Zones I and II) to cause a release of radioactive aerosol through this pathway. Chemical source terms during upset conditions in the EDL are also unlikely to be transported to and through the elevator shaft because the elevator is generally at a less negative pressure than EDL.

Drains in Zone I areas are part of the RLWS and have an associated negative pressure as long as the 340 vault is operating. All floor drains to the PS system have been closed off. Only sink drains remain. Drains are not considered a likely pathway for gaseous effluent releases.

Potential Gaseous Effluent Pathways from 3718G Building

As stated previously, the 3718G Building does not have an active forced-air ventilation system. Under normal operations, no gaseous effluent is released from the building. If a gaseous release occurred during upset conditions, airborne materials might be released through the two roof exhausts, if in operation, or out one of the three doors to the building. Chemicals in transit between the 3718G and 324 Buildings do not contribute gaseous effluents under normal operations. If an upset condition caused an airborne release, the release would be unfiltered and at ground level.

4.1.2 Liquid Effluent Pathways

Four liquid waste systems serve the 324 Facility: the SS system, the PS system, the RPS system, and the RLWS. Each of these systems are described in more detail in the following sections and shown schematically in sewer drawings in Section 2.0.

The 3718G Building does not produce any liquid effluents under normal operations and does not have any drains or liquid effluent systems. Chemicals in liquid form in the building are stored within a berm designed to contain potential spills.

Sanitary Sewer System

The 324 Facility SS serves only restrooms, lunchrooms, and change rooms. Under normal operating conditions, no hazardous chemicals or radionuclides are present in the SS effluent. No connections exist between the SS and any of the other liquid effluent systems.

Process Sewer System

The PS carries cooling water, process water, and other nonsanitary liquid wastes that do not contain radioactive or hazardous materials. In the 324 Facility, waste water from EDL-102, the chemical make-up area, HBEL, ventilation, and equipment in Room 317 are connected to the PS through sink drains only. All PS floor drains have been sealed.

Retention Process System

The RPS receives liquid waste that is normally free of radioactive contamination, but has some potential for such contamination (i.e., equipment cooling water, laboratory waste liquids, and floor drain liquids). The RPS is routed through piping to a diverter station that provides automatic diversion of flow to the RLWS in the event that radioactive contamination is detected. Flow is automatically diverted if radioactivity in the waste exceeds a preset level of $5 \times 10^{-5} \mu\text{Ci/mL}$ of ^{137}Cs -equivalent activity. If diversion does not occur, the 324 Facility liquid wastes are discharged to the 307 basin where a redundant check/screen for radioactivity is performed. If it passes the screening, the effluent is discharged to the 307 basin where a redundant check/screen for radioactivity is performed. If it passes the screening, the effluent is discharged to the 300 Area PS; if diverted, the liquid goes to the 300 Area RLWS.

Radioactive Liquid Waste System

The RLWS within the 324 Facility is a system of piping that discharges into holding tanks in the building. These holding tanks have the capacity of jetting or pumping their contents to other tanks in the building or to the 300 Area Waste Management Facility (340 Building), operated by WHC, under contract with DOE. Transfer is accomplished by jetting the waste via the 300 Area RLWS line, a double containment system with leak detection.

The RLWS holding tanks serve the B-Cell, the LOS, cubicle drains, the Room 18 diverter system pressure relief, tanks in the LLV, the LLV sump, the Room 4 sump, the Room 147 glovebox and hood sink drain, Room 146 hood sink drains and safety shower drains, the truck lock sump, the personnel decontamination sink and shower drains, sink drains from room 3F, and Tank 177, located in the wall of the fissile materials storage vault. (Presently, the drains in Room 3F and into Tank 177 are valved off and locked and tagged out of service.) Tanks containing high levels of radioactivity are in the HLV which provides appropriate shielding for the solutions.

4.2 Building Inventories

The building inventories of radionuclides and toxic chemicals are important to effluent characterization because of their potential for release. This section provides information on the types and forms of chemicals and radionuclides in the building under current operations.

4.2.1 Radionuclides

Radionuclides are used and stored only within Zone I areas of the 324 Facility. The other zones and the 3718G Building do not contain any radioactive materials, and radionuclides are transported through the other zones only in double or triple containment. Appendix B lists the amounts and forms of radionuclides in the building for current and near-future operations.

Much of the inventory is in a form that is not readily dispersed. A large amount of ^{137}Cs and ^{90}Sr has been vitrified and is present in the form of glass contained in specially designed canisters. A large quantity of ^{137}Cs is in the form of a rock salt in capsules that are essentially sealed sources. The majority of the fission products listed in Appendix B are contained in intact fuel rods stored in the hot cells.

Radionuclides that may contribute to the source term from the building under normal or upset conditions would be those in the form of gas or vapor (^3H for the tritium project in SMF), powder (^{137}Cs for the cesium encapsulation project in the SMF and dispersible holdup in B-Cell), and liquid (^{137}Cs , ^{90}Sr in tanks in B-Cell and the HLV). Fuel rods and cesium capsules that undergo destructive examination can also contribute to the source term from dust generated during the cutting process or gases, vapors, or crushed solid released after containment has been cut open. Holdup other than the dispersible dust in B-Cell is not considered likely to be released by normal or upset operating conditions.

4.2.2 Hazardous Chemicals

Over 200 different chemicals are used in the 324 and 3718G Buildings. Chemicals are tracked using the PNL Chemical Inventory System. Appendix C provides more information on chemicals.

4.3 Characterization of Source Terms Contributing to Effluent Streams

The characteristics of source terms that could contribute to each effluent stream during normal operating, shutdown, and upset conditions are described in this section. Source terms potentially released to gaseous effluent streams are discussed first, followed by source terms released to liquid effluent streams.

4.3.1 Gaseous and Aerosol Source Terms

Unconfined contact with ventilation air is the only prerequisite for an inventory to contribute a gas or aerosol source term to the gaseous effluent stream. Thus, all "passive" inventories stored in open containers, as well as those undergoing "active" processes such as cutting, pouring, and mixing, can produce gas or aerosol source terms. The following sections discuss potential source terms under normal, shutdown, and upset conditions.

Normal Operations

Under normal operating conditions, all releases of radioactive materials would occur in the Zone I ventilation system, undergo at least two stages of HEPA filtration, and be sampled and monitored for total alpha, total beta, and tritium. The Zone I activities that may cause source term generation of radioactive materials, their location, and the type of source term that may contribute to the gaseous effluent stream are listed in Table 4.2. Only the activities that have taken place in the last year, or are expected to take place in the near future, are included.

The radionuclide releases from normal operating processes can be roughly estimated based on current methods for release calculation (Ayer et al. 1988). Judging by this information, it seems likely that the fraction of the building inventory

Table 4.2. Activities Contributing Radioactive Source Terms Under Normal Conditions

Location	Activities	Source Term
<u>Zone I</u>		
RE cells	Transfer of materials into/out of cells	none
	Storage of fuel rods and segments	none
	Nondestructive examination of fuel rods	none
	Sampling of fuel rod fission gases	none
	Rod sectioning	mixed fission product (MFP) fine dust
	Storage of waste glasses	none
	Cell cleanup activities	^{137}Cs , ^{90}Sr dust
	Cutting, packaging	metal fines
	Resuspension of holdup	^{137}Cs , ^{90}Sr dust
	Storage of other radionuclides (Co source, Cs capsules)	none
	Transfer of materials into/out of cells	none
	Storage of Cs capsules	none
	Tritium rod examination gas sampling	^3H gas
	rod sectioning	^3H in metal fines
SMF cells	Cs capsule sectioning	^{137}Cs fine dust
	Cs encapsulation activities	^{137}Cs fine dust
	MOTA activities	ethanol vapors
	Transfer of fissile materials into/out of SVLA	slight potential for radioactive aerosol
	Storage of fissile materials	none
	Sparging of HL radioactive liquids	off-gases
SVLA	Transfer of fissile materials into/out of SVLA	slight potential for radioactive aerosol
	Storage of fissile materials	none
Storage vaults	Sparging of HL radioactive liquids	off-gases
Manipulator shop hood and glovebox	Decontamination and repair	potential for minor
	LL solid waste compaction	qty of LL aerosol
Loadout stall	Transfer of radioactive solutions	none
<u>Zone II</u>		
Basement labs 3E, 3F, and 3G	Currently inactive	none
	Storage of tanks of radioactive liquids	none
Storage vault	Storage of tanks of radioactive liquids	none
Cask handling area	Transfers in/out	none
Manipulator shop	Houses hood and glovebox for manipulator repair	none
Low-level canyon	Currently inactive	none

that is made airborne **within** the building during a year of normal operations is less than the annual release fraction that was assumed in Appendix B calculations for FEMP determination purposes. The Appendix B source term fractions--1.0 for gases and volatiles, 0.001 for nonvolatile powders and liquids, and 1×10^{-6} for solids and sealed sources--are therefore **upper** limits on the estimated annual release fraction **within** the building. The actual in-building source term estimates are easily a factor of 100 lower.

The radionuclide releases from the 324 Facility during normal operations depend on the in-building source term, the effectiveness of effluent filtration, and the amount of inventory that undergoes normal operations during the year. As indicated by Table 4.2, the source term from normal operations is expected to be primarily ^{137}Cs and ^{90}Sr particles, with some potential for ^3H releases during tritium rod examination and minor quantities of fission product dusts. These materials would be exhausted through the main facility stack which is monitored.

The Zone II ventilation system covers areas that are normally uncontaminated, but have a potential for contamination. Zone II includes the operating galleries surrounding the hot cells, the cask handling area, manipulator shop (except for the hood and glovebox), the low-level canyon, the storage vault (except for tank of off gases), and some of the basement laboratories. Activities in these areas are listed in Table 4.2.

The source term generation of hazardous chemicals from these activities is minor. Oils, solvents, and cleaning solutions are used in the hot cells to support manipulator repair and decontamination. Also, the Materials Open Test Assembly (MOTA) operation uses ethanol. Small amounts of these chemicals may become vaporized and released out the stack.

Chemicals are used more extensively in the EDL and HBEL, in Zones III and IV. Activities in these areas include nonradioactive pilot-scale testing of systems related to waste immobilization (i.e., high-level vitrification and ceramic melter). A number of different chemicals in large quantities may be used and comprise primarily inorganic salts, oxides, hydroxides, and heavy metals. The major chemical process in the 324 Facility is the HWVP process. Appendix C discusses hazardous chemicals in more detail.

Large quantities of chemicals are stored in the 3718G Building. Under normal operating conditions, these chemicals are confined to storage containers and no source term generation occurs either in the building or while in transit to the 324 Facility.

Shutdown Conditions

Most activities involving radioactive or hazardous materials would be suspended under shutdown conditions, and most radioactive materials and hazardous chemicals would be stored in closed containers. However, sparging tanks of high-level liquid waste would continue, providing a gaseous source term to the Zone I ventilation system. In addition, radioactive holdup would not be contained and could also be expected to contribute small quantities of resuspended radioactive material to the gaseous effluent stream in shutdown conditions. The airborne source term for shutdown conditions would be less than that for normal operations and would be monitored and sampled before release from the stack.

Upset conditions as considered in this document are those that are more than likely to occur. These events may either cause an unusual source term that follows a normal effluent pathway (source term upset), or a normal source term that follows an unusual pathway (flow path upset). Both of these types of upset conditions are discussed in this section.

Flow-Path Upsets. Flow-path upsets occur when normal source terms follow unintended paths to be released at unmonitored and/or unfiltered effluent exit points.

Flow-path upsets involving radioactive material could only occur because of upsets in the Zone I or Zone II ventilation systems. An Operational Safety Requirement (OSR) on the exhaust fans and safety interlocks between the supply and exhaust fans help to ensure that air flow travels the intended path. An OSR on HEPA filtration assures that the Zone I flow path goes through a minimum of two stages of HEPA filters and that the Zone II flow path goes through at least one stage of HEPA filters. Because of these OSRs and the importance of the ventilation system both to workers in the building and potential offsite releases, flow path upsets involving radioactive material are not likely to occur.

Flow-path upsets involving hazardous chemicals could result in normal releases escaping the building through unmonitored pathways. If components of the POG/VV system for the waste treatment studies in the EDL failed, the off gases would pass through one stage of HEPA filtration and be released from the building through unmonitored stub stacks. If such an upset occurred in the HBEL, the off gas would not be filtered as it exited the building through roof exhausters or became entrained in the air recirculation system. Evaluations are performed on a project-specific basis for activities that have the potential to release hazardous quantities of chemicals to the air. Controls (including monitoring) are identified and implemented from these project-specific evaluations.

Source-Term Upsets. Source-term upsets occur when an upset creates an unusually large source term, which then follows normal release paths (and so undergoes the normal amount of filtration).

Source-term upsets involving radioactive material could only occur in areas covered by the Zone I ventilation system. Although radioactive materials are transported through other zones and outdoors, the integrity of the shipping containers and controls used on packaging are such that radioactive material released in transit is not a credible upset condition. Source-term upsets include events such as spills, drops, small fires, equipment failures, and higher-than-expected levels of contamination on incoming shipments. Because the source-term upsets follow the normal ventilation path, they pass through at least two stages of HEPA filters and are exhausted from the main stack.

Source-term upsets involving hazardous chemicals could occur in EDL, the HBEL, or the 3718G Building. As for the radioactive source-term upsets, only the inventory in one container or location would be considered more than likely to occur. The EDL and associated laboratories are in the Zone III ventilation system, which uses one stage of HEPA filtration. The HBEL is in the Zone IV ventilation system and, thus, is not filtered. The 3718G Building is not filtered, either. As for flow-path upsets, the potential for source-term upsets involving hazardous chemicals is evaluated on a project-specific basis for those projects

with the potential to release large quantities of hazardous chemicals. Controls and monitoring are implemented based on the identified needs.

4.3.2 Liquid Source Terms

On exit from the 324 Facility, control and monitoring responsibility for each of the three liquid waste systems passes from PNL to WHC. Because the streams are under WHC control at the point of discharge to the environment, sampling to demonstrate compliance with regulations is performed by WHC. Although PNL does not have responsibility for compliance sampling of these 300 Area streams, PNL does have the responsibility for maintaining control and accountability for operational discharges from its facilities. Therefore, this section identifies the characteristics of the liquid effluent for each pathway, and notes the streams that should be sampled or monitored for characterization purposes. At the present time, PNL is not routinely sampling 324 Facility liquid effluent streams, but samplers are being installed to support the characterization of the effluent for FEMP purposes (rather than to define it for regulatory purposes).

Source terms to the liquid effluent pathways are those entering the SS, PS, or RPS systems. The RLWS sends effluents via casks and piping to other containment outside the building and does not release to the environment under normal conditions. The casks and double-containment piping are designed so that upset conditions would not cause an environmental release. The RLWS is ultimately directed to a downstream waste handling facility (the 340 Building) rather than to an environmental release point. Only the SS, PS, and RPS systems are discussed in this section.

Normal Operations

Under normal operations, the SS only receives effluent from the restrooms, lunchrooms, and change rooms. No radioactive or hazardous chemical source terms are normally released through this pathway. The PS, which serves EDL, HBEL, and some laboratory areas, also does not have a potential for containing radioactive material. Under normal operations, administrative controls require that hazardous chemicals used in the laboratory and rinse water from washing laboratory equipment are sent to chemical waste. Thus, hazardous chemicals are not released to the PS system under normal operations.

The RPS serves areas of potential contamination. However, the effluent from the RPS is normally free of radioactive contamination and hazardous chemicals. Liquid effluent from this system is monitored for gamma radioactivity before the effluent exits the 324 Facility.

Although monitoring the liquid effluent streams is not required, samplers are being installed on the PS and RPS streams from the 324 Facility to help characterize the effluents from the building.

The 3718G Building does not have any liquid effluent system and does not normally generate any liquid effluent.

Shutdown Conditions

That any liquid effluent source terms would occur during a building shut down is not likely. The activities that normally cause releases would be suspended during shut down. Only those maintenance activities that do not use radionuclides or any of the toxic chemicals of interest would continue.

Upset Conditions

Because of the separation between the SS and the building chemical and radioactive source terms, no upset would occur in which normal chemical or radioactive source terms can escape by using the SS as an abnormal flow path. For

the PS and RPS systems, an accidental spill of hazardous chemicals would be the only upset that might lead to a chemical release.

No flow path upsets could occur (e.g., failures of the diverter monitor or diversion valve) that would be adequate to cause a release of radioactivity to the PS from the RPS, because a radioactive source term is not normally present. However, because the RPS serves areas of potential radioactive contamination, a release of radioactive material could occur from spills or contamination of process water entering these systems. Such a release to the RPS could only be passed to the PS if the concentration of radionuclides were below the diversion set-point of 5×10^{-5} $\mu\text{Ci/ml}$ of ^{137}Cs or its gamma equivalent. If the radionuclides in the spill were alpha or beta emitters, or gamma emitters with concentrations higher than the value cited above for ^{137}Cs , the stream will pass through to the PS without diversion as a result of the source-term upset.

The only liquid (or soluble) radionuclide inventories are in the hot cells, LOS, and other areas that are served only by the RLWS. Therefore, radioactive spills should not be sources of releases to the RPS or PS systems. However, the RPS provides cooling water to several systems that contain liquid or soluble radioactive material, for example, the HLV storage tanks. This stream is monitored and can be diverted (as described above) so that it can enter the RLWS system if upset releases radioactive materials to the RPS.

The potential hazardous chemical source term from flow-path upsets would be a fraction of the chemical or slurry involved. A maximum upset condition would occur from a spill or dump of the largest single container of one of these chemicals into the PS or RPS. The concentration of toxic chemical would depend on the location and the rate at which the chemical was released to the liquid effluent stream. Because of the administrative and engineered controls on the liquid effluent systems, the probability is low that an upset in the 324 Facility would cause a liquid effluent release to these systems. However, a liquid effluent sampling system is to be installed in the 324 PS system to help characterize the stream.

The 3718G Building does not have a liquid effluent system. Spills of toxic chemicals in the building would be contained in a berm specifically designed for that purpose.

4.4 Conclusions

Under normal operations, radioactive airborne source terms are generated in Zone I areas of the 324 Facility and are monitored before their release from the stack. Any radioactive aerosol generated under upset conditions is also carried through the final HEPA filters and monitored before release at the main stack. Particles released from the building under normal operations are expected to be ^{137}Cs , ^{90}Sr , and fission product particles with some potential to release ^3H during activities with tritium.

Activities that use large quantities of chemicals in the 324 Facility are designed with project-specific off-gas cleanup systems. Under normal conditions, these activities include cleanup and analysis of gaseous effluents before release from the building. However, upset conditions during these activities or while transferring chemicals to the process (usually from the 3718G Building), could result in unmonitored gaseous releases of chemicals to the environment. Projects in which hazardous chemical releases could occur are evaluated on a case-by-case basis and specific monitoring installed when necessary.

The only liquid effluent system that is released to the 300 Area PS system and has a potential for containing radionuclides under normal or upset conditions is the RPS. This system includes monitoring for gamma radioactivity before the effluent is released to the 300 Area PS.

Under normal conditions, no hazardous chemicals are released to the SS, PS, and RPS liquid effluent systems. Upset conditions could occur that would result in chemical releases to the sewer systems. This stream is released to the 300 Area PS system operated by WHC. A sampling system is being installed on the 324 PS to characterize this stream.

The 3718G Building is used for chemical storage for the 324 Facility. No radioactive effluent, either gaseous or liquid, is released from this building under normal or upset conditions. No liquid chemical effluents are released under normal operating conditions; spills resulting from upsets would be contained with a berm within which all liquids are stored. Upset conditions could result in airborne chemical releases through the doors and vents of the building, but the resulting acute concentrations are too small to warrant monitoring or sampling.

4.5 References

40 CFR 61. 1990. *Subpart H--National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities*. 7-1-90 Edition. U.S. Environmental Protection Agency, Washington, D.C.

ACGIH. 1990. *1990-1991 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*. American Conference of Government Industrial Hygienists, Cincinnati, Ohio.

Ayer, J. E., A. T. Clark, P. Loysen, M. Y. Ballinger, J. Mishima, P. C. Owczarski, W. S. Gregory, and B. D. Nichols. 1988. *Nuclear Fuel Facility Accident Analysis Handbook*. NUREG-1320, U.S. Nuclear Regulatory Commission, Washington, D.C.

NIOSH. 1990. *NIOSH Pocket Guide to Chemical Hazards*. National Institute for Occupational Safety and Health, Washington, D.C.

WHC. 1985. *Safety Analysis Report for 324 Building*. HEDL-TC-1008, Westinghouse Hanford Company, Richland, Washington.

5.0 Effluent Point-of-Discharge Description

Points of liquid and airborne effluent discharge from the 324 Facility are described in this section.

The term "point of discharge," as used in this chapter, refers to the point at which the effluent leaves PNL control. For airborne emissions, the discharge point coincides with the point of effluent entry into the uncontrolled environment. Thus, "discharges" of airborne emissions must comply with DOE, EPA, and DOH emission control and monitoring requirements. Alternatively, liquid effluents originating in the 324 Facility remain in a controlled system at the "point of discharge," but the responsibility for the effluent stream, including its ultimate disposition, passes from PNL to the site operations contractor, WHC. As such, WHC has the responsibility for monitoring and controlling environmental discharges of liquid effluents.

WHC has established a separate facility effluent monitoring plan to cover 300 Area liquid effluent discharge monitoring and control systems. Although PNL does not control the discharge of liquid effluent from 300 Area facilities, PNL does have responsibility for characterizing effluents originating in its facilities and for exercising appropriate control over these effluent sources.

This section provides information on the final "point of discharge" of liquid and airborne effluents originating in the 324 Facility. Previous sections in this plan provide characterization data on facility radionuclide and chemical inventories (Section 2.0) and describe the various effluent pathways from the point of origin to the discharge point (Section 4.0). Sections 6.0 and 7.0 provide detailed descriptions of the sampling and monitoring systems for these discharge points.

5.1 Airborne Emission Exhaust Points

Airborne emissions from the 324 Facility are primarily via stacks and vents, although in some upset situations, as discussed in Section 4.0, minor out-leakage is possible via doorways and building leaks.

5.1.1 Numbered Exhaust Points

Numbered exhaust points include all point-source discharge locations except for sanitary and process sewer vents. These exhaust points are listed in Table 5.1 and their locations are shown in Figure 5.1 on a plan view of the 324 Facility. Each exhaust point is identified by a unique "EP" number in the table and on the figure. The EP numbers also correspond to exhaust points identified on the 324 Facility exhaust flow diagrams in Section 4.0. Thus, with the information provided in this plan, it is possible to start with an identified exhaust point and determine the origins within the facility of emissions at this point.

Emission sampling and monitoring are performed at the main facility stack, shown as exhaust sample point (ESP)-324-01-S in Figure 5.1. This monitoring location is also shown on the building exhaust flow diagram in Section 4.0. A detailed description of this sampling/monitoring system is provided in Section 7.0.

Where the exhaust system is powered by fans or blowers, nominal exhaust flow rates are given in Table 5.1. Before 1994, the exhaust flow rate at this point was measured using the Associated Air Balance Council (AABC) national standards

Table 5.1. 324 Facility Ventilation Exhaust Points

<u>Point Number^(a)</u>	<u>Placement^(b)</u>	<u>Outlet Dimensions</u>	<u>Volumetric Flow Rate, cfm^(c)</u>	<u>Principal Contributing Locations^(d)</u>	<u>Sampled^(e)</u>	<u>Additional Comments</u>
EP-324-01-S	Separate (159 ft AGL)	8-ft. dia	73,000	Zone I & II, EDL	Yes	See Note #1
EP-324-02-V	Roof	36 in. x 36 in.	17,400	Zone III		See Note #2
EP-324-03-V	Roof	36 in. x 36 in.	17,400	Zone III		See Note #2
EP-324-04-V	Roof	2-ft. dia	Natural draft	Rm. 309A		
EP-324-05-S	Roof	1-ft. dia	506	Rm. 309A fume hood		See Note #3
EP-324-06-S	Separate	1-ft. dia	Design: 5250	Rm. EDL-101		See Note #4
EP-324-07-V	Roof	2-ft. dia	Natural draft	EDL-101 room air		
EP-324-08-V	Roof	2-ft. dia	Natural draft	EDL-101 room air		
EP-324-09-V	Roof	1-ft. dia	Pressure relief	PSCM in EDL-102		See Note #5
EP-324-10-V	Roof	1-ft. dia	Pressure relief	LFCM in EDL-102		See Note #6
EP-324-11-V	Wall	36 in. x 36 in.	Natural draft	High-bay room air		
EP-324-12-S	Wall	14-in. dia	Unknown	Walk-in hood in high-bay		
EP-324-13-V	Wall	6-in. dia	Vessel vent	Process tank vent		See Note #7
EP-324-14-V	Wall	6-in. dia	Pressure relief	Pressure relief - high-temp. melter		See Note #8
EP-324-15-V	Wall	24 in. x 24 in.	Unknown	High-bay room air		
EP-324-16-V	Roof	4-ft. dia	Natural draft	Stairwell #6.		
EP-324-17-V	Roof	4-ft. dia	Design: 4000	Office areas		
EP-324-18-V	Roof	4-ft. dia	Design: 4000	Office areas		
EP-324-19-V	Roof	4-ft. dia	Natural draft	Corridor 30/31		
EP-324-20-V	Roof	4-ft. dia	Natural draft	Corridor 30/31		
EP-324-21-V	Roof	2-in. dia	Vessel vent	Tanks in Rms. 306, 309		
EP-324-22-V	Roof	48 in. x 48 in.	Unknown	Stairwell 2		

Table 5.1. (contd)

<u>Point Number^(a)</u>	<u>Placement^(b)</u>	<u>Outlet Dimensions</u>	<u>Volumetric Flow Rate, cfm^(c)</u>	<u>Principal Contributing Locations^(d)</u>	<u>Sampled^(e)</u>	<u>Additional Comments</u>
EP-324-23-V	Roof	48 in. x 48 in.	Natural draft	Mechanical rm.		
EP-324-24-V	Roof	48 in. x 48 in.	Natural draft	Mechanical rm.		
EP-325-25-V	Roof	6-in. dia	Design: 2000	Bldg. sample vacuum		See Note #9
EP-324-26-V	Roof	12 in. x 12 in.	Design: 1500	Office addition		
EP-324-27-V	Roof	1-ft. dia	Design: 1500	Crafts Shop		
EP-324-28-V	Roof	1-ft. dia	Design: 1500	Crafts Shop		
EP-324-29-V	Roof	6-in. dia	Design: 500	Welding Booth		

- (a) The last character in the 'EP' number identifies the exhaust point as a stack or vent. A stack is defined as a vertical structure extending at least 2.5 equivalent diameters beyond a flow disturbance.
- (b) Placement refers to how the exhaust structure is placed on the building. A structure penetrates the roof, a wall, or is separate from the main building. If the outlet is significantly above the building roof, the height above ground level (AGL) is given.
- (c) Based on most recent volumetric flow rate determination.
- (d) Detailed information on locations exhausted is provided on ventilation flow diagrams in Appendix A.
- (e) Sampler design and placement details are provided in Section 7.0.
- Note #1. 53,000 cfm can be maintained on emergency power. Temperature range is 60 to 80°F.
- Note #2. EP-324-02-V and EP-324-03-V are identical structures located side-by-side, and both exhaust the same facility locations.
- Note #3. Considered a Zone III exhaust.
- Note #4. Used rarely and only during lithium transfers.
- Note #5. Pressure relief from process ceramic melter.
- Note #6. Pressure relief from liquid fed ceramic melter.
- Note #7. Process vents only during filling of tank in the highbay (nonradioactive work only).
- Note #8. Temperature could exceed 100°F.
- Note #9. Being rerouted to filtered exhaust point.

ROOF PLAN
SCALE: NONE

Stom, Sea, Sewer, and
Process Sump Tanks
are not shown.

STACK VENT	
	POWERED EXHAUST
	GRAVITY EXHAUST
	NOT IN SERVICE

EMISSION SAMPLE POINT

INTAKE POINT

Figure 5.1. Building Exhaust Points

(AABC 1982). Since 1994, exhaust gas velocities and volumetric flow rates have been measured using the EPA Method 2 (40 CFR 60) velocity traverse procedure at the sampling location. The use of quarterly measurements was also implemented in 1994.

Results of annual volumetric flow rate measurements for the 324 main exhaust stack over the past thirteen years, made using AABC procedures, are shown in Table 5.2.

5.1.2 Other Potential Exhaust Points

Sanitary and process sewer vents constitute a pathway for exhaust to the environment; however, the systems do not contain radioactive contamination, and flow rates are cyclical as liquids pass through the piping.

The main ventilation air supply units for ventilation Zones I, II, III, and most of Zone IV (Section 2.0) have backdraft dampers and do not constitute a viable exhaust point from the facility. Small supply units for EDL-101 do not have backdraft dampers.

With the exception of the truck lock, the manipulator shop, and a dirty laundry storage area near the back dock, NO potentially radioactively contaminated areas have outside access doors. These areas are maintained at a lower pressure than the outside air, so flow is into these areas when an access door is open.

Table 5.2. Volumetric Flow Rate Measurements for 324 Main Exhaust

<u>Year Measurement Performed</u>	<u>Volumetric Flow Rate, cfm^(a)</u>
1981	87,000
1982	87,000
1983	94,000
1984	87,000
1985	87,000
1986	94,000
1987	95,000
1988	110,000
1989	100,000
1990	110,000
1991	87,000
1992	93,000 ^(b)
1993	73,000 ^(b)

(a) Measured flow rate rounded to two significant figures.

(b) Average of 12 monthly measurements.

NOTE: Flow measurements.

5.2 Liquid Effluent Discharge Points

Liquids effluents are discharged from the 324 Facility via the SS, the PS, and the RLWS (see descriptions in Section 2.0). These systems come under WHC control either just before or just after their exit from the building. Table 5.3 summarizes the characteristics of these systems, and Figures 2.4 and 2.5 show the general layout of liquid effluent systems in the 300 Area.

Within the 324 Facility, the PS line branches into two contributing systems: the PS and the RPS. The RPS line drains processes and locations normally not contaminated, but would have a potential for contamination in the event of a failure of an engineered barrier or administrative procedure. Under normal operating conditions, the RPS connects to the PS. As part of their liquid effluent control responsibility, WHC maintains a gamma-radiation monitor on the RPS line. If this monitor detects radiation in the RPS above its alarm point, a control valve is actuated that reroutes the RPS to the RLWS. The diverter station is operated and maintained by WHC.

These systems are currently not being sampled (characterized) by PNL, although efforts are under way to install samplers in the PS and RPS lines exiting the building (see Section 14.0).

Rainwater from the building roof and runoff from the loading dock drain to the soil at various locations around the building. No radioactive or chemical contamination is present on external building surfaces.

5.3 Reference

Associated Air Balance Council. 1982. *National Standards for Total System Balance*. AABC 1133 15th St. N.W., Washington D.C.

Table 5.3. Liquid Effluent Discharge Lines

<u>Liquid Discharge System</u>	<u>Pipe Size</u>	<u>Building Exit Point</u>
Sanitary sewer	6-in. dia	East service tunnel
Main process sewer	8-in. dia	East service tunnel
HBEL process sewer (2)	4-in. dia	West side of building, SW corner
RLWS (2)	4-in. dia	West side of high bay NE corner

6.0 Effluent Monitoring/Sampling System Requirements and Criteria

This section discusses design criteria for the 324 Facility airborne emissions measurement program.^(a) Criteria are established to ensure that effluent measurements are performed according to applicable regulations and guidance and are appropriate for existing facility operations.

In this section, the terms "sampling" and "monitoring" are used to distinguish between two types of airborne emissions measurement processes:

"Sampling" refers to collecting a representative portion of the emission over a period of time, with subsequent analysis for constituents of interest.

"Sampling" is an "after-the-fact" measurement.

"Monitoring", on the other hand, is measuring radionuclide emission rates by means of a detector located in the sample stream. "Monitoring" is a "real-time" measurement.

Airborne emission sampling is performed to demonstrate compliance with emission standards, to identify emission trends, and to provide evidence regarding the effectiveness of emission control systems (procedures and equipment). Emission monitoring is performed as a means to provide timely indication of a significant change in emission rate.

Section 7.0 describes design and operation of the airborne emission sampling/monitoring system at the 324 Facility with specific reference to the criteria discussed in this section.

6.1 Basis for Design Criteria

Effluent sampling and monitoring system design and operation criteria are based on the following regulations and guidance:

40 CFR 60. Environmental Protection Agency, "Regulations on Standards of Performance for New Stationary Sources, Appendix A: Reference Methods." U.S. Code of Federal Regulations.

40 CFR 61. 1990. "National Emission Standards for Hazardous Air Pollutants." U.S. Code of Federal Regulations.

American National Standards Institute (ANSI). 1980. "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities." ANSI N13.1 - 1980.

American National Standards Institute (ANSI). 1980. "Specifications and Performance of Onsite Instrumentation for Continuously Monitoring Radioactivity in Effluents." ANSI N42.18 1980b.

(a) Effluent streams from the 324 Facility are sent to one of the 300 Area liquid effluent systems (operated by WHC. However, a sampling/monitoring program is planned with data collection beginning in late 1994 to early 1995.). Thus, the 324 Facility does not have a liquid discharge directly to the environment.

U.S. Department of Energy. 1988. "General Environmental Protection Program." DOE 5400.1.

U.S. Department of Energy. 1990. "Radiation Protection of the Public and the Environment." DOE 5400.5.

U.S. Department of Energy. 1987. "General Design Criteria." DOE 6430.1A.

U.S. Department of Energy. 1991. *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*. DOE/EH-0173T. (Regulatory Guide)

Washington Department of Health. 1994. Radiation Protection - Air Emissions. Chapter 246-247 Washington Administrative Code.

Additional requirements for sampling/monitoring at the 324 Facility are prescribed in PNL operational and programmatic documents. These are:

Harmon, V.A., and B.G. Faulk. 1985. *Safety Analysis Report for the 324 Building*. HEDL-TC-1008, Hanford Engineering Development Laboratory, Richland, Washington.

6.2 Criteria for Airborne Radionuclide Emission Sampling

Airborne radionuclide emission points at PNL are classified as either "major" or "minor". These two categories are defined as follows.

Major emission points are those where radionuclide emissions could cause an offsite emission dose^(a) (OED) of 0.1 mrem, if emission controls were not applied. Sampling of major emission points is performed according to requirements in 40 CFR 61 Subpart H.

Minor emission points are those that potentially could release radionuclides, but not at the levels of a "major" point.

6.2.1 Sampling System Performance

Sampling at each major emission point shall be capable of detecting an annual radionuclide release quantity resulting in an offsite emission dose (OED) of 0.1 mrem.

(a) The annual offsite emission dose (OED) calculated here is the maximum committed effective dose equivalent that could be expected to be received by an offsite individual from facility airborne radionuclide emissions if the facility was operated without any HEPA filtration or other emission controls. The method for calculating the OED, as described in PNL-MA-8, consists of identifying the radionuclide inventory potentially available for release, multiplying this by a fractional release value, and multiplying this product times an emission dose factor calculated by the EPA Clean Air Act compliance code CAP-88. PNL-10061 provides additional discussion of this assessment method.

All radionuclides anticipated to contribute greater than 10% of the emission dose from the sampled emission point shall be accounted for, either by direct analysis or by inference from an indicator measurement.

Biases in emission measurements, arising from the sample collection and analysis process, shall be minimized through the judicious application of design and operation practices according to American National Standards Institute (ANSI) N13.1 and DOE/EH-0173T.

6.2.2 Sampling System Design Criteria

Samplers shall be located according to criteria in EPA Method 1 in Appendix A of 40 CFR 60. Method 1 states that

"Sampling or velocity measurement are to be performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame." However, the method also states that, "if necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and 0.5 diameters upstream from any flow disturbance".

Representative samples shall be withdrawn on a continuous basis at the sampling site following the guidance in ANSI N13.1, Appendix A, Section A3.2, which recommends a minimum of six extraction points for the 324 Facility stack (ESP-324-01-S). Furthermore, ANSI N13.1 recommends that each withdrawal point within a cylindrical stack be centered in an annular area of size equal to the cross sectional area divided by the number of extraction points. Withdrawal points may be on a single traverse or spaced to obtain samples from the total cross section. Additional design criteria for particulate and gaseous radionuclides are specified by ANSI N13.1 and DOE/EH-0173T.

6.2.3 Sampling System Operation

Sampling system operating criteria are based on regulations and guidance documents listed in 6.1.

Sampling shall be performed to quantify emissions over a calendar year period. Sample collection frequency shall be based on the need for unbiased samples while maximizing sensitivity and minimizing analytical costs. The period of sample collection, thus, should be as long as possible considering the half-life of the radionuclide, the capacity of the collection media, and the need for timely return of sampling data.

Because quarterly reports of facility emission trends are required by DOE (per Hanford RadCon Manual), the maximum sampling period should be three months. Where sample collection media with limited capacity are used (e.g., silica gel for water vapor collection, glass-fiber filter for particulate collection) sampling periods need to be reduced accordingly. Also, for sampling of short half-life radionuclides, the duration of the collection period should not exceed three half-lives; and a correction for decay of the nuclide should be made.

Laboratory analysis of samples shall be according to procedures required by Appendix B, Method 114 "Test Methods for Measuring Radionuclide Emissions

from Stationary Sources" in 40 CFR 61. Analyses should be conducted by radio-analytical laboratories according to prescribed statements of work. Work statements specify analytical performance requirements including minimum detectable activity (MDA), turnaround time, reporting requirements, quality control (QC) requirements, and sample handling.

Sampling program criteria in Section 6.2.1 specify an emission detection level of 0.01-mrem OED. The analytical MDA required to meet this criterion depends on a combination of factors, including sample size, stack flow rate, collection period, radionuclide half-life, and radionuclide emission dose factor.

Historically, laboratory analysis of particulate emission samples consisted of total activity (total alpha, total beta) measurements. Total activity measurements were performed because

- emissions have historically been very low
- potentially significant constituents of the emission stream were known
- the gross activity measurement is nondestructive; radionuclide-specific measurement could be performed on the sample if gross activity measurements show a potentially significant release quantity.

When gross activity measurements were used for assessing offsite dose, dose factors for the most restrictive radionuclide potentially contributing 10% or more to the annual emission dose were applied.

Beginning in 1993, airborne particulate samples were analyzed for several specific radionuclides in addition to the gross activity measurements. These specific analyses included those radionuclides potentially contributing 10% of the offsite dose from the building.

Exhaust stream flow rates at sampling locations shall be measured using EPA Method 2 (40 CFR 60). Beginning calendar year 1994, access to the vertical stack has permitted use of this method to measure flow in the 324 Facility stack. Flow rate measurements should be performed on a periodic basis, as well as following modifications to the exhaust system that could be expected to cause the average exhaust rate to differ by +/-10% from the previously measured rate. Normally, stack flow rates should be measured on a quarterly frequency. However, if instantaneous flow rate at the sample location is expected to deviate from the mean flow rate by a factor of two more than 10% of the time, and the (real) OED exceeds or is expected to exceed 1 mrem, continuous stack exhaust flow rate monitoring and totalizing should be provided (DOE/EH-0173T).

Air emission samplers should be designed to maximize the sensitivity of the sample, considering the capacity of the collection media, radioactive decay, and sample analysis costs.

Isokinetic sampling is required where particulate emissions are expected.^(a)

Under most operating conditions, isokinetic sampling can be adequately accomplished by operating the sampler so that 1) sample probes are aligned axially with the stack and point into the direction of stack flow, and 2) sample nozzle inlet velocity is maintained within a factor of two of the mean stack exhaust velocity at the sample location.^(b)

At the "major" emission points, The sampler is operated continuously, except during planned sampler maintenance or testing outages. When continuous sampling is required, the loss of sampling capability is limited to 24 h/month. If this limit is exceeded, special interim sampling is provided or pertinent facility operations are shut down.

6.3 Criteria for Emission Monitoring

6.3.1 General

Continuous emission monitoring is required for any emission system where

- a potential of greater than once per year exists for exceeding 20% of the OED standard of 10 mrem/yr (credit may be taken for emission control equipment such as HEPA filters) per DOE/EH-0173T
- continuous emission monitoring is specified by a SAR or operational safety requirement (OSR).

The main stack of the 324 Facility (EP-324-01-S) meets the criteria in the second bullet. The 324 Facility SAR requires continuous alpha and beta particulate and radioiodine monitoring.

6.3.2 Monitor Performance

The purpose of continuous emission monitoring is to detect a significant increase in stack emission rate. Rapid detection of such an increase may assist operational response actions. The 324 Facility stack monitoring system is not used to activate engineered control systems, is not relied on as a primary means for detecting an abnormal operating situation, and is not used to continuously monitor radionuclide release rates during normal facility operations.

The emission monitor should be able to detect a sudden release that could (assuming 95th percentile atmospheric dispersion under 2-h meteorological conditions) result in an OED of 2 mrem (i.e., 20% of the emission standard). The monitoring program should effectively provide notification to responsible personnel within 4 hours of onset of such a release.

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- (a) Emissions from the 324 stack are filtered using HEPA filters prior to discharge. Unless failure of a HEPA filter system occurs (an unlikely event), particle emissions are expected to be relatively small in size. Based on criteria in ANSI N13.1, isokinetic sampling for systems emitting particles less than 5- μ m aerodynamic diameter is not necessary. The DOE Regulatory Guide recommends isokinetic sampling when particles are greater than 0.5- μ m aerodynamic median diameter.
- (b) From Table C1 in ANSI N13.1, a sampler operating at an inlet velocity within a factor of two of the stack velocity or within a factor of two of the stack velocity at the sample extraction location will have a particle interception bias of 14% for a 4- μ m aerodynamic equivalent diameter (AED) particulate emission.

6.3.3 Monitor Design

General criteria for design of monitoring systems are provided in DOE/EH-0173T.

6.3.4 Monitor Operation

Monitors are operated continuously, except

- when the monitored exhaust system is not operating, if approved by the Building Manager and EC
- during planned maintenance or testing of the monitoring system if scheduled through the Building Manager.

During periods when the exhaust system is operating and sampling is required, loss of monitoring capability is not to exceed 4 hours at a time. If monitor outage exceeds this time, EC is required to specify requirements for interim sampling of emissions or shut down of pertinent operations.

Continuous stack monitors must provide easily discernible alarms to responsible personnel in continuously or frequently occupied areas. A frequently occupied area is one that is occupied at least once every 4 clock hours.

Flow rates through monitors should, in combination with other operating parameters, be sufficient to enable the monitor to detect an emission meeting the above dose criteria.

7.0 Characterization of Current Effluent Monitoring Systems

Airborne radionuclide emission sampling and monitoring is performed at the 324 main building stack (EP-324-01-S), the only building exhaust point that could potentially contain radionuclides under normal operating conditions.

The building stack, located on the northeast side of the 324 Facility, discharges ventilation exhaust from hot cells, maintenance shops, and canyon areas in the building at an average exhaust rate of 87,000 cfm.^(a) Because the stack flow is primarily building ventilation air, stack gas specific gravity, humidity, and temperature are typical of the ventilation exhaust from an occupied building.

To support development of a stack emission measurement program for the 324 Facility, knowledge of the types and quantities of radionuclides potentially present in the ventilation exhaust is necessary. An index of emission potential is used by PNL so that the relative significance of different radionuclides and different emission points can be compared. The index, expressed in terms of a projected potential dose equivalent to a maximum offsite receptor, is based on emission assessment methods in 40 CFR 60, Appendix D. It is assumed that no engineered emission controls (e.g., HEPA filters) are provided in the ventilation system, and that without such controls, the potential for radionuclide emissions is related to the quantity and physical form of radioactive material in the facility. This assessment method is described in PNL-10061 (Sula and Jette 1994).

Radionuclides of primary importance in the 324 Facility from an emission sampling standpoint were determined, using the above methods, to be: cesium-137, strontium-90, and plutonium-238. In addition to these radionuclides, tritium, because it is handled in significant quantities without a facility based ventilation emission control system,^(b) is also included in the list of important radionuclides. The emission measurement program is designed to monitor and quantify these radionuclides.

7.1 Sampling/Monitoring System Description

Continuous emission sampling and monitoring systems for particulate radionuclides is performed using isokinetic sampling systems (ESP-324-01-S and ESP-324-01M-S) that are compliant with NESHAP requirements in 40 CFR 61. The sampling and monitoring of radioactive gases (tritium, iodine) is conducted using a quasi-isokinetic sampling system (ESP-324-01-T). Table 7.1 summarizes the types of emissions measurements performed. Schematic diagrams are provided in Figures 7.1 and 7.2. Detailed descriptions are provided below.

(a) Based on average of total stack flow reported in annual emission reports from 1991 through 1993.

(b) However, tritium emissions are controlled at the point of generation in the building using source containment and off-gas traps.

Table 7.1. Airborne Emission Measurements - 324 Facility

Continuous Sampling	
	System Designation ^(a)
Particulate Radioactivity	ESP-324-01-S
Tritium (Condensible and Noncondensable)	ESP-324-01-T
Continuous Monitoring	
Particulate Alpha Activity	ESP-324-01M-S
Particulate Beta Activity	ESP-324-01M-S
Tritium Activity	ESP-324-01-T
Iodine-131 Vapor	ESP-324-01-T

(a) Systems are located at the main building stack (EP-324-01-S).

Figure 7.1. Schematic Diagram of Isokinetic Stack Sampling Systems

Figure 7.2. Schematic Diagram of Stack Gas Measurement Systems

7.1.1 Main Stack Particulate Emission Sampling System (ESP-324-01-S)

A NESHAP compliant airborne particulate radionuclide sampling system (ESP-324-01-S) was installed on the main building stack in late 1993. The system, which began operation in January 1994, complies with the sampler design criteria in Chapter 6.0.

The airborne particulate sampling system incorporates a six-nozzle, isokinetic sampling probe assembly (Figure 7.3) positioned in the stack 8.6 equivalent diameters downstream of the stack entrance and 6.0 equivalent diameters upstream of the stack exit (Figure 7.4). Probe nozzles (nozzle inlet diameter = 0.293") are located at the centers of equal annular areas according to requirements in ANSI N13.1 (1980).

A sample transport line extends from the probe assembly to the base of the stack where a sample collection filter is located (Figure 7.5). The transport line is made of stainless steel tubing and is heat traced, thermally insulated, and electrically grounded.

Stack particulate emission samples are withdrawn from the stack and through the sampling system by means of a dedicated vacuum system. The sampling rate is controlled using a control valve located downstream of the particulate sampling

Figure 7.3. Isokinetic Sample Probes Used in ESP-324-01-S and ESP-324-01M-S

Figure 7.4. Location of Isokinetic Sample Probes in 324 Facility Main Stack

Figure 7.5. Particulate Sample Collection Unit

filter. The control valve is adjusted so that the velocity of air entering the sample system through the sample probe assembly equals the average velocity of the stack gas at the sampling location. Sample flow is measured by a mass flowmeter upstream of the control valve (Figure 7.5). Stack velocities are measured on a quarterly frequency using EPA Method 2 (40 CFR 60).

Transport efficiency of the sample through the stack particulate sampling system has been calculated to be greater than 95% for an assumed 1 micron AMAD aerosol at nominal sampler and stack flow rates.^(a)

Airborne particles are collected on a 47-mm diameter glass fiber filter (Hollingsworth and Vose, Model LB5211). The LB5211 has an estimated retention efficiency for 0.3 micron particles of greater than 99.87% at face velocities of 180 fpm.^(b) The filter itself has a maximum rated flow of 26 cfm (Hi-Q Product Catalog) and a pressure drop of about 2-in. water at 4 cfm (Hering 1989).

The sample collection filter is replaced biweekly. The sample filter is stored for 7 days after removal from the sampler to permit decay of radon and thoron daughter radionuclides. The filter is then analyzed for radioactivity.

Each sample is screened individually for gross alpha and gross beta activity, and then the samples collected over a three month period (calendar quarter) are combined and analyzed for specific radionuclides (⁹⁰Sr, ¹³⁷Cs, ^{238,239}Pu, ²⁴¹Am). Sample analyses are performed by a subcontracted analytical laboratory using methods described in Chapter 9.0. Sample analysis results are evaluated as described in Section 7.3.

7.1.2 Main Stack Continuous Tritium Emission Sampling System (ESP-324-01-T)

Tritium as tritiated water (HTO) and tritium gas (HT) is sampled continuously using a two-stage sampling system (shown schematically in Figure 7.6).

The sample stream for the tritium sample system is withdrawn from the underground exhaust plenum to the stack. The stack exhaust plenum is a 7-ft-high by 8-ft-wide (cm x cm) rectangular tunnel running just below grade between the 324 Facility to the main stack. The plenum enters the stack about 1-ft below grade. The sampling probe is positioned in this exhaust plenum 7.5-ft (1 equivalent diameter) upstream of the entrance to the vertical stack and 55 ft (7.3 equivalent diameters) downstream of any flow disturbance. The probe assembly consists of a single, four-nozzle stainless steel isokinetic design that is inserted downward into the exhaust plenum. Nozzles are aligned vertically in the exhaust plenum with the top nozzle approximately 9.5 in. below the top of the tunnel, and the other three nozzles on 18 in. centers from the top nozzle. The probe nozzle inlets extend 10 in. upstream into the direction of plenum flow. Each nozzle has an inlet diameter of 0.43 in. The sample transport line penetrates the floor of the 324-A sample building. The line has an inside diameter of 0.87 in. and serves as

(a) Loss calculations were performed using DEPO Version 2.0 (Wong, 1991) A 1-micron AMAD polydisperse aerosol was assumed for the calculations based on the assumption that building operations and controls (HEPA filters) are "normal".

(b) Extrapolated from tests conducted by Hollingsworth and Vose at face velocities ranging from 11 to 60 fpm. (Reference Airborne Emission Monitoring Project Report "Evaluating Effluent Sampling Data", February 1993).

Figure 7.6. Tritium Sampling System

a header for subsample take-offs. Flow through the sample header is maintained at 4.5 cfm by sample pumps located in the 324-A building. Subsample flow rate to the tritium sampler is 200 mL/min^(a).

The tritium sample stream is pre-filtered to remove particulates and flow is measured using a rotameter. The sample stream then enters the first tritium collection unit, containing silica gel, to strip water vapor from the gas stream. Upon exit from the first stage, the now dry sample stream is heated to $>180^{\circ}\text{C}$ in the presence of a palladium catalyst to convert free hydrogen (HT and TT) to water vapor. The sample stream is then cooled to under 40°C and passed through the second silica gel collector to strip out the water vapor generated from the gaseous tritium.

The silica gel collection media is normally replaced with fresh media on a monthly basis; however, exchange may be more frequent if premature collector loading occurs^(b). Following the sampling period, the silica gel is removed from each collection column and sent to an analytical laboratory for determination of tritium content. Tritium emission quantities for the collection period are calculated assuming complete retention of sample in the collection column, and multiplying the quantity of tritium collected in the column by the ratio of the stack flow rate to the sampler flow rate.

- (a) Subsamples are also withdrawn from the primary sample stream for the continuous tritium monitor (~ 4 L/min) and continuous iodine monitor (~ 1.5 cfm). Additional subsample take-offs are available for other monitoring and sampling systems.
- (b) The collector unit is not allowed to exceed $2/3$ of its maximum calculated capacity of 225 mL water.

7.1.3 Continuous Particulate Emission Monitoring System (ESP-324-01M-S)

Stack air is continuously monitored for particulate radionuclides by a EG&G-Berthold LB-150D alpha-beta-pseudocoincident monitor (Figure 7.1).

Airborne particulates are withdrawn from the stack using an isokinetic sampling probe (described in Section 7.1.1) co-located with the isokinetic sampling probe used for particulate emission sampling. Probe configuration is similar to that of the particulate emission sampler, except the monitoring system is designed for higher flowrates (up to 28 scfm). Flow rate through the monitor is measured by a mass flowmeter and controlled using a manually operated gate valve. The monitor uses an 8" diameter glass-fiber filter to collect airborne particulate from the stack. The filter is mounted against a sandwich arrangement of gas-flow proportional radiation detectors to count the alpha, beta, and gamma emissions from the filter.

The monitoring system accounts for the presence of radioactive material associated with the decay products of naturally occurring radon isotopes by means of a timing gate to identify simultaneous alpha and beta emissions occurring on the filter. This method, referred to as the alpha-beta-pseudocoincidence-difference method (ABPD), uses the nearly simultaneous (pseudocoincident) alpha-beta decay transitions in the radon-220 and radon-222 decay chains as a means of distinguishing naturally occurring radionuclides from artificial radionuclides deposited on the sample filter^(a).

Near-isokinetic sampling conditions are maintained by adjusting the flow rate through the sample collection system so that the average airflow velocity through the sampler inlet nozzles corresponds to the average stack velocity measured at the nozzle locations. With an average stack flow of 87,000 cfm, a stack diameter of 10.33 ft., and a six-nozzle sample probe with nozzle inlets of 0.775 in., the nominal isokinetic sampling rate for the stack particulate radionuclide monitor is 20 cfm.

Local and remote annunciators provide indications of high particulate radionuclide emissions as well as monitor component failures.

7.1.4 Main Stack Continuous Tritium Monitoring System (ESP-324-01-T)

Tritium emissions via the main stack are continuously monitored by a Fempto-Tech ionization chamber. The primary sample stream is withdrawn from the exhaust plenum to the stack as described in section 7.1.2 (see Figure 7.2).

The tritium monitor subsample is controlled to about 4 L/min by a manually operated valve. The ionization chamber is contained within a 2-in. lead brick shield to eliminate interference from externally produced radiations. The monitor has both a front panel LED display and a chart recorder.

(a) Three gas-flow proportional counters in a sandwich configuration independently count the number of alpha, beta, and gamma emissions on the sample collection filter. In addition, alpha and beta emissions that are detected pseudocoincidentally are also counted. The number of pseudocoincident events times a scaling factor is subtracted from the total alpha and beta counts to yield the net event detections attributed to sources other than radon isotopes.

The tritium monitor provides a concentration range of 0.1 to 2000 $\mu\text{Ci}/\text{m}^3$, a stated accuracy within 3% of the reading, and an instrument noise level of less than 0.1%. The monitor is manufactured with a low and a high level alarm capability. These alarms activate relays which provide signals to local and central annunciator panels. The high level alarm point is activated if high tritium concentrations are detected. The low level alarm is used to indicate monitor failure. This is accomplished by setting the low level alarm to a very low concentration (0.1 $\mu\text{Ci}/\text{m}^3$) and adjusting the zero setting for the instrument to 4 $\mu\text{Ci}/\text{m}^3$, so that under normal operation (i.e., no detectable tritium in the stack air), the monitor will indicate about 4 $\mu\text{Ci}/\text{m}^3$ and the alarm point will be exceeded. As a result, during monitor operation, the low level alarm light on the local panel is constantly illuminated. In the event a detector fails, the tritium concentration recorded by the monitor will decrease to below 0.1 $\mu\text{Ci}/\text{m}^3$ (i.e., no signal from the detector), and the low level alarm relay will be disengaged. This change in relay position is annunciated at the central alarm panel.

Because the zero setting of the monitor is adjusted to read 4 $\mu\text{Ci}/\text{m}^3$ under conditions of normal ambient stack concentrations (i.e., zero tritium), this bias should be corrected by subtracting it from all instrument readings^(a).

7.1.5 Main Stack Continuous Radioiodine Monitoring System (ESP-324-01-T)

Iodine-131 is continuously monitored using a NaI detector with a single-channel analyzer tuned to the 364-KeV photopeak region to measure gamma emissions from iodine collected in an activated charcoal filter. The primary sample stream is withdrawn from the exhaust plenum to the stack as described in section 7.1.2 (see Figure 7.2). The subsample for the radioiodine monitor is withdrawn from the primary sample stream at 1.5 cfm.

The efficiency of the detector using a mock ^{131}I source (^{133}Ba) is approximately 6%, which corresponds to an ^{131}I efficiency of 7% (the 364-KeV photon from ^{131}I has 82% yield). Because the charcoal also adsorbs radon and thoron gases present in the exhaust stream, a gradual buildup of radon/thoron decay products is observed over the sample period. This buildup reaches an equilibrium count rate of around 100 cpm within a few days of adsorber media exchange.

The alarm level is set for 10,000 cpm which represents a stack ^{131}I , 4-h average concentration of $7.4\text{E-}9$ $\mu\text{Ci}/\text{mL}$ assuming a 1.5 cfm flow rate, 100% adsorber retention efficiency for ^{131}I , 6% detector efficiency, and negligible background contribution and line loss. Sampler flow rate is measured using a rotameter and flow rate is set using a control valve. The charcoal filter is replaced every two weeks.

7.2 Sampling and Monitoring System Performance

This section describes the performance capability of the stack sampling and monitoring systems in terms of the offsite dose potentially resulting from a release. The determination of minimum sampler capability and the evaluation of monitor alarm levels is based on a series of worst case exposure scenario assumptions, resulting in calculations of upper bound doses. Thus, the methods used here to

(a) For example, if a reading of 4 $\mu\text{Ci}/\text{m}^3$ is observed on the monitor, this represents a net tritium concentration of 0 $\mu\text{Ci}/\text{m}^3$ reading minus artificial background.

evaluate system capability are not appropriate for assessment of actual releases. A realistic assessment of the significance of a monitor reading may be made only by considering the actual operational and environmental conditions at the time of the release.

7.2.1 Stack Radionuclide Sampling System Performance

Performance criteria for sampling are provided in Section 6.0. Two of the criteria concern measurement sensitivity and the third concerns measurement bias. The criteria for bias is based on conformance of the system to design and operational guidance in ANSI N13.1(1980) and DOE/EH-0173T(1991). System description information in Section 7.1, are consistent with the design and operational guidance; thus, the bias criterion is met.

Sensitivity criteria (Section 6.0) for sampling are stated in terms of detectable off-site dose. According to the criteria, sampling should include measurement of radionuclides which could contribute greater than 10% of the potential effective dose equivalent for the release point. Per criteria in Section 6.0, radionuclides should be detectable at emission levels resulting in an annual committed effective dose equivalent of 0.01 mrem. For the 324 Facility, measured radionuclides are cesium-137, strontium-90, plutonium-238, and tritium. Total alpha activity and total beta activity are also measured to screen for other radionuclides in the stack exhaust.

Annual release quantities associated with an effective dose equivalent of 0.01 mrem were calculated from dose factors calculated using the EPA compliance code CAP-88 (Sula and Jette 1994). These values are shown in Table 7.2.

The sensitivity of particulate radionuclide sampling is proportional to the collection efficiency of the sampler, the fraction of the emission quantity that is collected by the sampler, and the level at which the radionuclide can be detected in the collected sample. Under isokinetic sampling conditions, the 324 Facility particulate sampler will intercept approximately 1/30,000 of the activity emitted via the stack (i.e., ratio of sampling rate to stack flow rate). Loss of particulates in the sampling system due to deposition, plateout, and filtering efficiency are estimated to be less than 5% for a 1-micron AMAD particulate aerosol^(a). Using the contractual minimum detection level specified in the analytical laboratory statement of work (Table 7.2), the annual minimum detectable release for specific radionuclides are as shown in Table 7.2.

Tritium (HTO) sampling capability is related to total quantity of water vapor collected in the sample. For a given tritium release rate, the concentration of tritium in water vapor adsorbed on the collector will be inversely proportional to the quantity of water collected on the column (that is, the water vapor containing tritium as HTO will be diluted by water vapor not containing HTO). The tritium collector is operated to a loading of 150 mL (operating procedures limit loading of collector to 2/3 of maximum rated capacity). Under worst-case sampling conditions (i.e., high humidity), 150 mL of water vapor will be collected in about 4 weeks. Analytical detection levels for tritium are 1.5 pCi for a 5-mL aliquot

(a) Calculated using DEPO 2.0 (Wong et.al. 1991) assuming a particulate aerosol with an AMAD of 1.0 microns.

Table 7.2. Detection of Significant Radionuclides in 324 Stack Emissions

Radionuclide	Analytical Limit (pCi/sample) ^(a)	Detectable Annual Release (Ci)	Release Resulting in 0.01 mrem (Ci) ^(e)
Beta Activity	2.8 ^(b)	2.3E-6	2.0E-3 (as ¹³⁷ Cs)
Alpha Activity	0.94 ^(b)	7.7E-7	5.4E-5 (as ²³⁸ Pu)
⁹⁰ Sr	0.15	1.9E-8	2.0E-3
¹³⁷ Cs	15	1.9E-6	2.0E-3
²³⁸ Pu	0.0075	9.5E-10	5.4E-5
Tritium (HTO)	45 ^(c)	6.6E-3	24
Tritium (HT)	6 ^(d)	8.9E-4	2400 ^(f)

(a) From ITAS Contract No. 108722-A-MI.

(b) Includes correction for 15% reduction of the alpha and beta emissions originating from the sample that are absorbed by the sample media and surface dirt on the filter (Higby 1984).

(c) Based on submission of silica gel containing 150 mL of water loading, and lab analysis minimum detection level of 1.5 pCi/aliquot for an aliquot size of 5 mL (i.e., 300 pCi/L).

(d) Based on submission of silica gel containing 20 mL of water loading, and lab analysis minimum detection level of 1.5 pCi/aliquot for an aliquot size of 5 mL (i.e., 300 pCi/L).

(e) Based on dose per release factors calculated using CAP-88 (Sula and Jette 1994).

(f) Dose factor for noncondensable tritium (HT) is about 100 times that for condensable (HTO) tritium.

from the submitted sample. For a 150 mL sample size (i.e., maximum column loading), the worst case minimum detectable tritium on the collector column would be 45 pCi. At a sampling rate of 200 mL/min (0.007 cfm), the stack to sample ratio is 1.2E7 (87,000 cfm/0.007 cfm). Assuming the sampler is 100% efficient for collection of tritium vapor, the stack release for each sample period will be 1.2E7 times the activity of tritium measured on the collector. For 12 sampling periods per year, the minimum annually detectable HTO emission is 0.006 Ci/year (1.2E7 times 12 samples/year times 45 pCi/sample).

The water vapor collected on the second (noncondensable forms of tritium) collection column is partially a function of the quantity of hydrogen in the atmosphere. However, because ambient air contains 0.5 ppm of hydrogen, at a 200 mL/min sample rate, the catalytic oxidizer will generate only about 1.5 mL of water over a 2-week period. Quantitative collection of this small amount of adsorbed water vapor is difficult, so additional hydrogen is injected into the sample stream to increase the quantity of collected water vapor to approximately 20 mL. The injection gas is nitrogen-hydrogen gas (3% H₂ in N₂). The addition of this gas mixture at 20 mL/min will generate an additional 20 mL of water loading over a 4-week sampling period. Since the sensitivity of tritium measurement is inversely proportional to the quantity of water loading on the collection column, the operation of the noncondensable tritium column at a water loading of 20 mL will achieve a detection level of 20/150 = 0.133 times that of the condensable tritium column under full (150 mL) water loading.

From Table 7.2, it is apparent that the capability of the 324 Facility stack sampling system exceeds the minimum criteria for detection of radionuclides in emissions.

7.2.2 Monitoring System Performance

This section describes the performance of the continuous stack monitoring systems for the 324 Facility. The purpose of the continuous stack monitoring systems are to annunciate to operations personnel of the occurrence of a potentially "significant" radionuclide emission from the main building stack (EP-324-01-S). Although the 324 Facility conditions do not require continuous stack emission monitoring DOE/EH-0173T (DOE 1991), such monitors are nevertheless required during certain activities by the building Safety Analysis Report (Harmon and Faulk 1985) and the Tritium Target Program Safety Evaluation Document (Ballinger and Jette 1990).

As described in Chapter 6.0, emission monitoring systems should be able to detect a non-routine release that could result in an offsite effective dose equivalent of 2 mrem (i.e., 20% of the annual airborne radionuclide emission standard; DOE 1990). The ability of the monitoring systems to meet this criteria is discussed in this section. Alarm annunciation setpoints for the monitoring systems should be maintained at or below the 2 mrem criteria level^(a).

Acute exposure scenario dose calculations, performed using GENII 1.485, provide the following estimates of emission quantity resulting in a 2 mrem dose:^(b)

$$\begin{aligned}\text{Alpha Activity (Pu-238)} &= 630 \mu\text{Ci} \\ \text{Beta Activity (Sr-90)} &= 12,500 \mu\text{Ci}.\end{aligned}$$

Monitor response to a radionuclide release is a function of the monitor sample collection and detection efficiency as well as the size of the sample. Under isokinetic sampling conditions, the 324 Facility stack monitor will intercept approximately 1/4300 of the release. Additionally, it is reasonable to assume that the failure of a filter system may have occurred as part of the accident and that emissions with a failed filter system could result in the presence of relatively large particles in the emission stream. Assuming a 10-micron AED monodisperse aerosol, sample collection and transport efficiency were calculated to be about 40%, using the DEPO computer code (Wong, et.al. 1991). In addition to these losses, it is assumed that 15% of the alpha and beta emissions originating in the sample are absorbed by the sample media and surface dirt on the filter (Higby 1984). For detecting emitted radiations, a nominal counting efficiency of 20% for both alpha and beta activity is assumed based on monitor performance tests.

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- (a) Alarm setpoints below the minimum criteria level are developed in consideration of environmental ALARA objectives and existing facility conditions.
- (b) Based on unit dose factors calculated using GENII 1.485 for the draft revision of 324 Building Safety Analysis Report. Calculations assumed an elevated release from the 48 meter high building stack and an offsite receptor located on a farm near the east bank of Columbia River, 1500 meters to the east of the stack. The release is assumed to occur during the Fall harvest season during adverse meteorological dispersion conditions (i.e., conditions resulting in limited dispersion conditions that would not be encountered more than 5% of the time).

In consideration of the above described factors, the 2 mrem release quantities (630 μCi alpha, 12,500 μCi beta), will result in the deposition on the collection filter of 0.06 μCi alpha and 1.2 μCi beta, and the net countrates from the deposited material will be 370 cps and 7300 cps for alpha and beta respectively.^(a)

The continuous particulate monitoring system has only recently been placed into operation and at this time there is insufficient data on background measurements to enable assessment of the actual minimum release that could be detected by the monitoring system. Airborne particulate radionuclide monitor performance figures are summarized in Table 7.3.

Tritium monitoring using the Fempto-Tech monitor (described in section 7.1.4), is conducted during tritium target processing work associated with the Tritium Target Program^(b) which commenced in 1991.

Based on the revised 324 Facility Safety Analysis Report (SAR), the offsite effective dose equivalent for a one curie release of tritium (as HTO) is $9.3\text{E-}5$ rem. Thus, a 22 Ci release could result in a 2 mrem effective dose equivalent to an offsite individual. Averaged over 2 hours at a flow rate of 87,000 cfm, this equates to a stack tritium concentration of $73 \mu\text{Ci}/\text{m}^3$.

As described in section 7.1.4, the tritium monitor is operated with an artificial background setting of $4 \mu\text{Ci}/\text{m}^3$. The maximum setpoint for a high concentration alarm is thus $73 \mu\text{Ci}/\text{m}^3$ higher than the background, or $77 \mu\text{Ci}/\text{m}^3$.

Assuming that a concentration reading at three times the normal background reading of $4 \mu\text{Ci}/\text{m}^3$ is evidence of a tritium release, an estimate of the minimum detectable tritium concentration can be made. A factor 3 times the normal background reading of $4 \mu\text{Ci}/\text{m}^3$, or $12 \mu\text{Ci}/\text{m}^3$ is equivalent to a stack tritium concentration of $8 \mu\text{Ci}/\text{m}^3$ (i.e., $12 \mu\text{Ci}/\text{m}^3$ minus the artificial background setting

Table 7.3. Stack Particulate Radionuclide Monitoring Capability^(a)

	Maximum Alarm Level	
	Alpha (^{238}Pu)	Beta (^{90}Sr)
Acute Stack Release (μCi)	630 μCi	12,500 μCi
Offsite Receptor Dose (mrem)	2 mrem	2 mrem
Monitor Net Count Rate ^(b)	400 cps	7000 cps

(a) Assuming 10-micron diameter particles.

(b) Rounded to one significant figure.

(a) At these count rates, contribution from radon daughters on the collection filter will be insignificant. Thus, the count rate observed for total activity will be the same as that indicated for the "net corrected" activity by the monitor.

(b) As described in the Tritium Target Rod Examination Program - Safety Evaluation Document (Ballinger et.al. 1990).

of 4 $\mu\text{Ci}/\text{m}^3$), which is indicative of a 2 hour release concentration with a potential offsite dose consequence of 0.2 mrem.

The continuous ^{131}I monitor uses a NaI detector and a single-channel analyzer to measure ^{131}I photon emissions in the 364-KeV photopeak region. Efficiency for a mock ^{131}I source (^{133}Ba) is on the order of 5 to 6%, which corresponds to an ^{131}I efficiency of 6 to 7% (364-KeV photon from ^{131}I has 82% yield). Because the charcoal also adsorbs radon and thoron gases present in the exhaust stream, a gradual buildup of radon/thoron daughters is observed over the sample period. This buildup reaches an equilibrium count rate of around 100 cpm within a few days of adsorber media exchange.

The iodine monitor alarm level is set for 10,000 cpm.^(a) This level represents a stack ^{131}I 4-h average concentration of $5.6\text{E-}9 \mu\text{Ci}/\text{mL}$ assuming a 2-cfm sample flow rate, 100% adsorber retention efficiency for ^{131}I , 6% detector efficiency, and negligible background contribution and line loss.

7.3 Handling of Sampling and Monitoring Data

Results obtained from the record sampling program are used to evaluate existing facility emission levels and to calculate annual emission quantities for compliance determination and reporting purposes. Results are also used to prepare a quarterly emission trends report.

Particulate samples are collected as described in section 7.1. Analysis of samples by a laboratory is described in Chapter 9. Data is evaluated as described in an internal procedure titled: "Evaluating Effluent Sampling Data" (issued February 1993). Data evaluation procedures are based on guidance in DOE/EH-0173T *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* and EPA 520/1-80-012 *Upgrading Environmental Radiation Data*.

Airborne emission sampling data are reviewed for anomalies and trends. Provisional release estimates are updated throughout the sampling year (calendar year) as data are received. At the completion of the calendar year, data are reviewed and the provisional release estimate is refined as necessary to account for anomalies or missing data as well as any significantly skewed data set. Anomalous data are investigated and conclusions of the investigation are documented.

Final release quantities include corrections for isokinetic sampling efficiency, sample transport losses, sample self-absorption, decay, counting efficiency, background, and collection media efficiency.

7.4 Calibration and Maintenance of Equipment

Sampling and monitoring equipment are maintained and calibrated according to predetermined schedules. Stack flow rates are measured using a standard-type pitot tube that is recognized by EPA as a primary calibration standard. Rotameters are calibrated or checked as described in preceding sections.

(a) The historical alarm setpoint for the iodine monitor. Operation of the monitor has continued despite the elimination of iodine from the facility. Efforts are underway to remove the monitoring system.

Radiation monitoring equipment is calibrated annually by the Hanford Instrument Evaluations Section of PNL. This group has responsibility for calibration of all portable radiation protection instrumentation at Hanford.

Sampling systems are inspected weekly by the PNL Radiation Protection Section for proper flow rate setting and system operation. Monitoring systems are inspected each workday. In addition, response and alarm tests are periodically conducted.

7.5 Alternative Sampling Methods

Alternative stack particulate collection capability is provided by the stack continuous airborne particulate radionuclide monitor (ESP-324-01M-S). A particulate sampler could also be collected using system ESP-324-01-T in the event of a failure of system ESP-324-01-S.

If a continuous monitoring system fails such that safety requirements in the building SAR are not met, major facility operations are put on standby until an adequate monitoring program is reestablished. All monitoring systems have replacement units available, so down time is usually limited to a few hours at most.

Alternative methods exist for assessing impacts of facility emissions. Workplace air monitoring systems provide evidence of the presence or absence of radionuclides in room air. Contamination surveys, routinely performed throughout the facility, provide additional evidence of contamination spreads. Air emission control systems are routinely checked for leaks. Differential pressure gauges installed across each filter bank would provide evidence of filter plugging or breakthrough. An extensive environmental surveillance program is operated for the Hanford Site by PNL. This program is described in detail in the Hanford Site Environmental Monitoring Plan. The program performs ambient air sampling around the 300 Area perimeter as well as along the Hanford Site boundary and in adjacent communities. In addition to ambient air sampling, the environmental surveillance program samples groundwater, river water, drinking water, food-stuffs, soil, native vegetation, and aquatic and terrestrial animals. Annual reports issued by the Hanford Environmental Surveillance Program document the results of these samples.

7.6 References

American National Standards Institute (ANSI). 1980. "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities". ANSI N13.1-1980.

Ballinger, M. Y., S. J. Jette, and W. S. Kelly. 1990. Tritium Target Rod Examination--Safety Evaluation Document (SED). PNL-7512, Pacific Northwest Laboratory, Richland, Washington.

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U.S. Department of Energy. 1991. Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance. DOE/EH-0173T.

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Sula, M. J., and S. J. Jette. 1994. PNL-10061. Pacific Northwest Laboratory Facility Radionuclide Inventory Assessment, CY 1993-1994. October 1994.

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8.0 Historical Monitoring/Sampling Data for Effluent Streams

The 324 Facility was built in 1965 to provide a diversified capability to conduct high-level radioactive chemical processing and metallurgical engineering studies. Some of the effluent streams from the facility have been sampled and monitored over the history of operations. Information from historical sampling and monitoring is provided in this section to aid in providing a basis for future monitoring needs. Section 8.1 describes historic sampling and monitoring data under normal operating conditions for air and liquid effluent streams. Section 8.2 provides estimates of the types of releases and release pathways experienced during plant operations under upset conditions.

8.1 Normal Conditions

Sampling and monitoring of some of the air and liquid effluent stream has occurred since the 324 Facility started operations. The types and location of sampling and monitoring and methods of analysis are described in this section for normal operations. Discussion is generally limited to the past seven years because this time period is the most relevant to future operations and monitoring needs; the 324 Facility was transferred to PNL in June 1987.

8.1.1 Air Effluent Monitoring/Sampling

Effluent air from the 324 Facility has been sampled and monitored downstream of the final HEPA filters for radioactive particles. The sampling and monitoring system were not significantly modified from 1987-1991 except for the addition of ^3H sampling in 1990. Prior to 1990, monitoring of gross alpha and beta and sampling of ^{131}I , gross alpha and beta were provided. As described in Section 7.0, a probe array with four sample nozzles located in the duct just upstream of the 324 Facility stack (ESP-324-01-S) was used to provide continuous air monitoring and weekly record samples. The sampling and monitoring systems were upgraded in 1994 (see Section 7.0).

A portion of the stack gas was passed through CAMs that detected alpha and beta activity. Samples were collected by passing a continuous stream of the stack air through a particulate filter and charcoal bed. (The charcoal bed was removed in 1992.) The filter samples were analyzed for total alpha and total beta and the charcoal beds were analyzed for ^{131}I .

In 1987, control of building operations was transferred from WHC to PNL and the analyses were done as described in Section 9.0. The MDL under the present analysis method varies from sample to sample because it is sensitive to changes in background (which are highly variable) and counting time.

Estimated emissions calculated from the sampling data from 1987 to 1994 are shown in Table 8.1. A few values in Table 8.1 are reported as less-than values because samples, collected for analysis on a weekly basis, often contained levels of contaminant lower than the detection limit. Each of the weekly measurements were summed, including those assigned with a value of less than detection limit, to obtain the total for the year.

Table 8.1. 324 Facility Stack Sampling Data

Year	Estimated Emissions, Ci/yr			³ H
	Total Alpha	Total Beta	¹³¹ I	
1988	<6.8E-6	<2.4E-4	<7.1E-5	
1989	<5.7E-7	<1.2E-4	<5.9E-5	
1990	<6.9E-7	<3.1E-5	<6.2E-5	<0.5
1991	1.2E-6	6.1E-5		9.7E-1
1992	3.9E-7	6.4E-7		3.2E+1
1993	2.2E-7	5.7E-7		3.7E+0

The deficiencies in the sampling method are described in Section 7.0. Because of these deficiencies, the values given in Table 8.1 have some degree of uncertainty. However, these data show that releases of contaminant from the stack can be measured. A longer collection period (2-week samples) was instated in 1991 to provide larger samples with higher contaminant concentrations, which allow better resolution of the data.

8.1.2 Liquid Effluent Monitoring/Sampling

Liquid waste streams in the 324 Facility have been served by four systems as described in Section 4.0. Table 8.2 lists the four systems and summarizes the type of historical monitoring/sampling each system has had. As noted in Table 8.2, no monitoring of the SS or PS took place at the 324 Facility. However, sampling of the composite liquid waste from the 300 Area was done before the waste was disposed of in trenches. A brief description of the sampling and analysis program is given in the *Westinghouse Hanford Company Effluent Report for 300, 400, and 1100 Area Operations for Calendar Year 1989* (McCarthy 1990). Because this sampling program is not specific to the 324 Facility, the historical data from it are not given in this report.

The RPS has been monitored with a counting instrument that detects excessive levels of radioactivity (gamma detector) in the liquid waste. The liquid was passed through a diverter station. The diverters were set up to automatically divert RPS effluent to the RLWS line if radionuclides were detected at or above 5×10^{-5} Ci/mL of ¹³⁷Cs equivalent. The station was set up to automatically reset when the level of radioactivity dropped below the set point. Diverter alarms could annunciate in various locations in the 324 Facility if diversion occurred, and a sample could be taken automatically. Data from the monitor were not recorded.

Normally, the 324 Facility RPS passed through the diverter station and subsequently into the 300 Area PS lines. The composite liquid waste from all the 300 Area PS lines was sampled before the liquid was discharged to the 300 Area process trenches. A description of the sampling and analysis program is provided by McCarthy (1990). Sampling data from this program are not specific to 324 Facility PS lines, and thus, are not included in this report.

The RLWS served liquid waste streams expected to contain radioactive liquids. This system was composed of pipes and holding tanks within the 324 Facility. Waste from the holding tanks was jetted or pumped to the 340 Building via the 300 Area RLWS line (a double containment pipe provided with a sump alarm in

Table 8.2. Summary of Historical Liquid Monitoring/Sampling

System	Notes
Sanitary sewer	No sampling or monitoring at 324 Facility; sampled as composite with other 300 Area SS.
Process sewer	No sampling or monitoring at 324 Facility; sampled as composite with other 300 Area PS; grab samples taken in 1989.
Retention process sewer	Monitored at diverter station in 324 Facility; grab samples taken in 1989; sampled as composite with other 300 Area PS.
Radioactive liquid waste system	Sampled at 324 Facility prior to transfer and at 340 Building after transfer.

case leakage occurs from the primary pipe) or to a cask in the LOS and was then transported by truck to the 200 Area tanks. Waste from the RLWS was sampled at the 324 Facility before transfer to the 340 Building. Composite water in the holding tanks at the 340 Building was then sampled before being transferred to the 200 Area by rail car. Because the RLWS stream was not released to the environment, the sampling program is not pertinent to the FEMP.

No historical monitoring or sampling of nonradioactive constituents in the 324 Facility has occurred except for grab samples taken in 1989. The samples were scheduled, collected, preserved, shipped, and analyzed according to the procedures of EPA protocol SW-846 (EPA 1986). A detailed description of the collection and analysis is given in the *Waste Stream Characterization Report* (Westinghouse Hanford Company 1989). Data from this effort are shown in Appendix D. The data indicate that releases from the 324 Facility to the PS line at the time of sampling are much less than the effluent release limits used by WHC to ensure that releases meet regulatory requirements. These limits are called administrative control values (ACVs).

8.2 Upset Conditions

The nature of upset conditions that have occurred during the operating history of the 324 Facility is shown by Table 8.3, which summarizes the reportable unusual occurrences (UO) that took place from 1977 to 1994. The type of events shown in Table 8.3 could be expected to occur during future operations. However, as noted in the table, none of these events resulted in an environmental release.

Accidents in the hot cells such as spills, off-gas releases, and fires have also occurred. Aerosols produced by these accidents were carried with cell exhaust gases and trapped on HEPA filters. A small fraction of the aerosol that got through the filters was released out the 324 Facility stack. Stack gases were monitored as described in Sections 7.0 and 8.1. Liquid waste from upset conditions remained in the cell until removal via cleanup operations. This waste was not monitored and did not result in a release of liquid effluent to sewer systems or to the environment.

Table 8.3. Unusual Occurrences in the 324 Facility

Type of Event	Number of Events
Loss of contamination control; no injury, overexposure, or environmental release.	5
Procedural violations or design errors; no actual consequences.	11
Chemical spills; no injury, overexposure, or environmental releases.	2
Personnel injury; finger lacerated, crushed foot, falling object struck worker.	3
Receipt of contaminated equipment in incoming shipment; no other consequences.	1
Equipment failure or damage consequences.	4
An Unreviewed Safety Question declared (on B-Cell Cleanout Program)	1

8.3 References

EPA. 1986. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, Third Edition. SW-846, U.S. Environmental Protection Agency, Washington, D.C.

McCarthy, M. J. 1990. *Westinghouse Hanford Company Effluent Report for 300, 400, and 1100 Area Operations for Calendar Year 1989*. WHC-EP-0267-1, Westinghouse Hanford Company, Richland, Washington.

Westinghouse Hanford Company. 1989. *Waste Stream Characterization Report*. WHC-EP-0287, Richland, Washington.

9.0 Analysis of Effluent Samples

This section provides information on the analytical laboratories and procedures used to analyze samples collected in support of the PNL effluent monitoring program. As stated in previous sections, these samples may contain radioactivity associated with emissions from the 324 Facility main stack. Because liquid discharges from the 324 Facility are sampled by WHC at the point of discharge to the uncontrolled environment, and because sampling for chemical constituents is currently not performed, analysis of PNL-collected effluent samples is limited to determining radioactivity in samples collected from the main building stack.

Section 7.0 describes the types of samples collected by the main building stack sampling system. These are particulate radionuclides on filter paper, and tritium on silica gel. The laboratories and procedures used to perform these analyses are described in Section 9.1. Section 9.2 provides a description of the chain-of-custody procedures employed by PNL and its supporting analytical laboratories.

9.1 Analytical Procedures

Analytical procedures for alpha and beta particulate radioactivity and isotopic analysis are provided in this section. The principal radionuclides in 324 Facility emissions are described in Section 6.0. These radionuclides are detectable using procedures described in this section.

9.1.1 Determination of Alpha and Beta Activity on Particulate Air Filter

Particulate air filter samples are collected every two weeks, as described in Section 7.0. The samples are initially delivered to a laboratory at the 3745 Building operated by PNL's Radiation Protection Section. The samples are held at the 3745 Building to allow adequate decay of Radon daughter radionuclides.

Record Alpha and Beta Activity Determination by ITAS-Richland

Following the hold time for Radon daughter decay, each particulate filter is delivered to the International Technology Analytical Services-Richland (ITAS) analytical laboratory. ITAS operates under contract to Battelle and performs analyses on a large variety of effluent and environmental samples. Work under the contract is performed according to documented requirements in a Statement of Work.

Samples are received, logged in, classified, and analyzed according to procedures documented as Standard Operating Procedures (SOPs).

The ITAS particulate alpha and beta analysis method is described in SOP 30-05. Samples are counted on an alpha and beta proportional counter. The counters are operated with a full open energy window and are calibrated using ^{239}Pu and ^{90}Sr sources corrected for self-absorption. As specified in the Statement of Work, required detection levels are 0.8-pCi alpha and 2.4-pCi beta activity on a filter for Type I and Type II errors of 0.05. For the 324 Facility stack, this equates to a detectable concentration of $4\text{E-}16 \mu\text{Ci/cm}^3$ alpha and $1\text{E-}15 \mu\text{Ci/cm}^3$ beta. Section 7.0 addresses the performance capability of the particulate emission sampling program in terms of detectable offsite dose.

9.1.2 Determination of Tritium in Silica Gel Column

Tritium in air is collected by trapping moisture in a column of silica gel. Following collection, the silica gel is removed from the column, placed in a polyethylene container, capped, and delivered to ITAS for analysis.

As stated previously, ITAS operates under contract to Battelle according to a documented Statement of Work. The tritium analysis procedure is documented by ITAS as SOP 20-H-02.

The procedure consists of quantitatively desorbing water collected in the silica gel column and counting for tritium using liquid scintillation spectrometry. The water is removed from the silica gel by heating under a vacuum and collecting with a freeze trap. A 5-mL aliquot is removed from the collected water for liquid scintillation counting. The detection level for tritium in water, as specified in the Statement of Work, is 300 pCi/L of water, assuming a sample size of at least 5 mL. PNL tritium samplers are designed and operated to provide the required sample size. Sensitivity of the measurement is highly dependent on the water loading of the sampler, with analytical sensitivity indirectly proportional to sampler loading. Assuming that a sampler is fully loaded with adsorbed water, after a 1-month sample period, a stack tritium concentration of $2\text{E-}11 \mu\text{Ci}/\text{cm}^3$ is detectable.

9.1.3 Isotopic Analysis

The record particulate filters analyzed by ITAS for alpha and beta discussed in Section 9.1.1 are further analyzed for ^{90}Sr , ^{241}Am , ^{238}Pu , $^{239/240}\text{Pu}$, and by gamma scan. These analyses are performed by ITAS on particulate samples composited on a quarterly basis.

The ITAS composite preparation and analysis methods used for the above isotopes are listed in Table 9.1. As specified in the Statement of Work, required detection levels are also listed in Table 9.1.

Before digesting the particulate filters for isotopic analysis, the filters are grouped by quarter and submitted to a gamma scan analysis. The quarterly groups of samples are transferred to a standard geometry container for counting on the gamma detectors. Intrinsic Germanium (HPGE) detectors are used to detect isotopes with gamma ray energies between 60 and 2000 Kev. The "n-type" HPGE or Low Energy Photon Detectors (LEPD) are generally used for isotopes with gamma ray energies less than 200Kev. Activity is determined using a Nuclear Data computer system.

Table 9.1. Isotopic Separation and Analysis Methods

Method	ITAS SOP	MDA, pCi
Air Filter Preparation and Compositing	RD-3242	-NA-
Gamma Analysis Sample Preparation, All Matrices	RD-3219	200
Electrodeposition Procedure for the Actinides	30-ED-02	-NA-
Strontium Determination for Environmental Matrices	20-Sr-03	10
Isotopic Plutonium Determination, All Matrices	RD-3209	1
Isotopic Americium/Curium Determination	RD-3206	1

Following the gamma scan, the quarterly groups are digested and the elements of interest are separated from other elements and the sample matrix by radiochemistry. Strontium-90 content is determined by the radiochemical separation and counting of a daughter element, yttrium-90. The strontium is separated from other elements radiochemically, then yttrium-90 is permitted to grow into equilibrium with the strontium-90. The yttrium-90 is then separated and processed to determine the chemical recovery and counted on a low background beta proportional counter. The quantity of strontium-90 is then determined based on the quantity of the daughter yttrium-90 produced.

Plutonium is separated from other elements and the sample matrix by adsorption on an anion exchange column. The plutonium is then processed radiochemically and electroplated or coprecipitated on rare earth fluorides. Isotopic concentrations of the deposited material is determined by alpha spectrometry. Following the removal of the plutonium, the sample matrix is further processed radiochemically and the americium and curium removed by passing the sample through a cation exchange column. The americium and curium are eluted from the column and either electroplated or coprecipitated. As with the plutonium, isotopic concentrations of the deposited material is determined by alpha spectrometry.

9.2 Chain-of-Custody Procedures

Chain-of-custody procedures for air emission samples are documented in PNL-MA-508. Procedures include provisions for transfer of samples between operational staff, to and from regulated storage areas, and to the analytical laboratory. Both PNL and its offsite analytical services contractor implement chain of custody within the Laboratory.

Analytical laboratory chain-of-custody procedures are documented in PNL-MA-508 for the preliminary analyses of particulate emission samples, and in ITAS SOP RD-20800 and Laboratory Support Manual RD-2201 for record analysis of particulate air filters and silica gel collectors.

Samples are stored for one year before being discarded.

10.0 Notifications and Reporting Requirements

10.1 Off-Normal Event Notification and Reporting

This section identifies the requirements and provides an overview of the procedural steps for the notification, investigation, and reporting of all environmental off-normal events for Battelle, Pacific Northwest Laboratories operations. This section provides a basic outline of the environmental off-normal event information available in PNL-MA-7, *Off-Normal Event Reporting System*, and DOE 5000.3B, "Occurrence Reporting and Processing of Operations Information."

NOTE: In this section, all discussion of off-normal events refers only to the environmental category of these events.

The basic objective of the system is to gather data on environmental off-normal events to

- obtain immediate resources required to deal with the off-normal event and coordinate activities
- alert PNL management to off-normal operating conditions and activities
- make proper notification to DOE and regulatory agencies
- allow management to make decisions concerning any corrective action to prevent recurrence
- perform analyses using all available data to identify any trends in events
- distribute findings useful to others.

10.1.1 Definitions

Emergency: The most serious occurrence category requiring an increased alert status for onsite personnel and, in specified cases, for offsite authorities.

Event: A real-time occurrence (e.g., pipe break, valve failure, loss of power).

Federally permitted release: Any release that satisfies the definition of "federally permitted release" in 40 CFR 302.3.

Hazardous substance or material: Any solid, liquid, or gaseous material that satisfies the regulatory definition provided in 40 CFR 300. Oil is excluded from this definition.

Logbook only off-normal event: An off-normal event that has a low potential for creating a serious safety hazard.

Occurrence Classifier: A senior staff member who is knowledgeable and experienced in off-normal event reporting who concurs with the facility manager on the final decision on categorizing occurrences.

Occurrence Report: A written evaluation of an event or condition that is prepared in sufficient detail to enable a 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.

Off-normal event (ONE): An unplanned or unexpected event, or the discovery of a deficiency in a procedure, plan, or system. The event must have real or potentially undesirable effects on personnel, equipment, facilities, or programs. Effects can include damage, loss, failure, or delays that can have undesirable results.

Off-normal occurrence: Abnormal or unplanned events or conditions that adversely affect, potentially affect, or are indicative of degradation in the safety, security, environmental or health protection performance, or operation of a facility.

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.

Release: 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 unenclosed containment structures.

Reportable occurrence: Events or conditions to be reported in accordance with the criteria defined in DOE 5000.3A.

Reportable quantity: For any Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substance, the quantity established in Table 302.4 and Appendix B of 40 CFR 302, the release of which requires notification unless federally permitted.

Unusual occurrence: A nonemergency occurrence that has significant impact, or potential for impact, on safety, environment, health, security, or operations.

10.1.2 Categorization of ONE

ONE reporting requirements vary depending primarily on the categorization of the event. A ONE may be categorized as an emergency, an unusual occurrence, an off-normal occurrence, or a logbook entry only.

NOTE: Any of the above categories could easily become elevated to a higher severity event.

PNL-MA-7, Appendix B, "Categorization of Reportable Occurrences," provides a generic list of occurrences to guide the occurrence classifier in categorizing reportable occurrences. Occurrences have been arranged into nine groups that relate to DOE operations. Only the environmental group is addressed in this section.

Within each environmental grouping is a list of occurrences derived from DOE 5000.3A. They are categorized as emergency, unusual occurrences, or

off-normal occurrences. The list presents a minimum set of standards that reflect the DOE-desired degree of significance in categorization. The information contained in these categories is presented in Table 10.1.

Table 10.1. Categorization of Off-Normal Events

Condition/Event	Definition	E	UO	ONO
Group 2) Environmental				
2)A. Radionuclide Releases	Any release of radionuclide material to controlled or uncontrolled areas in concentrations which, if averaged over a period of 24 hours, would exceed 5 times the respective Reportable Quantities (RQs) specified for such materials in 40 CFR 302.	X		
	Release of a radionuclide material that exceeds a Federally permitted release by the amount of a CERCLA RQ or, where no Federally permitted release exists, the release exceeds the RQ.		X	
	Release of radionuclide material that violates environmental requirements in Federal permits, Federal regulations, or DOE standards.		X	
	Release below Emergency levels which requires immediate (less than four hours) reporting to Federal regulatory authorities or triggers specific action levels for an outside Federal agency.		X	
	Any release of radionuclide material to controlled or uncontrolled areas that is not part of a normal monitored release and exceeds 50% of a CERCLA RQ specified for such material per 40 CFR 302.			X
	Any controlled release of radionuclide material that occurs as a monitored part of normal operations which exceeds what historical data and/or analysis show is expected as a result of normal operations.			X
	Any monitored facility or site boundary where exposure or concentrations exceed what historical data and/or analysis show is expected as a result of normal operations.			X
	Any detection of a radionuclide in a sanitary or storm sewer, waste or process stream, or any holding points where such a material is not expected.			X
	Any controlled, uncontrolled, or accidental release which is not classified as an Unusual Occurrence but which will be reported in writing to State/local agencies in a format other than routine monthly or quarterly reports.			X
2)B. Release of Hazardous Substances/Regulated Pollutants/Oil (Spills or releases of ethylene glycol and glycol ethers reported at levels in excess of 100 pounds)	Any actual or potential release of material to the environment that results in or could result in significant offsite consequences (e.g., need to relocate people, major wildlife kills, major wetland degradation, major aquifer contamination, need to secure downstream water supply intakes, etc.).	X		
	Any release of hazardous substances or regulated pollutants in concentrations which exceed 5 times the respective RQs specified for such materials in 40 CFR 302.	X		
	Release of a hazardous substance or regulated pollutant that exceeds a CERCLA RQ per 40 CFR 302 or exceeds a Federally permitted release by an RQ.		X	
	Release of a hazardous substance, regulated pollutant, or oil that violates environmental requirements in Federal permits, Federal regulations, or DOE standards.		X	
	Release below Emergency levels that requires immediate (less than four hours) reporting to Federal regulatory agencies or triggers specific action levels for an outside Federal agency.		X	

Table 10.1. (contd)

Condition/Event	Definition	E	UO	ONO
Group 2) Environmental				
	Any release of 100 gallons or more of oil.		X	
	Release of a hazardous substance or regulated pollutant to controlled or uncontrolled areas that is not part of a normal, monitored release and exceeds 50% of a CERCLA RQ as specified for such material per 40 CFR 302.			X
	Any release of oil less than Unusual Occurrence level but greater than 10 gallons.			X
	Any detection of a toxic or hazardous substance in a sanitary or storm sewer, waste or process stream, or any holding points where such a material is not expected.			X
	Any controlled, uncontrolled, or accidental release which is not classified as an Unusual Occurrence but which will be reported in writing to State/local agencies in a format other than routine monthly or quarterly reports.			X
	Any controlled release of hazardous/regulated material that occurs as a monitored part of normal operations which exceeds what historical data and/or analysis shows is expected as a result of normal operations.			X
	Any general environmental monitoring where concentration increases to a level which exceeds what historical data and/or analysis shows is expected as a result of normal operations.			X
2)C. Hazardous material contamination due to PNL operations	Discovery of contamination that results or could result in significant consequences (i.e., exceeding safe exposure limits to workers or public).	X		
	Discovery of onsite or offsite hazardous material contaminations in concentrations that exceed 5 times the respective RQs specified for such materials in 40 CFR 302.	X		
	Discovery of onsite or offsite contamination due to PNL operations which does not represent an immediate threat to the public, that exceeds a reportable quantity for such materials per 40 CFR 302.		X	
	Any discovery of groundwater contamination that is not part of an existing plume previously identified in either an annual report or in any CERCLA/RCRA activity or report.		X	
	Discovery of onsite contamination attributable to PNL operations that exceeds 50% of a reportable quantity for such material per 40 CFR 302.			X
2)D. Ecological Resources	Any occurrence causing significant impact to any ecological resource for which PNL is a trustee (i.e., destruction of a critical habitat, damage to a historic/archeological site, damage to wetlands, etc.).		X	
2)E. Agreement/Compliance Activities	Any agreement, compliance, remediation, or permit-mandated activity for which formal notification has been received from the relevant regulatory agency that a site plan is not satisfactory, or that a site is considered to be in noncompliance with schedules or requirements.		X	
	Any occurrence under any agreement or compliance area that requires notification of an outside regulatory agency within four hours or less, or triggers an outside regulatory agency action level, or otherwise indicates specific interest/concern from such agencies.		X	
	Any occurrence under any agreement or compliance area that will be reported in writing to outside agencies in a format other than routine monthly or quarterly reports.			X

10.1.3 Event Notification Procedure

Staff members must make notifications to ensure activation of emergency response personnel and proper communication of facts to PNL management, DOE, and others.

NOTE: First priority is always given to the appropriate emergency action necessary to control an event.

PNL-MA-7 provides specific procedures in off-normal events requiring immediate emergency assistance, event notification procedures, off-normal event investigation, off-normal event reporting, and off-normal event recovery.

10.2 Periodic Routine Effluent Monitoring Reports

On a periodic basis, effluent monitoring data are gathered by PNL on specific DOE Richland Operations Office (RL) facilities for compilation and reporting to DOE and the various regulatory agencies.

The following report is submitted on a monthly basis.

- Ecology is provided with a status of all reportable spills from the previous month through RL.

The following reports are submitted on an annual basis.

- The Air Emissions Report for the Hanford Site is submitted to the EPA and the Washington Department of Health for the Hanford Site radiological emissions.
- The Annual Radioactive Effluent and Onsite Discharge Data Report is submitted to DOE-Headquarters, the EPA, and DOH through RL after compilation by EG&G Idaho.
- The Hanford Site Environmental Report is submitted to DOE-Headquarters, the EPA, Ecology, and DOH through RL.

11.0 Interface with the Operational Environmental Surveillance Program

Environmental surveillance of the 300 area and the surrounding onsite and offsite areas is performed by the PNL Hanford Site Surface Environmental Surveillance Project and the PNL Site-Wide Groundwater Monitoring Project. These projects should be notified in the event of actual or apparent new or off-normal discharges to the soil, surface waters, or air so they can assist in assessing their environmental and compliance significance. The data from these programs are also useful to verify the occurrence or nonoccurrence of facility releases. These surveillance projects are described in detail in the Hanford Site Environmental Monitoring Plan.

12.0 Quality Assurance Plan

A Quality Assurance Plan (Quality Assurance Plan for PNL Radionuclide Air Emission Monitoring, FO-011) was developed to address quality assurance with regard to radionuclide air emission monitoring. The QA Plan applies to Battelle's PNL facility airborne radionuclide emission monitoring activities.

The QA program described by the plan is based on the following documentation:

- the U.S. Environmental Protection Agency (EPA) QAMS-005/80, *Interim Guidelines for Preparing Quality Assurance Project Plans*
- DOE 5700.6C, "Quality Assurance"
- DOE 5400.1, "General Environmental Protection Program"
- DOE/EH-0173T, "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance"
- applicable criteria of ASME NQA-1, *Quality Assurance Requirements for Nuclear Facilities*, as reflected in PNL's *Quality Assurance Manual*, PNL-MA-70, and associated implementing procedures.

Additions to, or deviations, from PNL-MA-70 procedures are documented in the plan under the appropriate criteria headings.

The QA Plan addresses the sections of QAMS-005/80, with additional sections added to incorporate necessary modifications or clarifications to the supporting NAQ-1 and DOE Order 5700.6C-based QA Program, as documented in PNL-MA-70. A cross reference between the format used in the plan and the format recommended in DOE 5400.1 is provided in Appendix A to the plan. Where DOE Order 5400.1 requirements appear primarily in PNL-MA-70 instead of the plan, a reference to PNL-MA-70 is provided.

A QA Plan addressing monitoring of liquid effluents is being developed in concert with the installation and development of PNL's liquid effluent monitoring program. A plan has been drafted and will be completed in 1995.

13.0 Internal and External Plan Review

DOE 5400.1 (DOE 1988a), states that the EMP will be reviewed annually and updated every three years. As a support document for the EMP, the FEMP will also be updated every three years. Additionally, this plan will be updated, as necessary, after each major change in facility processes, structure, ventilation and liquid collection systems, monitoring equipment, waste treatment, or a significant change to SARs or safety assessments. At a minimum, the FEMP assessment will be performed annually.

14.0 Compliance Assessment

The sampling systems for radioactive air emissions have been upgraded to meet 40 CFR 61 requirements. The air monitoring systems are planned to be upgraded.

The point of environmental release of liquid effluents from the 324 Facility is the 300 Area process trench. Monitoring of 300 Area liquid effluents is conducted by WHC. PNL will initiate installation of liquid effluent sampling for the 324 Facility PS during FY 1995 as part of a program to characterize building contributions to the 300 Area liquid waste streams.

14.1 Basis for Compliance Assessment

Standards and criteria used for system design and operation have been listed previously in Section 6.1. These include EPA requirements in 40 CFR 61, "National Emission Standard for Hazardous Air Pollutants" and DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*. These requirements are communicated to PNL management and staff via PNL-MA-8, *Waste Management and Environmental Compliance*.

14.2 Summary of Existing Sampler Compliance Deficiencies and Scheduled Corrective Actions

No compliance-related deficiencies have been identified for the existing 324 Facility stack sampling/monitoring system (Section 7.0).

14.3 Program Upgrades

Over the past several years, a significant effort has been made to upgrade PNL's effluent monitoring program. The upgrades are summarized as follows.

- The sampling system for radioactive air emissions have been upgraded to meet 40 CFR 61 requirements.
- Revisions to the liquid effluents chapters of PNL-MA-8 are being made. The revised chapters include administrative guidelines and practices for monitoring and controlling effluents to the liquid waste streams. The revision will be issued in 1995.
- Procedures for collection and analysis of record air samplers have been updated.
- The quality assurance plan, covering all elements of the PNL radioactive air emissions monitoring program, has been updated.
- Air sample line loss assessments have been performed using the DEPO computer code.
- Stack velocity and volumetric flow rate measurement procedures, conforming to EPA Method 2, have been implemented.
- Data accessibility, management, and security have been improved through database upgrades.

- Documented statements of work have been prepared for required support functions such as sample collection, sample analysis, stack velocity measurement, instrument calibration, and maintenance.
- Data handling procedures have been documented.

Additional program upgrades are planned. These are as follows:

- The radioactive particulate CAM in the 324 Building main stack will be upgraded.
- Documented statements of work will be prepared for database support.
- Liquid effluent sampling systems will be installed on building process sewer and retention process sewer lines.

Appendix A

Description of Laboratories in 324 Facility

A.1 Labs 22, 115, 207, 208, 210, 212

A.1.1 Description of Technical Activities

These nonradioactive laboratories support waste immobilization research. Standard activities include chemical mixing, glass production using high-temperature furnaces, biodegradation using nonhazardous micro-organisms, and other research supporting waste characterization and immobilization. The labs are equipped with fume hoods, sinks, compressed air, and other standard services.

A.1.2 Chemical Inventory

The chemical inventory primarily comprises inorganics salts, oxides, hydroxides, acids (nitric, sulfuric, and acetic), and heavy metals at less than reportable quantities.

A.1.3 Waste Streams

All hazardous waste streams generated are handled in accordance with policies outlined in PNL-MA-8. Satellite waste accumulation areas are set up as needed to support current lab research.

A.2 EDL-101, EDL-102, High Bay, and Tank Pit

A.2.1 Description of Technical Activities

These areas support the nonradioactive pilot-scale testing of systems related to in situ vitrification, ceramic melter development, biological degradation, double-shell tank resuspension and transport, grout immobilization, and Hanford Waste Vitrification Program development tasks.

A.2.2 Chemical Inventory

No chemicals are inventoried in these areas. Batches of feed stock used in pilot-scale testing of waste immobilization systems are mixed in designated chemical handling areas and then transferred to process holding tanks prior to pilot system operation. The feed stocks primarily comprise inorganic salts, oxides, hydroxides, and heavy metals. The volumes of hazardous materials contained in process tanks prior to processing operations can be as high as several thousand liters.

A.2.3 Waste Streams

All hazardous waste streams generated are handled in accordance with policies outlined in PNL-MA-8. Satellite waste accumulation areas are set up as needed to support current lab research.

A.3 Radiochemical Cells A, B, C, D, and Airlock

A.3.1 Description of Technical Activities

The radiochemical cells support a wide range of radioactive research and development activities. The research is centered around waste vitrification technologies such as ceramic melters and studies involving spent nuclear fuel.

A.3.2 Chemical/Radionuclide Inventory

No chemicals are inventoried in this area. The majority of the radionuclide inventory for these hot cells comprises ^{137}Cs and ^{90}Sr .

A.3.3 Waste Streams

The majority of solid and liquid waste generated from these hot cells is low-level nonhazardous radioactive waste. Current clean out of B-cell is generating high-level waste and also some radioactive mixed waste in the form of contaminated lead. The radioactive mixed waste is packaged according to the SDAR and stored in a <90-day area until transport to the 200 Area. Legacy high-activity mixed waste is currently stored in B-Cell due to past operations.

A.4 Room 147

A.4.1 Description of Technical Activities

This room is designated for manipulator decontamination and repair and low-level solid radioactive waste compaction.

A.4.2 Chemical/Radionuclide Inventory

The only chemicals inventoried in this area are oils, solvents, and decontamination solutions to support manipulator repair. Radionuclides present are associated with the low-level waste and contaminated manipulators.

A.4.3 Waste Streams

Low-level solid and liquid waste generated is disposed of in accordance with approved methods identified in applicable SDARs and the 300 Area RLWS procedure.

A.5 Room 146

A.5.1 Description of Technical Activities

This radioactive laboratory is currently conducting laboratory-scale waste vitrification systems development.

A.5.2 Chemical/Radionuclide Inventory

Typically low toxicity chemicals and low activity radionuclides are inventoried.

A.5.3 Waste Streams

Low-level solid waste from room clean out activities and lab operations are currently being generated and disposed according to approved methods.

A.6 SMF Hot Cells and Galleries

A.6.1 Description of Technical Activities

Typical activities conducted in the SMF hot cells include tritium extraction, cesium chloride encapsulation, and spent fuel characterization. These programs are on hold are no longer being funded.

A.6.2 Chemical/Radionuclide Inventory

The only chemicals currently inventoried include oils, solvents, and cleaning solutions to support manipulator repair and decontamination. Radionuclide inventory primarily comprises encapsulated ^{137}Cs , and in the future up to 5,000 Ci tritium.

A.6.3 Waste Streams

Radioactive low-level solid waste is the primary stream being generated at this time. When the Fast Flux Test Facility support program "MOTA" is operating, large volumes of radioactive mixed waste is generated and stored in a <90-day area. The radioactive mixed waste generated is a contaminated mixture of alcohol and water packaged in plastic-lined 55-gal drums.

A.7 Basement Area 3A, 3B, 3C, 3D, 3J, 3H, and 3K

A.7.1 Description of Technical Activities

These rooms currently support the storage and nondestructive assay of special nuclear materials. Special nuclear materials are stored in either a critically safe vault and or an approved MBA depending on type and quantities of radionuclides.

A.7.2 Chemical/Radionuclide Inventory

Radionuclide inventory is maintained according to fissile material protocols.

A.7.3 Waste Streams

Small quantities low-level solid waste are generated and properly disposed of.

A.8 Basement Area 3E, 3F, and 3G

A.8.1 Description of Technical Activities

These lab areas are currently inactive. Services include two fume hoods and one shielded glovebox.

A.8.2 Chemical/Radionuclide Inventory

None.

A.8.3 Waste Streams

None.

Appendix B

Projection of Offsite Emission Dose

DOE Order 5400.1 states that Environmental Monitoring Plans (EMP) "shall be prepared for each site, facility, or process that uses, generates, releases, or manages significant pollutants or hazardous materials" (DOE Order 5400.1, IV-2). To support the EMP, FEMPs are being prepared for those facilities that have the potential to release significant pollutants or hazardous materials. A methodology has been developed to determine whether potential releases of radioactive material are significant. This method is that same as that used to determine whether monitoring is required for the National Emission Standards for Hazardous Air Pollutants (NESHAPs - U.S. Code of Federal Regulations, Title 40 Part 161, Subparts H and I) and is described in *Pacific Northwest Laboratory Facilities Radionuclide Inventory Assessment CY 1992-1993* (Sula and Jette 1994, PNL-10061).

The first step in the method (called the FEMP Determination when used to determine whether or not a FEMP is needed for a facility) is to obtain a listing of the facility inventory. The inventory includes the radionuclide, isotope, quantity, and form. Form can be gas, liquid or powder, solid (nondispersible), contained (in sealed sourced or DOT containers), or exempt (sealed sources meeting certain criteria). At PNL, radioactive source and material information is maintained using three separate inventory systems: 1) facilities management radioactive materials inventory, 2) composite radioactive materials inventory, and 3) nuclear materials inventory. An identifier on the inventory listing indicates the inventory system that the information was obtained from. Additional detail on the FEMP Determination method is provided in PNL-10061. The attached table contains the inventory information for the 324 Building for 1994. The total unmitigated dose from the inventory is 7400 mrem using the inventory-based method. Most of this dose is from ^{137}Cs and ^{90}Sr in a dirt matrix in the bottom of B-Cell.

<u>Nuclide</u>	<u>Quantity</u>	<u>Units</u>	<u>Form</u>	<u>Inv.</u>	<u>Rel.Proj.</u>	<u>Units</u>	<u>Dose Fact.</u>	<u>Dose</u>
CS-137	4.72E+06	CI	S	1	4.7E+00	CI	5.02E+00	2.4E+01
SR-90	3.58E+06	CI	S	1	3.6E+00	CI	4.96E+00	1.8E+01
CS-137	2.29E+05	CI	S	1	2.3E-01	CI	5.02E+00	1.1E+00
CS-134	5.00E+03	CI	S	1	5.0E-03	CI	2.18E+00	1.1E-02
SR-90	1.09E+05	CI	S	1	1.1E-01	CI	4.96E+00	5.4E-01
Y-90	1.10E+04	CI	S	1	1.1E-02	CI	1.12E-02	1.2E-04
BA-133	6.50E+04	CI	S	1	6.5E-02	CI	1.54E+00	1.0E-01
H-3	7.02E+02	CI	S	1	7.0E-04	CI	4.23E-04	3.0E-07
CO-60	1.30E+03	CI	S	1	1.3E-03	CI	5.11E+00	6.6E-03
NI-63	1.42E+03	CI	S	1	1.4E-03	CI	1.05E-02	1.5E-05
KR-85	7.22E+03	CI	S	1	7.2E-03	CI	9.42E-07	6.8E-09
SR-90	1.32E+05	CI	S	1	1.3E-01	CI	4.96E+00	6.5E-01
Y-90	1.32E+05	CI	S	1	1.3E-01	CI	1.12E-02	1.5E-03
SB-125	2.62E+02	CI	S	1	2.6E-04	CI	6.32E-01	1.7E-04
CS-134	6.00E+02	CI	S	1	6.0E-04	CI	2.18E+00	1.3E-03
CS-137	1.92E+05	CI	S	1	1.9E-01	CI	5.02E+00	9.6E-01
BA-133	1.81E+05	CI	S	1	1.8E-01	CI	1.54E+00	2.8E-01
PM-147	1.46E+03	CI	S	1	1.5E-03	CI	2.84E-02	4.1E-05
SM-151	8.80E+02	CI	S	1	8.8E-04	CI	1.80E-02	1.6E-05
EU-154	7.06E+03	CI	S	1	7.1E-03	CI	4.06E+00	2.9E-02
EU-155	1.37E+03	CI	S	1	1.4E-03	CI	1.71E-01	2.3E-04
CS-137	1.06E+06	CI	L	1	1.1E+03	CI	5.02E+00	5.3E+03
SR-90	4.12E+05	CI	L	1	4.1E+02	CI	4.96E+00	2.0E+03
CS-137	1.30E+04	CI	S	1	1.3E-02	CI	5.02E+00	6.5E-02
SR-90	1.30E+04	CI	S	1	1.3E-02	CI	4.96E+00	6.4E-02
MN-54	3.00E-03	CI	S	1	3.0E-09	CI	3.50E-01	1.1E-09
FE-55	2.11E+01	CI	S	1	2.1E-05	CI	7.02E-03	1.5E-07
CO-60	3.90E-01	CI	S	1	3.9E-07	CI	5.11E+00	2.0E-06
NI-63	1.50E-02	CI	S	1	1.5E-08	CI	1.05E-02	1.6E-10
ZN-65	4.00E-02	CI	S	1	4.0E-08	CI	4.42E-01	1.8E-08
H-3	2.60E+01	CI	S	1	2.6E-05	CI	4.23E-04	1.1E-08
CO-60	4.80E+01	CI	S	1	4.8E-05	CI	5.11E+00	2.5E-04
NI-63	5.30E+01	CI	S	1	5.3E-05	CI	1.05E-02	5.6E-07
KR-85	2.69E+02	CI	S	1	2.7E-04	CI	9.42E-07	2.5E-10
SR-90	4.92E+03	CI	S	1	4.9E-03	CI	4.96E+00	2.4E-02
Y-90	4.92E+03	CI	S	1	4.9E-03	CI	1.12E-02	5.5E-05
SB-125	1.00E+01	CI	S	1	1.0E-05	CI	6.32E-01	6.3E-06
CS-134	2.20E+01	CI	S	1	2.2E-05	CI	2.18E+00	4.8E-05
CS-137	7.16E+03	CI	S	1	7.2E-03	CI	5.02E+00	3.6E-02
BA-133	6.75E+03	CI	S	1	6.7E-03	CI	1.54E+00	1.0E-02
PM-147	5.40E+01	CI	S	1	5.4E-05	CI	2.84E-02	1.5E-06
SM-151	3.30E+01	CI	S	1	3.3E-05	CI	1.80E-02	5.9E-07
EU-154	2.63E+02	CI	S	1	2.6E-04	CI	4.06E+00	1.1E-03
EU-155	5.10E+01	CI	S	1	5.1E-05	CI	1.71E-01	8.7E-06
CO-60	8.10E+02	CI	S	1	8.1E-04	CI	5.11E+00	4.1E-03
MN-54	1.08E+02	CI	S	1	1.1E-04	CI	3.50E-01	3.8E-05
FE-55	5.08E+02	CI	S	1	5.1E-04	CI	7.02E-03	3.6E-06
NI-59	1.20E+00	CI	S	1	1.2E-06	CI	8.27E-03	9.9E-09
NB-94	1.00E-03	CI	S	1	1.0E-09	CI	1.62E+01	1.6E-08
H-3	8.50E-01	CI	S	1	8.5E-07	CI	4.23E-04	3.6E-10

C-14	4.00E-04	CI	S	1	4.0E-10	CI	5.06E-02	2.0E-11
SR-90	4.72E+04	CI	S	1	4.7E-02	CI	4.96E+00	2.3E-01
CS-134	2.14E+02	CI	S	1	2.1E-04	CI	2.18E+00	4.7E-04
CS-137	7.30E+04	CI	S	1	7.3E-02	CI	5.02E+00	3.7E-01
EU-154	4.96E+02	CI	S	1	5.0E-04	CI	4.06E+00	2.0E-03
SB-125	1.00E-01	CI	S	1	1.0E-07	CI	6.32E-01	6.3E-08
FE-55	1.28E+05	CI	S	1	1.3E-01	CI	7.02E-03	9.0E-04
MN-54	9.07E+03	CI	S	1	9.1E-03	CI	3.50E-01	3.2E-03
CO-60	4.41E+03	CI	S	1	4.4E-03	CI	5.11E+00	2.3E-02
NI-63	1.86E+03	CI	S	1	1.9E-03	CI	1.05E-02	2.0E-05
CS-137	6.17E+04	CI	C	1	0.0E+00	CI	5.02E+00	0.0E+00
Pu-239	5.00E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	5.00E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
CM-244	1.35E-03	CI	C	2	0.0E+00	CI	1.55E+02	0.0E+00
CS-137	2.60E-03	CI	C	2	0.0E+00	CI	5.02E+00	0.0E+00
CS-134	7.30E-04	CI	C	2	0.0E+00	CI	2.18E+00	0.0E+00
SR-90	1.81E-03	CI	C	2	0.0E+00	CI	4.96E+00	0.0E+00
CO-60	1.33E-03	CI	C	2	0.0E+00	CI	5.11E+00	0.0E+00
Pu-239	5.06E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
U(dep)	1.00E+02	grams	C	2	0.0E+00	grams	2.33E-05	0.0E+00
Pu-239	1.20E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.50E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.50E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.50E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	5.00E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.40E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	3.03E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.02E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	3.00E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
TH-230	3.00E-09	CI	C	2	0.0E+00	CI	1.21E+02	0.0E+00
CS-137	7.55E-03	CI	C	2	0.0E+00	CI	5.02E+00	0.0E+00
SR-90	1.42E-03	CI	C	2	0.0E+00	CI	4.96E+00	0.0E+00
SR-90	1.42E-03	CI	C	2	0.0E+00	CI	4.96E+00	0.0E+00
AM-241	1.08E-05	CI	C	2	0.0E+00	CI	2.94E+02	0.0E+00
CS-137	1.02E-05	CI	C	2	0.0E+00	CI	5.02E+00	0.0E+00
CO-60	1.22E-05	CI	C	2	0.0E+00	CI	5.11E+00	0.0E+00
Cf-252	1.20E-06	grams	C	2	0.0E+00	grams	4.32E+04	0.0E+00
U(90%)	9.60E+00	grams	C	2	0.0E+00	grams	4.25E-03	0.0E+00
Cf-252	1.60E-06	grams	C	2	0.0E+00	grams	4.32E+04	0.0E+00
Pu-238	1.10E+00	grams	C	2	0.0E+00	grams	3.16E+03	0.0E+00
Pu-239	8.00E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Am-241	2.00E-01	grams	C	2	0.0E+00	grams	9.50E+02	0.0E+00
Pu-238	1.00E+00	grams	C	2	0.0E+00	grams	3.16E+03	0.0E+00
Pu-238	1.00E+00	grams	C	2	0.0E+00	grams	3.16E+03	0.0E+00
Pu-238	1.10E+00	grams	C	2	0.0E+00	grams	3.16E+03	0.0E+00
CS-137	7.00E-05	CI	C	2	0.0E+00	CI	5.02E+00	0.0E+00
SE-75	1.00E-01	CI	C	2	0.0E+00	CI	9.10E-01	0.0E+00
Pu-238	2.00E-01	grams	C	2	0.0E+00	grams	3.16E+03	0.0E+00
CF-252	1.01E-05	CI	C	2	0.0E+00	CI	8.09E+01	0.0E+00
Pu-239	1.60E-03	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	6.70E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00

Pu-239	2.70E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	6.70E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.33E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.00E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.32E-02	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.34E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	3.34E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	6.68E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.00E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.30E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.30E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.70E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.00E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Am-241	1.00E-01	grams	C	2	0.0E+00	grams	9.50E+02	0.0E+00
Am-241	1.00E-01	grams	C	2	0.0E+00	grams	9.50E+02	0.0E+00
CS-137	5.36E-02	Cl	C	2	0.0E+00	Cl	5.02E+00	0.0E+00
Pu-239	1.00E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.00E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.30E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
SE-75	1.00E-01	Cl	C	2	0.0E+00	Cl	9.10E-01	0.0E+00
CO-60	1.35E-04	Cl	C	2	0.0E+00	Cl	5.11E+00	0.0E+00
CO-60	6.95E-05	Cl	C	2	0.0E+00	Cl	5.11E+00	0.0E+00
U(dep)	1.27E+04	grams	C	3	0.0E+00	grams	2.33E-05	0.0E+00
U(20%)	1.28E+05	grams	C	3	0.0E+00	grams	6.41E-04	0.0E+00
U(90%)	3.91E+02	grams	C	3	0.0E+00	grams	4.25E-03	0.0E+00
Am-241	5.00E-01	grams	C	3	0.0E+00	grams	9.50E+02	0.0E+00
Cm-244	1.20E+00	grams	C	3	0.0E+00	grams	1.29E+04	0.0E+00
Cf-252	9.00E-01	grams	C	3	0.0E+00	grams	4.32E+04	0.0E+00
Pu(6%)	1.06E+03	grams	C	3	0.0E+00	grams	1.60E+01	0.0E+00
U-233	7.00E-01	grams	C	3	0.0E+00	grams	7.09E-01	0.0E+00
U(nat)	2.40E+03	grams	C	3	0.0E+00	grams	4.40E-05	0.0E+00
Np-237	1.90E+02	grams	C	3	0.0E+00	grams	1.84E-01	0.0E+00
Pu-238	1.07E+01	grams	C	3	0.0E+00	grams	3.16E+03	0.0E+00
U(dep)	1.25E+04	grams	C	3	0.0E+00	grams	2.33E-05	0.0E+00
U(dep)	1.04E+06	grams	S	3	1.0E+00	grams	2.33E-05	2.4E-05
U(20%)	1.20E+06	grams	S	3	1.2E+00	grams	6.41E-04	7.7E-04
Pu-242	6.17E+02	grams	S	3	6.2E-04	grams	7.41E-01	4.6E-04
Am-241	2.20E+00	grams	S	3	2.2E-06	grams	9.50E+02	2.1E-03
Am-243	1.66E+02	grams	S	3	1.7E-04	grams	5.47E+01	9.1E-03
Cm-244	9.42E+01	grams	S	3	9.4E-05	grams	1.29E+04	1.2E+00
Pu(6%)	2.70E+04	grams	S	3	2.7E-02	grams	1.60E+01	4.3E-01
U(nat)	7.10E+03	grams	S	3	7.1E-03	grams	4.40E-05	3.1E-07
Np-237	8.54E+02	grams	S	3	8.5E-04	grams	1.84E-01	1.6E-04
Th-232	1.15E+05	grams	S	3	1.2E-01	grams	2.18E-05	2.5E-06

Nuclide	Quantity	Units	Form	Inv.	Rel.Prol.	Units	Dose Fact.	Dose
CS-137	4.72E+06	CI	S	1	4.7E+00	CI	5.02E+00	2.4E+01
SR-90	3.58E+06	CI	S	1	3.6E+00	CI	4.96E+00	1.8E+01
CS-137	2.29E+05	CI	S	1	2.3E-01	CI	5.02E+00	1.1E+00
CS-134	5.00E+03	CI	S	1	5.0E-03	CI	2.18E+00	1.1E-02
SR-90	1.09E+05	CI	S	1	1.1E-01	CI	4.96E+00	5.4E-01
Y-90	1.10E+04	CI	S	1	1.1E-02	CI	1.12E-02	1.2E-04
BA-133	6.50E+04	CI	S	1	6.5E-02	CI	1.54E+00	1.0E-01
H-3	7.02E+02	CI	S	1	7.0E-04	CI	4.23E-04	3.0E-07
CO-60	1.30E+03	CI	S	1	1.3E-03	CI	5.11E+00	6.6E-03
NI-63	1.42E+03	CI	S	1	1.4E-03	CI	1.05E-02	1.5E-05
KR-85	7.22E+03	CI	S	1	7.2E-03	CI	9.42E-07	6.8E-09
SR-90	1.32E+05	CI	S	1	1.3E-01	CI	4.96E+00	6.5E-01
Y-90	1.32E+05	CI	S	1	1.3E-01	CI	1.12E-02	1.5E-03
SB-125	2.62E+02	CI	S	1	2.6E-04	CI	6.32E-01	1.7E-04
CS-134	6.00E+02	CI	S	1	6.0E-04	CI	2.18E+00	1.3E-03
CS-137	1.92E+05	CI	S	1	1.9E-01	CI	5.02E+00	9.6E-01
BA-133	1.81E+05	CI	S	1	1.8E-01	CI	1.54E+00	2.8E-01
PM-147	1.46E+03	CI	S	1	1.5E-03	CI	2.84E-02	4.1E-05
SM-151	8.80E+02	CI	S	1	8.8E-04	CI	1.80E-02	1.6E-05
EU-154	7.06E+03	CI	S	1	7.1E-03	CI	4.06E+00	2.9E-02
EU-155	1.37E+03	CI	S	1	1.4E-03	CI	1.71E-01	2.3E-04
CS-137	1.06E+06	CI	L	1	1.1E+03	CI	5.02E+00	5.3E+03
SR-90	4.12E+05	CI	L	1	4.1E+02	CI	4.96E+00	2.0E+03
CS-137	1.30E+04	CI	S	1	1.3E-02	CI	5.02E+00	6.5E-02
SR-90	1.30E+04	CI	S	1	1.3E-02	CI	4.96E+00	6.4E-02
MN-54	3.00E-03	CI	S	1	3.0E-09	CI	3.50E-01	1.1E-09
FE-55	2.11E+01	CI	S	1	2.1E-05	CI	7.02E-03	1.5E-07
CO-60	3.90E-01	CI	S	1	3.9E-07	CI	5.11E+00	2.0E-06
NI-63	1.50E-02	CI	S	1	1.5E-08	CI	1.05E-02	1.6E-10
ZN-65	4.00E-02	CI	S	1	4.0E-08	CI	4.42E-01	1.8E-08
H-3	2.60E+01	CI	S	1	2.6E-05	CI	4.23E-04	1.1E-08
CO-60	4.80E+01	CI	S	1	4.8E-05	CI	5.11E+00	2.5E-04
NI-63	5.30E+01	CI	S	1	5.3E-05	CI	1.05E-02	5.6E-07
KR-85	2.69E+02	CI	S	1	2.7E-04	CI	9.42E-07	2.5E-10
SR-90	4.92E+03	CI	S	1	4.9E-03	CI	4.96E+00	2.4E-02
Y-90	4.92E+03	CI	S	1	4.9E-03	CI	1.12E-02	5.5E-05
SB-125	1.00E+01	CI	S	1	1.0E-05	CI	6.32E-01	6.3E-06
CS-134	2.20E+01	CI	S	1	2.2E-05	CI	2.18E+00	4.8E-05
CS-137	7.16E+03	CI	S	1	7.2E-03	CI	5.02E+00	3.6E-02
BA-133	6.75E+03	CI	S	1	6.7E-03	CI	1.54E+00	1.0E-02
PM-147	5.40E+01	CI	S	1	5.4E-05	CI	2.84E-02	1.5E-06
SM-151	3.30E+01	CI	S	1	3.3E-05	CI	1.80E-02	5.9E-07
EU-154	2.63E+02	CI	S	1	2.6E-04	CI	4.06E+00	1.1E-03
EU-155	5.10E+01	CI	S	1	5.1E-05	CI	1.71E-01	8.7E-06
CO-60	8.10E+02	CI	S	1	8.1E-04	CI	5.11E+00	4.1E-03
MN-54	1.08E+02	CI	S	1	1.1E-04	CI	3.50E-01	3.8E-05
FE-55	5.08E+02	CI	S	1	5.1E-04	CI	7.02E-03	3.6E-06
NI-59	1.20E+00	CI	S	1	1.2E-06	CI	8.27E-03	9.9E-09
NB-94	1.00E-03	CI	S	1	1.0E-09	CI	1.62E+01	1.6E-08
H-3	8.50E-01	CI	S	1	8.5E-07	CI	4.23E-04	3.6E-10

C-14	4.00E-04	CI	S	1	4.0E-10	CI	5.06E-02	2.0E-11
SR-90	4.72E+04	CI	L	1	4.7E+01	CI	4.96E+00	2.3E+02
CS-134	2.14E+02	CI	L	1	2.1E-01	CI	2.18E+00	4.7E-01
CS-137	7.30E+04	CI	L	1	7.3E+01	CI	5.02E+00	3.7E+02
EU-154	4.96E+02	CI	L	1	5.0E-01	CI	4.06E+00	2.0E+00
SB-125	1.00E-01	CI	L	1	1.0E-04	CI	6.32E-01	6.3E-05
FE-55	1.28E+05	CI	S	1	1.3E-01	CI	7.02E-03	9.0E-04
MN-54	9.07E+03	CI	S	1	9.1E-03	CI	3.50E-01	3.2E-03
CO-60	4.41E+03	CI	S	1	4.4E-03	CI	5.11E+00	2.3E-02
NI-63	1.86E+03	CI	S	1	1.9E-03	CI	1.05E-02	2.0E-05
CS-137	6.17E+04	CI	C	1	0.0E+00	CI	5.02E+00	0.0E+00
Pu-239	5.00E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	5.00E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
CM-244	1.35E-03	CI	C	2	0.0E+00	CI	1.55E+02	0.0E+00
CS-137	2.60E-03	CI	C	2	0.0E+00	CI	5.02E+00	0.0E+00
CS-134	7.30E-04	CI	C	2	0.0E+00	CI	2.18E+00	0.0E+00
SR-90	1.81E-03	CI	C	2	0.0E+00	CI	4.96E+00	0.0E+00
CO-60	1.33E-03	CI	C	2	0.0E+00	CI	5.11E+00	0.0E+00
Pu-239	5.06E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
U(dep)	1.00E+02	grams	C	2	0.0E+00	grams	2.33E-05	0.0E+00
Pu-239	1.20E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.50E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.50E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.50E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	5.00E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.40E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	3.03E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.02E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	3.00E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
TH-230	3.00E-09	CI	C	2	0.0E+00	CI	1.21E+02	0.0E+00
CS-137	7.55E-03	CI	C	2	0.0E+00	CI	5.02E+00	0.0E+00
SR-90	1.42E-03	CI	C	2	0.0E+00	CI	4.96E+00	0.0E+00
SR-90	1.42E-03	CI	C	2	0.0E+00	CI	4.96E+00	0.0E+00
AM-241	1.08E-05	CI	C	2	0.0E+00	CI	2.94E+02	0.0E+00
CS-137	1.02E-05	CI	C	2	0.0E+00	CI	5.02E+00	0.0E+00
CO-60	1.22E-05	CI	C	2	0.0E+00	CI	5.11E+00	0.0E+00
Cf-252	1.20E-06	grams	C	2	0.0E+00	grams	4.32E+04	0.0E+00
U(90%)	9.60E+00	grams	C	2	0.0E+00	grams	4.25E-03	0.0E+00
Cf-252	1.60E-06	grams	C	2	0.0E+00	grams	4.32E+04	0.0E+00
Pu-238	1.10E+00	grams	C	2	0.0E+00	grams	3.16E+03	0.0E+00
Pu-239	8.00E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Am-241	2.00E-01	grams	C	2	0.0E+00	grams	9.50E+02	0.0E+00
Pu-238	1.00E+00	grams	C	2	0.0E+00	grams	3.16E+03	0.0E+00
Pu-238	1.00E+00	grams	C	2	0.0E+00	grams	3.16E+03	0.0E+00
Pu-238	1.10E+00	grams	C	2	0.0E+00	grams	3.16E+03	0.0E+00
CS-137	7.00E-05	CI	C	2	0.0E+00	CI	5.02E+00	0.0E+00
SE-75	1.00E-01	CI	C	2	0.0E+00	CI	9.10E-01	0.0E+00
Pu-238	2.00E-01	grams	C	2	0.0E+00	grams	3.16E+03	0.0E+00
CF-252	1.01E-05	CI	C	2	0.0E+00	CI	8.09E+01	0.0E+00
Pu-239	1.60E-03	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	6.70E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00

Pu-239	2.70E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	6.70E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.33E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.00E+01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.32E-02	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.00E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.30E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.30E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.70E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.00E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Am-241	1.00E-01	grams	C	2	0.0E+00	grams	9.50E+02	0.0E+00
Am-241	1.00E-01	grams	C	2	0.0E+00	grams	9.50E+02	0.0E+00
CS-137	5.36E-02	Cl	C	2	0.0E+00	Cl	5.02E+00	0.0E+00
Pu-239	1.00E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	2.00E-01	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
Pu-239	1.30E+00	grams	C	2	0.0E+00	grams	1.24E+01	0.0E+00
SE-75	1.00E-01	Cl	C	2	0.0E+00	Cl	9.10E-01	0.0E+00
CO-60	1.35E-04	Cl	C	2	0.0E+00	Cl	5.11E+00	0.0E+00
CO-60	6.95E-05	Cl	C	2	0.0E+00	Cl	5.11E+00	0.0E+00
U(dep)	1.27E+04	grams	C	3	0.0E+00	grams	2.33E-05	0.0E+00
U(20%)	1.28E+05	grams	C	3	0.0E+00	grams	6.41E-04	0.0E+00
U(90%)	3.91E+02	grams	C	3	0.0E+00	grams	4.25E-03	0.0E+00
Am-241	5.00E-01	grams	C	3	0.0E+00	grams	9.50E+02	0.0E+00
Cm-244	1.20E+00	grams	C	3	0.0E+00	grams	1.29E+04	0.0E+00
Cf-252	9.00E-01	grams	C	3	0.0E+00	grams	4.32E+04	0.0E+00
Pu(6%)	1.06E+03	grams	C	3	0.0E+00	grams	1.60E+01	0.0E+00
U-233	7.00E-01	grams	C	3	0.0E+00	grams	7.09E-01	0.0E+00
U(nat)	2.40E+03	grams	C	3	0.0E+00	grams	4.40E-05	0.0E+00
Np-237	1.90E+02	grams	C	3	0.0E+00	grams	1.84E-01	0.0E+00
Pu-238	1.07E+01	grams	C	3	0.0E+00	grams	3.16E+03	0.0E+00
U(dep)	1.04E+06	grams	S	3	1.0E+00	grams	2.33E-05	2.4E-05
U(20%)	1.20E+06	grams	S	3	1.2E+00	grams	6.41E-04	7.7E-04
Pu-242	6.17E+02	grams	S	3	6.2E-04	grams	7.41E-01	4.6E-04
Am-241	2.20E+00	grams	S	3	2.2E-06	grams	9.50E+02	2.1E-03
Am-243	1.66E+02	grams	S	3	1.7E-04	grams	5.47E+01	9.1E-03
Cm-244	9.42E+01	grams	S	3	9.4E-05	grams	1.29E+04	1.2E+00
Pu(6%)	2.70E+04	grams	S	3	2.7E-02	grams	1.60E+01	4.3E-01
U(nat)	7.10E+03	grams	S	3	7.1E-03	grams	4.40E-05	3.1E-07
Np-237	8.54E+02	grams	S	3	8.5E-04	grams	1.84E-01	1.6E-04
Th-232	1.15E+05	grams	S	3	1.2E-01	grams	2.18E-05	2.5E-06

Appendix C

Nonradioactive Hazardous Materials Characterization

DOE Order 5400.1 states that Environmental Monitoring Plans (EMP) "shall be prepared for each site, facility, or process that uses, generates, releases, or manages significant pollutants or hazardous materials" (DOE Order 5400.1, IV-2). The Facility Effluent Monitoring Plans (FEMPs) that are being prepared to support the EMP include the consideration of nonradioactive hazardous materials. No methodology has been developed to determine the potential release of nonradioactive hazardous chemicals, but hazardous chemicals are considered for the facilities that are determined to need a FEMP from potential radioactive airborne emissions.

A listing of the chemicals used in the building is obtained using the PNL Chemical Inventory System. The inventory information includes the location, chemical name, and quantity. In some cases the manufacturer and individual container quantities are also tracked. In addition, the CIS data includes the reportable quantity (RQ) of the chemical. RQs are obtained from 40 CFR 302 and are the amounts which, if released to the environment from a facility, require notification to the National Response Center. RQs can indicate the relative hazard of a chemical. The building inventory as of mid May 1994 is given in Table C.1 for 324 and Table C.2 for 3718G.

For the FEMP facilities, chemicals that may be present in greater than RQ amounts were identified to characterize the potential for emissions of nonradioactive hazardous materials. These chemicals are listed below for the 324 Building, and for the 3718 Building, which is used for chemical storage for 324 Building activities. Table C.3 lists the chemicals, quantity of chemical in a container, and the number of containers (units) with that quantity for chemicals present in greater than RQ quantities. (If no units are given, the information is for a single container.) The last column provides the RQ.

Table C.1. 324 Building

May 16, 1994

BATTELLE NORTHWEST LABS
CHEMICAL INVENTORY SYSTEM

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Reportable Quantities Chemical Listing for Bldg: 324

Room No	RQ Code	Chemical Name	PNL Chem No	CAS Number	MSDS Number	Container Number	Mfr Name	Cont Qty	Unit	Converted Amount	Conv Unit
101	QD	ACETONE	275	67641	1005	16939		1.000	PT	.82	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	77417	ALDRICH CH	2.000	L	7.02	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	77418	ALDRICH CH	500.000	ML	1.76	LB
	QD	METHANOL	2417	67561	1329	16941		400.000	ML	.70	LB
	QD	METHYL ALCOHOL	2417	67561	1329	16937		400.000	ML	.70	LB
	QC	METHYLENE CHLORIDE	20282	75092	1350	68262	FISHER	2.000	L	5.84	LB
	QC	METHYLENE CHLORIDE	20282	75092	1350	68263	FISHER	2.000	L	5.84	LB
	QC	METHYLENE CHLORIDE	20282	75092	1350	68264	FISHER	2.000	L	5.84	LB
	QC	METHYLENE CHLORIDE	20282	75092	1350	68265	FISHER	2.000	L	5.84	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68165	BAKER	500.000	ML	2.35	LB
	QB	TETRACHLOROETHENE	934	127184	1418	77491	ALDRICH SP	4.000	L	10.56	LB
	QB	TETRACHLOROETHYLENE	934	127184	1418	16943	LABEL DEST	800.000	ML	2.11	LB
	QC	TOLUENE	11080	108883	1560	68261	ALDRICH	2.000	L	3.81	LB
	QB	TRICHLOROETHYLENE	1685	79016	1567	16601		4.000	L	12.89	LB
	QB	TRICHLOROETHYLENE	1685	79016	1567	16762		2.000	L	6.44	LB
	QB	TRICHLOROETHYLENE	1685	79016	1567	16766		600.000	ML	1.93	LB

sum										74.44	
106	QD	ACETONE, REAGENT ACS	275	67641	1005	*****	WHC STORES	1.000	QT	1.65	LB
	QD	ACETONE, REAGENT ACS	275	67641	1005	*****	WHC STORES	1.000	QT	1.65	LB
	QC	ANTIMONY TRIOXIDE	22662	1309644	1667	*****	VWR SCIENT	125.000	G	.28	LB

sum										3.57	
115	QD	ACETIC ACID	20193	64197	1003	16744		2.000	L	4.62	LB
	QD	ACETIC ACID	20193	64197	1003	16745		3.000	L	6.93	LB
	QD	ACETIC ACID	20193	64197	1003	16746		3.000	L	6.93	LB
	QD	ACETIC ACID	20193	64197	1003	68121	ALDRICH	500.000	G	1.10	LB
	QD	ACETIC ACID	20193	64197	1003	68122	ALDRICH	500.000	G	1.10	LB
	QD	ACETIC ACID	20193	64197	1003	68324	ALDRICH	500.000	G	1.10	LB
	QD	ACETIC ACID	20193	64197	1003	68325	ALDRICH	500.000	G	1.10	LB
	QD	ACETONE	275	67641	1005	68548	MALLINCKRO	950.000	ML	1.65	LB
	QB	AMMONIA	23626	7664417	1039	68134	ALDRICH	1.000	L	.00	LB
	QD	AMMONIUM CHLORIDE	285	12125029	1772	24616	ALDRICH	500.000	G	1.10	LB
	QX	BROMINE	23652	7726956	1064	16632		56.800	GM	.13	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	16672		5.000	ML	.02	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	16673		5.000	ML	.02	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	16675		5.000	ML	.02	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	16676		5.000	ML	.02	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	16677		5.000	ML	.02	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	16678		5.000	ML	.02	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	16679		5.000	ML	.02	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	16680		5.000	ML	.02	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	17931	?	200.000	ML	.70	LB
	QX	CHLORDANE AND TOXAPHENE IN	20117	57749	2627	16682	SUPLECO IN	5.000	ML	.01	LB

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Room No	RQ Code	Chemical Name	PNL Chem No	CAS Number	MSDS Number	Container Number	Mfr Name	Cont Qty	Unit	Converted Amount	Conv Unit
METHANOL											
115	QX	CHLORDANE AND TOXAPHENE IN METHANOL	20117	57749	2627	16683	SUPLECO IN	5.000	ML	.01	LB
	QX	CHLORDANE AND TOXAPHENE IN METHANOL	20117	57749	2627	16684	SUPLECO IN	5.000	ML	.01	LB
	QA	CHLOROFORM IN METHANOL	44391		26037	16664	SUPLECO IN	5.000	ML	.01	LB
	QA	CHLOROFORM IN METHANOL	44391		26037	16665	SUPLECO IN	5.000	ML	.01	LB
	QA	CHLOROFORM IN METHANOL	44391		26037	16666	SUPLECO IN	5.000	ML	.01	LB
	QA	CHLOROFORM IN METHANOL	44391		26037	16669	SUPLECO IN	5.000	ML	.01	LB
	QA	CHLOROFORM STANDARD	29	67663	1128	77223	SUPELCO	1.000	ML	.00	LB
	QA	CUPRIC CHLORIDE	23579	7447394	1672	68414	SIGMA	50.000	G	.11	LB
	QA	CUPRIC SULFATE	439	7758987	2125	68270	SIGMA	100.000	G	.22	LB
	QB	HEXACHLOROETHANE	20220	67721	3451	67151	ANALABS	500.000	GM	1.10	LB
	QB	HEXACHLOROETHANE	20220	67721	3451	68358	ALDRICH	100.000	G	.22	LB
	QD	HYDROCHLORIC ACID	88	7647010	1250	16653		6.000	LB	6.00	LB
	QD	HYDROCHLORIC ACID	88	7647010	1250	16654		6.000	LB	6.00	LB
	QD	HYDROCHLORIC ACID	88	7647010	1250	16655		6.000	LB	6.00	LB
	QD	HYDROCHLORIC ACID	88	7647010	1250	16656		3.000	LB	3.00	LB
	QX	HYDROGEN PEROXIDE	23649	7722841	1257	68269	SIGMA	500.000	ML	1.32	LB
	QB	IRON (II) CHLORIDE (1	67	7758943	6259	683465	ALDRICH	5.000	G	.01	LB
	QC	IRON (III) CHLORIDE	23642	7705080	1211	16725	JOHNSON MA	150.000	GM	.33	LB
	QX	MERCURY(II) CHLORIDE	23583	7487947	2247	80006	ALDRICH CH	500.000	G	1.10	LB
	QD	METHANOL	2417	67561	1329	77427	BAXTER	1.000	L	1.74	LB
	QD	METHANOL	2417	67561	1329	77429	BAXTER	1.000	L	1.74	LB
	QD	METHANOL	2417	67561	1329	77445	BAXTER	1.000	L	1.74	LB
	QC	METHYLENE CHLORIDE	20282	75092	1350	24762		500.000	ML	1.46	LB
	QC	METHYLENE CHLORIDE IN METHANOL	44390		27243	16662	SUPECO INC	5.000	ML	.01	LB
	QB	NICKEL CHLORIDE	23643	7718549	5851	68363	SIGMA	100.000	G	.22	LB
	QC	NITRIC ACID	134	7697372	1384	16643		7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	16644		7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	16645		7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	16646		7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	16647		2.000	LB	2.00	LB
	QC	NITRIC ACID	134	7697372	1384	16648		1.000	L	3.08	LB
	QC	NITRIC ACID	134	7697372	1384	16649		700.000	ML	2.16	LB
	QC	NITRIC ACID	134	7697372	1384	16650		800.000	ML	2.47	LB
	QC	NITRIC ACID	134	7697372	1384	16651		1.000	FOZ	.09	LB
	QC	NITRIC ACID	134	7697372	1384	16652		1.000	FOZ	.09	LB
	QC	NITRIC ACID	134	7697372	1384	16657		900.000	ML	2.78	LB
	QC	NITRIC ACID	134	7697372	1384	16658		.500	PT	.73	LB
	QC	NITRIC ACID	134	7697372	1384	16659		1.000	PT	1.46	LB
	QC	NITRIC ACID REAGENT	134	7697372	1384	80009	FISHER SCI	2.500	L	7.71	LB
	QA	PENTACHLOROETHANE	20339	76017	6124	3769	ANALABS	100.000	MG	.00	LB

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Room No	RQ Code	Chemical Name	PNL Chem No	CAS Number	MSDS Number	Container Number	Mfr Name	Cont Qty	Unit	Converted Amount	Conv Unit
115	QA	PENTACHLOROETHANE	20339	76017	6124	68351	SUPELCO	500.000	ML	1.10	LB
	QA	PENTACHLOROETHANE	20339	76017	6124	68352	SUPELCO	500.000	ML	1.10	LB
	QC	PHENOL	21090	108952	1422	16631		85.200	GM	.19	LB
	QD	PHOSPHORIC ACID	23624	7664382	1428	80005	ALDRICH CH	500.000	G	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	16717		20.000	GM	.04	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	68369	SIGMA	250.000	G	.55	LB
	QC	SODIUM FLUORIDE	26092	7681494	1491	16695		1.000	LB	1.00	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	16755		150.000	GM	.33	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68180	BAKER	500.000	ML	2.35	LB
	QB	SODIUM NITRITE	23608	7632000	1495	16732		500.000	GM	1.10	LB
	QB	SODIUM NITRITE	23608	7632000	1495	16733		500.000	GM	1.10	LB
	QB	SODIUM NITRITE	23608	7632000	1495	68385	ALDRICH	10.000	G	.02	LB
	QB	SODIUM NITRITE	23608	7632000	1495	68386	ALDRICH	10.000	G	.02	LB
	QB	SODIUM NITRITE	23608	7632000	1495	68387	ALDRICH	10.000	G	.02	LB
	QB	SODIUM NITRITE	23608	7632000	1495	68388	ALDRICH	10.000	G	.02	LB
	QB	SODIUM NITRITE	23608	7632000	1495	68389	ALDRICH	10.000	G	.02	LB
	QB	SODIUM NITRITE	23608	7632000	1495	68391	ALDRICH	10.000	G	.02	LB
	QB	SODIUM NITRITE	23608	7632000	1495	68392	ALDRICH	10.000	G	.02	LB
	QB	SODIUM NITRITE	23608	7632000	1495	68393	ALDRICH	10.000	G	.02	LB
	QB	SODIUM NITRITE	23608	7632000	1495	68394	ALDRICH	10.000	G	.02	LB
	QD	SODIUM PHOSPHATE, DIBASIC	216	7558794	1886	16711		250.000	GM	.55	LB
	QD	SODIUM PHOSPHATE, DIBASIC	216	7558794	1886	16735		1.000	LB	1.00	LB
	QB	SODIUM SELENITE	23976	10102188	2689	68364	SIGMA	25.000	G	.06	LB
	QC	SULFURIC ACID	23627	7664939	1529	16638		3.000	L	12.16	LB
	QC	SULFURIC ACID	23627	7664939	1529	16639		3.000	L	12.16	LB
	QC	SULFURIC ACID	23627	7664939	1529	16640		3.000	L	12.16	LB
	QC	SULFURIC ACID	23627	7664939	1529	16641		2.500	L	10.13	LB
	QX	TRICHLOROACETYL CHLORIDE	20340	76028	6755	77492	ALDRICH SP	50.000	ML	.18	LB
	QC	ZINC CHLORIDE ANHYDROUS	23615	7646857	1600	16716	JOHNSON MA	25.000	GM	.06	LB
	QC	ZINC CHLORIDE SOLUTION	23615	7646857	1600	16629		1.000	PT	1.04	LB
*****										169.26	
sum											
131	QC	TOLUENE PURIFIED	11080	108883	1560	68535	MANUFACTUR	1.000	PT	.90	LB
*****										.90	
sum											
139	QD	ACETONE	275	67641	1005	17312		1.000	GAL	6.59	LB
	QD	ACETONE	275	67641	1005	17313		1.000	QT	1.65	LB
	QD	ACETONE	275	67641	1005	68236	MALLINCKRO	1.000	QT	1.65	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	68235	UNKNOWN (U	1.000	QT	2.08	LB
*****										11.96	
sum											
146	QC	SODIUM HYDROXIDE	2448	1310732	1105	17462		1.000	KG	2.20	LB

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Room No	RQ Code	Chemical Name	PNL Chem No	CAS Number	MSDS Number	Container Number	Mfr Name	Cont Qty	Unit	Converted Amount	Conv Unit

		sum								2.20	
147	QC	XYLENE	254	1330207	1592	68502	ALLIED CHE	1.000	PT	1.25	LB

		sum								1.25	
180	QC	POTASSIUM HYDROXIDE	144	1310583	1442	*****	NOAH	50.000	KG	110.13	LB
	QC	SODIUM FLOURIDE	26092	7681494	1491	*****	NOAH	20.000	KG	44.05	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	*****	NOAH	400.000	KG	881.06	LB
	QB	SODIUM NITRITE	23608	7632000	1495	*****	NOAH	200.000	KG	440.53	LB

		sum								1,475.77	
182	QA	CHLOROFORM	29	67663	1128	702803	ALDRICH	100.000	ML	.33	LB
	QA	CHLOROFORM STANDARD	29	67663	1128	77225	SUPELCO	1.000	ML	.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QC	NITRIC ACID	134	7697372	1384	*****	WESTINGHO	7.000	LB	7.00	LB
	QB	PERCHLOROETHYLENE	934	127184	1418	*****	SCOTT SPEC	1.000	UNIT S	.00	LB
	QB	PERCHLOROETHYLENE	934	127184	1418	*****	SCOTT SPEC	1.000	UNIT S	.00	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	*****	VAN WATERS	1100.000	LB	1,100.00	LB
	QB	TRICHLOROETHYLENE	1685	79016	1567	*****	SCOTT SPEC	1.000	UNIT S	.00	LB
	QB	TRICHLOROETHYLENE	1685	79016	1567	*****	SCOTT SPEC	1.000	UNIT S	.00	LB

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Reportable Quantities Chemical Listing for Bldg: 324

Room No	RQ Code	Chemical Name	PNL Chem No	CAS Number	MSDS Number	Container Number	Mfr Name	Cont Qty	Unit	Converted Amount	Conv Unit
182	QC	ZINC CHLORIDE	23615	7646857	1600	#####	SIGMA	250.000	G	.55	LB

sum										1,212.88	
207	QD	ACETIC ACID	20193	64197	1003	68577	VWR SCIENT	500.000	ML	1.16	LB
	QD	HYDROCHLORIC ACID	88	7647010	1250	68576	VWR SCIENT	1.000	L	2.60	LB
	QC	NITRIC ACID	134	7697372	1384	68574	VWR SCIENT	500.000	ML	1.54	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68575	VWR SCIENT	1.000	L	4.69	LB

sum										9.99	
208	QD	ACETONE	275	67641	1005	65551	MALLINCKRO	950.000	ML	1.65	LB
	QD	ACETONE	275	67641	1005	68546	MALLINCKRO	950.000	ML	1.65	LB
	QD	ACETONE	275	67641	1005	68547	MALLINCKRO	950.000	ML	1.65	LB
	QD	ACETONE	275	67641	1005	68549	MALLINCKRO	950.000	ML	1.65	LB
	QD	ACETONE	275	67641	1005	68550	MALLINCKRO	950.000	ML	1.65	LB
	QD	ACETONE	275	67641	1005	68551	MALLINCKRO	950.000	ML	1.65	LB
	QD	ANTIMONY	23552	7440360	1982	68195	BAKER	500.000	ML	1.10	LB
	QX	ARSENIC	273	7440382	1930	24664		500.000	ML	1.10	LB
	QA	BERYLLIUM	380	7440417	1731	24666	BAKER	500.000	ML	1.10	LB
	QA	CADMIUM	57	7440439	2232	24663		500.000	ML	1.10	LB
	QB	CHLOROPHENOL	20677	95578	2251	16813		60.000	GM	.13	LB
	QD	COPPER	30147	7440508	2371	24652		500.000	ML	1.10	LB
	QD	EDTA-2NA	26036	6381926	1180	16804		30.000	GM	.07	LB
	QC	FERRIC CHLORIDE	23642	7705080	1211	68187	EM INDUSTR	500.000	G	1.10	LB
	QB	FORMALDEHYDE	161	50000	1224	16850		1.000	PT	1.13	LB
	QB	FORMALDEHYDE	161	50000	1224	16851		1.000	PT	1.13	LB
	QB	FORMALDEHYDE	161	50000	1224	16852		1.000	PT	1.13	LB
	QD	HYDROCHLORIC ACID BAKER ANALYZED	88	7647010	1250	77186	VWR SCIENT	2.500	L	6.50	LB
	QD	HYDROCHLORIC ACID BAKER ANALYZED	88	7647010	1250	77187	VWR SCIENT	2.500	L	6.50	LB
	QD	HYDROCHLORIC ACID BAKER ANALYZED	88	7647010	1250	77188	VWR SCIENT	2.500	L	6.50	LB
	QD	HYDROCHLORIC ACID BAKER ANALYZED	88	7647010	1250	77189	VWR SCIENT	2.500	L	6.50	LB
	QD	HYDROCHLORIC ACID BAKER ANALYZED	88	7647010	1250	77190	VWR SCIENT	2.500	L	6.50	LB
	QD	HYDROCHLORIC ACID BAKER ANALYZED	88	7647010	1250	77194	VWR SCIENT	2.500	L	6.50	LB

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Reportable Quantities Chemical Listing for Bldg: 324

Room No	RQ Code	Chemical Name	PNL Chem No	CAS Number	MSDS Number	Container Number	Mfr Name	Cont Qty	Unit	Converted Amount	Conv Unit
208	QB	HYDROFLOURIC ACID	23625	7664393	1251	24638		500.000	ML	1.08	LB
	QB	HYDROFLOURIC ACID	23625	7664393	1251	24640		500.000	ML	1.08	LB
	QB	HYDROFLOURIC ACID	23625	7664393	1251	24641		500.000	ML	1.08	LB
	QX	HYDROQUINONE	91	123319	1262	24627		500.000	GM	1.10	LB
	QX	LEAD	97	7439921	1288	16854		4.000	LB	4.00	LB
	QX	LEAD	97	7439921	1288	16894		5.000	LB	5.00	LB
	QX	LEAD	97	7439921	1288	24659		500.000	ML	1.10	LB
	QX	MERCURIC OXIDE	24474	21908532	2240	16829		1.000	LB	1.00	LB
	QX	MERCURIC OXIDE	24474	21908532	2240	16838		800.000	GM	1.76	LB
	QX	MERCURY	2160	7439976	1323	16853		50.000	GM	.11	LB
	QX	MERCURY	2160	7439976	1323	24657		500.000	ML	14.92	LB
	QC	METHYLENE CHLORIDE	20282	75092	1350	16803		900.000	ML	2.63	LB
	QB	NICKEL	147	7440020	2093	16856		5.000	LB	5.00	LB
	QB	NICKEL	147	7440020	2093	24650		500.000	ML	1.10	LB
	QA	NICKEL HYDROXIDE	24089	12054487	1378	16885		15.000	GM	.03	LB
	QC	NITRIC ACID	134	7697372	1384	24832 ?		2.500	L	7.71	LB
	QC	NITRIC ACID	134	7697372	1384	24833 ?		2.500	L	7.71	LB
	QC	NITRIC ACID	134	7697372	1384	24835 ?		2.500	L	7.71	LB
	QC	NITRIC ACID	134	7697372	1384	24836 ?		2.500	L	7.71	LB
	QC	NITRIC ACID	134	7697372	1384	24837 ?		2.500	L	7.71	LB
	QC	NITRIC ACID	134	7697372	1384	24842 ?		2.500	L	7.71	LB
	QC	NITRIC ACID 40%	134	7697372	1384	68141	NATIONAL I	1.000	GAL	11.67	LB
	QB	P-DIOXANE	21414	123911	1409	68462	BAKER ANAL	500.000	ML	1.32	LB
	QB	P-DIOXANE	21414	123911	1409	68463	BAKER ANAL	500.000	ML	1.32	LB
	QX	PHOSPHORUS	23651	7723140	4339	24679		500.000	ML	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17422		500.000	GM	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17423		500.000	GM	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17424		500.000	GM	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17425		500.000	GM	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17426		500.000	GM	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17427		500.000	GM	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17428		500.000	GM	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17429		500.000	GM	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17431		500.000	GM	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17432		500.000	GM	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17433		500.000	GM	1.10	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17434		500.000	GM	1.10	LB
	QB	POTASSIUM PERMANGANATE	23648	7722647	1445	16846		100.000	GM	.22	LB
	QB	SELENIUM	23704	7782492	3396	24653		500.000	ML	1.10	LB
	QB	SELENIUM	23704	7782492	3396	24686		500.000	ML	1.10	LB
	QC	SILVER	202	7440224	2983	24681		500.000	ML	1.10	LB
	QC	SILVER METAL	202	7440224	2983	16857		2.000	FOZ	.13	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	16879		1450.000	GM	3.19	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	16881		1.000	LB	1.00	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	17435		1.000	KG	2.20	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	17436		1.000	KG	2.20	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	17437		1.000	KG	2.20	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	17438		1.000	KG	2.20	LB

Table C.1. (contd)

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BATTELLE NORTHWEST LABS
CHEMICAL INVENTORY SYSTEM

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Reportable Quantities Chemical Listing for Bldg: 324

Room No	RQ Code	Chemical Name	PNL Chem No	CAS Number	MSDS Number	Container Number	Mfr Name	Cont Qty	Unit	Converted Amount	Conv Unit
208	QC	SODIUM HYDROXIDE	2448	1310732	1105	17439		1.000	KG	2.20	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68190	ORION	475.000	ML	2.23	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68585	BAKER	500.000	ML	2.35	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68586	BAKER	500.000	ML	2.35	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68587	BAKER	500.000	ML	2.35	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68588	BAKER	500.000	ML	2.35	LB
	QB	SODIUM NITRITE	23608	7632000	1495	16865		500.000	GM	1.10	LB
	QB	SODIUM NITRITE	23608	7632000	1495	16866		500.000	GM	1.10	LB
	QB	SODIUM NITRITE	23608	7632000	1495	16868		400.000	GM	.88	LB
	QB	SODIUM NITRITE, 98% MIN BAKER ANALYZED REAGENT	23608	7632000	1495	77149	VWR SCIENT	500.000	G	1.10	LB
	QC	SULFURIC ACID	23627	7664939	1529	24642		2.500	L	10.13	LB
	QC	SULFURIC ACID	23627	7664939	1529	24643		2.500	L	10.13	LB
	QC	SULFURIC ACID	23627	7664939	1529	24644		2.500	L	10.13	LB
	QC	SULFURIC ACID	23627	7664939	1529	24645		2.500	L	10.13	LB
	QC	SULFURIC ACID	23627	7664939	1529	24646		2.500	L	10.13	LB
	QC	SULFURIC ACID	23627	7664939	1529	24647		2.500	L	10.13	LB
	QX	TELLURIUM	24194	13494809	2245	24676		500.000	ML	1.10	LB
	QC	ZINC	2422	7440666	2315	24651		500.000	ML	1.10	LB
***** sum										272.63	
210	QC	ANTIMONY TRIOXIDE	22662	1309644	1667	77478	BAKER	125.000	G	.28	LB
	QX	CADMIUM OXIDE	22651	1306190	2234	16767	BAKER	500.000	G	1.10	LB
	QD	COPPER POWDER	30147	7440508	2371	24624		500.000	G	1.10	LB
	QC	FERRIC NITRATE	24038	10421484	1214	16917		100.000	GM	.22	LB
	QB	LEAD NITRATE	23968	10099748	1291	77465	XXXXXXXX	900.000	G	1.98	LB
	QB	NICKEL	147	7440020	2093	16855		5.000	LB	5.00	LB
	QB	NICKEL NITRATE	26051	14216752		16871		250.000	GM	.55	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	16914		100.000	GM	.22	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17154	ARGENT	2.500	KG	5.51	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	77239	VWR SCIENT	50.000	G	.11	LB
	QB	POTASSIUM PERMANGANATE	23648	7722647	1445	68404	FISHER SCI	400.000	G	.88	LB
	QB	POTASSIUM PERMANGANATE	23648	7722647	1445	77472	XXXXXX	5.000	G	.01	LB
	QC	SODIUM FLOURIDE	26092	7681494	1491	68407	UNKNOWN	100.000	G	.22	LB
	QD	SODIUM PHOSPHATE DIBASIC	216	7558794	1886	17051	CHEM WEST	.800	LB	.80	LB
	QD	SODIUM PHOSPHATE, TRIBASIC	23599	7601549	3679	16887		4.000	LB	4.00	LB
***** sum										21.98	
212	QA	CHLOROFORM STANDARD	29	67663	1128	77224	SUPELCO	1.000	ML	.00	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	77250	BAKER	500.000	G	1.10	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	77251	J.T. BAKER	500.000	G	1.10	LB
***** sum										2.21	

Table C.1. (contd)

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BATTELLE NORTHWEST LABS
CHEMICAL INVENTORY SYSTEM

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Reportable Quantities Chemical Listing for Bldg: 324

Room No	RQ Code	Chemical Name	PNL Chem No	CAS Number	MSDS Number	Container Number	Mfr Name	Cont Qty	Unit	Converted Amount	Conv Unit
22	QD	ACETONE	275	67641	1005	16940		1.000	PT	.82	LB
	QD	AMMONIUM CHLORIDE	285	12125029	1772	80102	SIGMA	500.000	G	1.10	LB
	QD	AMMONIUM CHLORIDE	285	12125029	1772	80116	SIGMA CHEM	500.000	G	1.10	LB
	QX	AROCHLOR 1260	24058	11096825	20713	77216	CHEM SERVI	600.000	MG	.00	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	77213	ALDRICH	100.000	ML	.35	LB
	QA	CARBON TETRACHLORIDE	412	56235	1102	77214	ALDRICH	100.000	ML	.35	LB
	QA	CHLOROFORM	29	67663	1128	77201	SIGMA	100.000	ML	.33	LB
	QA	CHLOROFORM	29	67663	1128	77202	ALDRICH	100.000	ML	.33	LB
	QA	CUPRIC CHLORIDE	23579	7447394	1672	80110	SIGMA	100.000	G	.22	LB
	QC	CYCLOHEXANE ANHYDROUS	21172	110827	1145	80091	ALDRICH	1.000	L	1.72	LB
	QC	CYCLOHEXANE ANHYDROUS	21172	110827	1145	80094	ALDRICH	100.000	ML	.17	LB
	QC	CYCLOHEXANE ANHYDROUS	21172	110827	1145	80095	ALDRICH	1.000	L	1.72	LB
	QC	CYCLOHEXANE ANHYDROUS	21172	110827	1145	80096	ALDRICH	1.000	L	1.72	LB
	QC	CYCLOHEXANE ANHYDROUS	21172	110827	1145	80097	ALDRICH	1.000	L	1.72	LB
	QC	CYCLOHEXANE ANHYDROUS	21172	110827	1145	80098	ALDRICH	1.000	L	1.72	LB
	QC	DICHLOROMETHANE	20282	75092	1350	77211	ALDRICH	100.000	ML	.29	LB
	QC	DICHLOROMETHANE	20282	75092	1350	77212	ALDRICH	100.000	ML	.29	LB
	QC	ETHYLBENZENE ANHYDROUS	20821	100414	1198	80092	ALDRICH	1.000	ML	.00	LB
	QC	ETHYLBENZENE ANHYDROUS	20821	100414	1198	80093	ALDRICH	100.000	ML	.19	LB
	QD	METHANOL	2417	67561	1329	77428	BAXTER	1.000	L	1.74	LB
	QD	METHANOL	2417	67561	1329	77442	BAXTER	1.000	L	1.74	LB
	QD	METHANOL	2417	67561	1329	77444	BAXTER	1.000	L	1.74	LB
	QD	METHANOL	2417	67561	1329	77446	BAXTER	1.000	L	1.74	LB
	QD	METHANOL	2417	67561	1329	77447	BAXTER	1.000	L	1.74	LB
	QD	METHANOL	2417	67561	1329	77448	BAXTER	1.000	L	1.74	LB
	QD	METHANOL	2417	67561	1329	77449	BAXTER	1.000	L	1.74	LB
	QD	METHYL ALCOHOL	2417	67561	1329	1010247	ALDRICH	500.000	ML	.87	LB
	QC	SODIUM FLORIDE	26092	7681494	1491	77203	ALDRICH	50.000	G	.11	LB
	QC	SODIUM FLORIDE	26092	7681494	1491	77204	ALDRICH	50.000	G	.11	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68154	BAKER	500.000	ML	2.35	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68155	BAKER	500.000	ML	2.35	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68156	BAKER	500.000	ML	2.35	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68157	BAKER	500.000	ML	2.35	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68159	BAKER	500.000	ML	2.35	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68160	BAKER	500.000	ML	2.35	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68163	BAKER	500.000	ML	2.35	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	68164	BAKER	500.000	ML	2.35	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	77192	SIGMA CHEM	500.000	G	1.10	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	77193	SIGMA CHEM	500.000	G	1.10	LB
	QB	TETRACHLOROETHYLENE	934	127184	1418	77196	ALDRICH	100.000	ML	.26	LB
	QB	TETRACHLOROETHYLENE	934	127184	1418	77197	ALDRICH	100.000	ML	.26	LB
	QB	TRICHLOROETHYLENE	1685	79016	1567	77199	ALDRICH	1.000	L	3.22	LB
	QB	TRICHLOROETHYLENE	1685	79016	1567	77200	ALDRICH	1.000	L	3.22	LB
	QD	TRIETHYLAMINE	21339	121448	1573	80023	FISHER SCI	100.000	G	.22	LB
	QB	TRIMETHYLAMINE	20308	75503	1578	80022	FISHER SCI	100.000	G	.22	LB

Table C.1. (contd)

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BATTELLE NORTHWEST LABS
CHEMICAL INVENTORY SYSTEM

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Reportable Quantities Chemical Listing for Bldg: 324

Room No	RQ Code	Chemical Name	PNL Chem No	CAS Number	MSDS Number	Container Number	Mfr Name	Cont Qty	Unit	Converted Amount	Conv Unit
sum										55.80	
6666	QD	ACETONE	275	67641	1005	92074	UNKNOWN	1.000	QT	1.65	LB
	QC	XYLENE	254	1330207	1592	92068	UNKNOWN	4.000	GAL	39.96	LB

sum										41.61	
702	QD	ACETONE	275	67641	1005	86863	NORTHWEST	1.000	QT	1.65	LB

sum										1.65	
705	QC	TOLUENE PURIFIED	11080	108883	1560	86908	CHEM WEST	1.000	PT	.90	LB

sum										.90	
711	QB	ANHYDROUS AMMONIA	23626	7664417	1039	68328	ALDRICH	170.000	G	.37	LB
	QB	TRIMETHYLAMINE GAS	20308	75503	1578	24784	ALDRICH	400.000	GM	.88	LB

sum										1.26	

Table C.2. 3718G Building

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BATTELLE NORTHWEST LABS
CHEMICAL INVENTORY SYSTEM

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Reportable Quantities Chemical Listing for Bldg: 3718G

Room No	RQ Code	Chemical Name	PNL Chem No	CAS Number	MSDS Number	Container Number	Mfr Name	Cont Qty	Unit	Converted Amount	Conv Unit
1	QD	ACETIC ACID SOLUTION	20193	64197	1003	16782		1.750	L	4.04	LB
	QD	ACETONE	275	67641	1005	17132		50.000	ML	.09	LB
	QD	ANTHRACENE	2419	120127	1040	17050		400.000	GM	.88	LB
	QC	ANTIMONY OXIDE	22662	1309644	1667	17206		2.000	LB	2.00	LB
	QX	ARSENIC TRIOXIDE	270	1327533	2231	16769	CHEMWEST	1.000	LB	1.00	LB
	QC	BATTERY FLUID	23857	8014957	6154	17240	PANAMETRIC	1.000	GAL	16.05	LB
	QC	BATTERY FLUID	23857	8014957	6154	17241	?	1.000	GAL	16.05	LB
	QA	COPPER SULFATE	439	7758987	2125	17201		50.000	LB	50.00	LB
	QA	COPPER SULFATE	439	7758987	2125	17202		50.000	LB	50.00	LB
	QB	DICHLOROBENZENE	24551	25321226		16773	JT BAKER C	100.000	GM	.22	LB
	QD	EDTA STANDARD	26036	6381926	1180	16779	JT BAKER C	500.000	ML	1.10	LB
	QD	ETHYLENEDIAMINETETRACETIC A CID	26036	6381926	1180	24759	NOAH TECHN	17.000	LB	17.00	LB
	QC	FERRIC NITRATE	24038	10421484	1214	17091		30.000	GM	.07	LB
	QC	FERRIC NITRATE	24038	10421484	1214	17124		440.000	LB	440.00	LB
	QC	FERRIC SULFATE	23939	10028225	1216	17200		35.000	LB	35.00	LB
	QC	FERROUS SULFATE	23647	7720787	2871	17195		110.000	LB	110.00	LB
	QC	FERROUS SULFATE	23647	7720787	2871	77393	SIGMA	250.000	G	.55	LB
	QD	FORMIC ACID	20192	64186	1226	17368		50.000	L	131.97	LB
	QD	FORMIC ACID	20192	64186	1226	17369		40.000	L	105.58	LB
	QD	FORMIC ACID	20192	64186	1226	17370		220.000	GAL	2,197.85	LB
	QD	HYDROCHLORIC ACID	88	7647010	1250	17378		10.000	LB	10.00	LB
	QD	HYDROCHLORIC ACID	88	7647010	1250	24830		2.500	L	6.50	LB
	QD	HYDROCHLORIC ACID	88	7647010	1250	68460	NALGENE	7.000	L	18.19	LB
	QB	HYDROFLUORIC ACID	23625	7664393	1251	17375		450.000	ML	.97	LB
	QB	HYDROFLUORIC ACID	23625	7664393	1251	17376		75.000	ML	.16	LB
	QB	LEAD NITRATE	23968	10099748	1291	17084		110.000	LB	110.00	LB
	QA	MERCURY NITRATE	23958	10045940	1321	17090		.500	LB	.50	LB
	QD	METHANOL	2417	67561	1329	*****	BAXTER SCI	1.000	LB	1.00	LB
	QD	METHANOL	2417	67561	1329	*****	B&J BRAND	1.000	L	1.74	LB
	QA	NICKEL HYDROXIDE	24089	12054487	1378	17142		300.000	LB	300.00	LB
	QA	NICKEL HYDROXIDE	24089	12054487	1378	17157		20.000	LB	20.00	LB
	QA	NICKEL HYDROXIDE	24089	12054487	1378	17158		75.000	LB	75.00	LB
	QA	NICKEL HYDROXIDE	24089	12054487	1378	17159		100.000	LB	100.00	LB
	QB	NICKEL NITRATE	26051	14216752		17095	NOAH TECHN	7.000	LB	7.00	LB
	QB	NICKEL NITRATE	26051	14216752		17126	NOAH TECHN	250.000	LB	250.00	LB
	QB	NICKEL NITRATE	26051	14216752		17128	NOAH TECHN	24.000	LB	24.00	LB
	QB	NICKEL NITRATE	26051	14216752		17129	NOAH TECHN	100.000	LB	100.00	LB
	QB	NICKEL NITRATE	26051	14216752		24750	NOAH TECHN	1.000	LB	1.00	LB
	QC	NITRIC ACID	134	7697372	1384	16780	GFS CHEMIC	250.000	ML	.77	LB
	QC	NITRIC ACID	134	7697372	1384	16781		800.000	ML	2.47	LB
	QC	NITRIC ACID	134	7697372	1384	17254		40.000	FOZ	3.70	LB
	QC	NITRIC ACID	134	7697372	1384	17255		40.000	FOZ	3.70	LB
	QC	NITRIC ACID	134	7697372	1384	17256		40.000	FOZ	3.70	LB
	QC	NITRIC ACID	134	7697372	1384	17266		35.000	LB	35.00	LB
	QC	NITRIC ACID SOLUTION	134	7697372	1384	77221	VAN WATERS	50.000	GAL	583.59	LB
	QB	NITRITE STANDARD	23608	7632000	1495	*****	FISHER SCI	500.000	ML	1.10	LB

Table C.2. (contd)

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CHEMICAL INVENTORY SYSTEM

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Reportable Quantities Chemical Listing for Bldg: 3718G

Room No	RQ Code	Chemical Name	PNL Chem No	CAS Number	MSDS Number	Container Number	Mfr Name	Cont Qty	Unit	Converted Amount	Conv Unit
1	QD	PHOSPHORIC ACID	23624	7664382	1428	16784		500.000	ML	1.86	LB
	QD	PHOSPHORIC ACID	23624	7664382	1428	17257		330.000	LB	330.00	LB
	QD	PHOSPHORIC ACID	23624	7664382	1428	17258		110.000	GAL	1,545.26	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17143		400.000	LB	400.00	LB
	QC	POTASSIUM HYDROXIDE	144	1310583	1442	17144		400.000	LB	400.00	LB
	QB	POTASSIUM PERMANGANATE	23648	7722647	1445	17038		1.500	KG	3.30	LB
	QB	POTASSIUM PERMANGANATE	23648	7722647	1445	17039		2.500	KG	5.51	LB
	QB	POTASSIUM PERMANGANATE	23648	7722647	1445	17040		2.500	KG	5.51	LB
	QB	POTASSIUM PERMANGANATE	23648	7722647	1445	17041		2.500	KG	5.51	LB
	QB	POTASSIUM PERMANGANATE	23648	7722647	1445	17108	X	20.000	LB	20.00	LB
	QB	POTASSIUM PERMANGANATE	23648	7722647	1445	68427	NOAH TECHN	50.000	LB	50.00	LB
	QA	SELENIUM (IV) OXIDE	23571	7446084	1756	17213		2.000	LB	2.00	LB
	QX	SILVER NITRATE	23680	7761888	1472	17093		10.000	LB	10.00	LB
	QX	SILVER NITRATE	23680	7761888	1472	17101		2.000	KG	4.41	LB
	QX	SILVER NITRATE	23680	7761888	1472	17122		12.000	LB	12.00	LB
	QX	SILVER NITRATE	23680	7761888	1472	68443	CERAC	425.000	G	.94	LB
	QA	SODIUM DICHROMATE	23688	7775113	1486	17049		35.000	LB	35.00	LB
	QA	SODIUM DICHROMATE	23688	7775113	1486	17193		200.000	LB	200.00	LB
	QC	SODIUM FLUORIDE	26092	7681494	1491	17022		40.000	LB	40.00	LB
	QC	SODIUM FLUORIDE	26092	7681494	1491	17023		2.000	KG	4.41	LB
	QC	SODIUM FLUORIDE	26092	7681494	1491	17024		1.000	LB	1.00	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	17166		60.000	LB	60.00	LB
	QC	SODIUM HYDROXIDE	2448	1310732	1105	24755		50.000	LB	50.00	LB
	QD	SODIUM PHOSPHATE TRIBASIC	23973	10101890	1509	24781	NOAH TECHN	100.000	LB	100.00	LB
	QD	SODIUM PHOSPHATE TRIBASIC	23973	10101890	1509	24782	NOAH TECHN	100.000	LB	100.00	LB
	QC	SULFURIC ACID	23627	7664939	1529	16785		8.000	LB	8.00	LB
	QC	SULFURIC ACID	23627	7664939	1529	17377		15.000	LB	15.00	LB
	QC	ZINC NITRATE	23700	7779886	1866	17260	NOAH TECHN	12.000	LB	12.00	LB
	QC	ZINC NITRATE	23700	7779886	1866	17264		4.000	LB	4.00	LB
	QC	ZINC NITRATE	23700	7779886	1866	17275		600.000	LB	600.00	LB

sum										8,865.24	

Table C.3.

RQCHEM.XLS

Bldg	Rm	Chemical	Qty, lbs	Units	RQ, lbs
324	115	Hydrogen Peroxide	1.32		1
		Mercury Chloride	1.1		1
	182	Potassium Hydroxide	1100		1000
	208	Arsenic	1.1		1
		Hydroquinone	1.1		1
		Lead	4		1
			5		1
			1.1		1
		Mercuric Oxide	1.76		1
		Mercury	14.92		1
		Phosphorous	1.1		1
		Tellurium	1.1		1
		Cadmium Oxide	1.1		1
3718G	1	Copper Sulfate	50	2	10
		Nickel Hydroxide	300		10
			20		10
			75		10
			100		10
		Nickel Nitrate	250		100
		Silver Nitrate	10		1
			4.41		1
			12		1
		Sodium Dichromate	35		10
			200		10

Appendix D

Data from Waste Stream Characterization Report (Westinghouse Hanford Company. 1989. *Waste Stream Characterization Report*. WHC-EP-0287, Richland, Washington.)

300 Area Process Sewer Effluent Sampling

Sample Point Number: 14

Location: Between 308 and 324 in line with "high bay"

Type: Manhole

Buildings Involved: 324 (partial, Cold Process Sewer)

Note: Call Mike Pueschner for SEA (6-3693). Check upstream manhole to assure no non-324 flow (since process effluents from 309, 331, 337, 338 are pumped batch-wise by the 3906 lift station past this point).

Diagram:

28909068.14

300 Area Wastewater-Sample Point 14

ID: 3WOD, S=58049, 05/11/89 10:16
(B=58050,T=58051)

Detected Analytes

.....

Note: Units are PFB unless otherwise indicated.

Key	Analyte	Result
.....		
S	Alpha Activity (pCi/L)	2.66E+00
S	Alkalinity (Method B)	5.78E+04
S	Barium	3.30E+01
S	Boron	3.70E+01
S	Calcium	2.33E+04
S	Chloride	4.10E+03
S	Chloroform	2.90E+01
S	Conductivity-Field (uS)	3.28E+02
S	Fluoride (ISE)	2.12E+02
S	Iron	1.17E+02
S	Magnesium	5.35E+03
S	Manganese	5.00E+00
S	Nitrate	1.10E+03
S	pH-Field	6.30E+00
S	Potassium	1.68E+03
S	Silicon	4.72E+03
S	Sodium	5.74E+03
S	Strontium	1.03E+02
S	Sulfate	1.88E+04
S	Suspended Solids	5.40E+03
S	Temperature-Field (celsius)	1.97E+01
S	Total Carbon	1.50E+04
S	Total Dissolved Solids	9.30E+04
S	TOX (LDL)	1.61E+02
S	Uranium	3.85E+00
S	Zinc	2.50E+01

Key: S = Sample, E = Extract, B = Blank, T = Trip Blank

300 Area Wastewater-Sample Point 14

ID: 3WOD, S=58058, 05/15/89 10:50
(B=58059,T=58060)

Detected Analytes

Note: Units are PFB unless otherwise indicated.

Key	Analyte	Result

S	Beta Activity (pCi/L)	2.30E+00
S	Alkalinity (Method B)	4.90E+04
S	Barium	3.00E+01
S	Boron	2.10E+01
S	Calcium	2.19E+04
S	Chloride	5.00E+03
S	Chloroform	2.50E+01
S	Conductivity-Field (uS)	2.22E+02
S	Fluoride (ISE)	2.16E+02
S	Halogenated hydrocarbons	1.00E+02
S	Iron	5.30E+01
S	Magnesium	4.92E+03
B	Methylene chloride	1.60E+01
S	Nitrate	5.80E+03
S	Phosphate	8.40E+03
S	pH-Field	6.85E+00
S	Potassium	1.54E+03
S	Silicon	4.12E+03
S	Sodium	5.15E+03
S	Strontium	1.00E+02
S	Sulfate	1.87E+04
S	Suspended Solids	1.03E+04
S	Temperature-Field (celsius)	2.26E+01
S	TOC	2.20E+03
S	Total Carbon	1.44E+04
S	Total Dissolved Solids	1.29E+05
S	TOX (IDL)	1.63E+02
S	Trichloromonofluoromethane	1.20E+01
S	Unknown	4.70E+01
S	Uranium	1.25E+00
S	Zinc	1.70E+01

Key: S = Sample, E = Extract, B = Blank, T = Trip Blank

300 Area Wastewater-Sample Point 14

ID: 3WOD, S-58121, 05/24/89 13:39
(B-58122,T-58123)

Detected Analytes

Note: Units are PPB unless otherwise indicated.

Key	Analyte	Result

S	Beta Activity (pCi/L)	3.02E+00
S	Alkalinity (Method B)	5.43E+04
S	Aluminum	1.55E+02
S	Barium	3.20E+01
S	Boron	2.10E+01
S	Calcium	1.98E+04
S	Chloride	3.80E+03
S	Chloroform	3.70E+01
S	Conductivity-Field (uS)	1.91E+02
S	Copper	1.40E+01
S	Fluoride (ISE)	1.92E+02
S	Iron	1.67E+02
S	Magnesium	4.55E+03
S	Manganese	8.00E+00
S	Nitrate	1.90E+03
S	pH-Field	6.36E+00
S	Potassium	1.35E+03
S	Silicon	3.84E+03
S	Sodium	4.27E+03
S	Strontium	9.10E+01
S	Sulfate	1.77E+04
S	Suspended Solids	5.00E+03
S	Temperature-Field (celsius)	2.46E+01
S	TOC	2.10E+03
S	Total Carbon	1.37E+04
S	Total Dissolved Solids	8.25E+04
S	TOX (LDL)	2.78E+02
S	Uranium	1.73E+00
S	Zinc	4.20E+01

Key: S = Sample, E = Extract, B = Blank, T = Trip Blank

300 Area Wastewater-Sample Point 14

ID: 3WOD, S-58250, 07/20/89 11:02
(B-58251,T-58252,E-58253)

Detected Analytes

.....

Note: Units are PPB unless otherwise indicated.

Key	Analyte	Result
.....		
S	Alpha Activity (pCi/L)	1.44E+00
S	Acetone (VOA)	1.00E+01
S	Alkalinity (Method B)	4.37E+04
S	Ammonia	6.58E+02
S	Barium	2.90E+01
S	Bis(ethylhexyl) phthalate	3.40E+01
S	Calcium	1.81E+04
S	Chloride	4.51E+03
S	Chlorodifluoromethane	2.04E+02
S	Chloroform	1.90E+01
S	Conductivity-Field (uS)	1.95E+02
S	Fluoride (ISE)	2.27E+02
S	Iron	3.10E+01
S	Magnesium	4.16E+03
B	Methylene chloride	1.26E+02
T	Methylene chloride	4.00E+01
S	Nitrate	1.38E+03
S	pH-Field	5.66E+00
S	Potassium	8.78E+02
S	Silicon	2.16E+03
S	Sodium	3.21E+03
S	Strontium	8.70E+01
S	Sulfate	1.83E+04
S	Total Carbon	2.29E+04
S	Total Dissolved Solids	8.60E+04
S	TOX (LDL)	2.09E+02
S	Unknown	5.20E+01
S	Unknown amide	2.40E+01
S	Unknown amine	3.70E+01
S	Unknown fatty acid	1.30E+01

Key: S = Sample, E = Extract, B = Blank, T = Trip Blank

300 Area Wastewater-Sample Point 14

ID: 3WOD, S=58250, 07/20/89 11:02
(B=58251,T=58252,E=58253)

Detected Analytes

Note: Units are PPB unless otherwise indicated.

Key	Analyte	Result

S	Unknown fatty acid	1.60E+02
S	Unknown fatty acid	1.80E+01
S	Unknown fatty acid	5.90E+01
S	Unknown fatty acid ester	1.00E+01
S	Uranium	4.37E-01
S	Zinc	2.50E+01

Key: S = Sample, E = Extract, B = Blank, T = Trip Blank

300 Area Wastewater-Sample Point 14

Sample ID 3WOD: 4 UST Samples

Detected Analytes

Note: Units are PPB unless otherwise indicated.

Analyte	N	Average	Minimum	Maximum	90% CI	
.....	..					
Alpha Activity (pCi/L)	2	2.0E+00	1.4E+00	2.7E+00	3.9E+00	120
Beta Activity (pCi/L)	2	2.7E+00	2.3E+00	3.0E+00	3.8E+00	200
Acetone (VOA)	1	1.0E+01				
Alkalinity (Method B)	4	5.1E+04	4.4E+04	5.8E+04	5.6E+04	
Aluminum	1	1.5E+02				
Ammonia	1	6.6E+02				
Barium	4	3.1E+01	2.9E+01	3.3E+01	3.2E+01	1000
Bis(ethylhexyl) phthalate	1	3.4E+01				
Boron	3	2.6E+01	2.1E+01	3.7E+01	3.6E+01	
Calcium	4	2.1E+04	1.8E+04	2.3E+04	2.3E+04	
Chloride	4	4.4E+03	3.8E+03	5.0E+03	4.8E+03	25000
Chlorodifluoromethane	1	2.0E+02				
Chloroform	4	2.7E+01	1.9E+01	3.7E+01	3.4E+01	
Conductivity-Field (uS)	4	2.3E+02	1.9E+02	3.3E+02	2.9E+02	1000
Copper	1	1.4E+01				
Fluoride (ISE)	4	2.1E+02	1.9E+02	2.3E+02	2.2E+02	2000
Halogenated hydrocarbons	1	1.0E+02				
Iron	4	9.2E+01	3.1E+01	1.7E+02	1.4E+02	
Magnesium	4	4.7E+03	4.2E+03	5.3E+03	5.2E+03	
Manganese	2	6.5E+00	5.0E+00	8.0E+00	1.1E+01	
Nitrate	4	2.5E+03	1.1E+03	5.8E+03	4.3E+03	45000
Phosphate	1	8.4E+03				
pH-Field	4	6.3E+00	5.7E+00	6.8E+00	6.7E+00	2-12.5
Potassium	4	1.4E+03	8.8E+02	1.7E+03	1.6E+03	
Silicon	4	3.7E+03	2.2E+03	4.7E+03	4.6E+03	
Sodium	4	4.6E+03	3.2E+03	5.7E+03	5.5E+03	
Strontium	4	9.5E+01	8.7E+01	1.0E+02	1.0E+02	
Sulfate	4	1.8E+04	1.8E+04	1.9E+04	1.9E+04	250,000
Suspended Solids	3	6.9E+03	5.0E+03	1.0E+04	1.0E+04	
Temperature-Field (celsius)	3	2.2E+01	2.0E+01	2.5E+01	2.5E+01	
TOC	2	2.1E+03	2.1E+03	2.2E+03	2.3E+03	
Total Carbon	4	1.6E+04	1.4E+04	2.3E+04	2.0E+04	
Total Dissolved Solids	4	9.8E+04	8.3E+04	1.3E+05	1.2E+05	
TOX (LCL)	4	2.0E+02	1.6E+02	2.8E+02	2.5E+02	
Trichloromethane	1	1.2E+01				

300 Area Wastewater-Sample Point 14

Sample ID 3W0D: 4 UST Samples

Detected Analytes

Note: Units are PPB unless otherwise indicated.

Analyte	N	Average	Minimum	Maximum	90% CI
Unknown	2	5.0E+01	4.7E+01	5.2E+01	5.7E+01
Unknown amide	1	2.4E+01			
Unknown amine	1	3.7E+01			
Unknown fatty acid	4	6.2E+01	1.3E+01	1.6E+02	1.2E+02
Unknown fatty acid ester	1	1.0E+01			
Uranium	4	1.8E+00	4.4E-01	3.8E+00	3.0E+00
Zinc	4	2.7E+01	1.7E+01	4.2E+01	3.6E+01

300 Area Wastewater-Sample Point 14, Special

ID: 3W1D, S=58337, 09/03/89 13:05
(B=58258,T=58259,E=58260)

Detected Analytes

Note: Units are PFB unless otherwise indicated.

Key	Analyte	Result

S	Alkalinity (Method B)	4.80E+04
S	Barium	3.50E+01
S	Boron	1.70E+01
S	Calcium	2.16E+04
S	Chloride	4.30E+03
S	Chloroform	4.90E+01
S	Conductivity-Field (uS)	1.59E+02
S	Copper	1.40E+01
S	Fluoride (ISE)	1.91E+02
S	Magnesium	5.04E+03
B	Methylene chloride	6.00E+00
T	Methylene chloride	6.00E+00
S	pH-Field	5.29E+00
S	Potassium	1.09E+03
S	Silicon	2.58E+03
S	Sodium	3.58E+03
S	Strontium	1.05E+02
S	Sulfate	1.75E+04
S	Temperature-Field (celsius)	3.15E+01
S	Total Carbon	1.34E+04
S	Total Dissolved Solids	7.90E+04
S	TOX (LDL)	2.12E+02
S	Uranium	4.64E-01
S	Zinc	2.30E+01

Key: S = Sample, E = Extract, B = Blank, T = Trip Blank

300 Area Process Sewer Effluent Sampling

Sample Point Number: 15.

Location: Basement of 324 (SK-3-20358, Zone E-13)

Type: Clean-out access in pipeline

Buildings Involved: 324 (Retention Process Sewer)

Note: Contact Mike Pueschner for SEA (6-3693).

Diagram:

300 Area Wastewater-Sample Point 15

ID: 3WOE, S=58052, 05/12/89 09:57
(B=58053,T=58054)

Detected Analytes

Note: Units are PPB unless otherwise indicated.

Key	Analyte	Result

S	Alpha Activity (pCi/L)	1.30E+00
S	Beta Activity (pCi/L)	2.46E+00
S	Alkalinity (Method B)	4.50E+04
S	Barium	3.00E+01
S	Calcium	1.78E+04
S	Chloride	3.30E+03
S	Chloroform	1.70E+01
S	Conductivity-Field (uS)	1.59E+02
S	Fluoride (ISE)	1.72E+02
S	Magnesium	4.49E+03
S	pH-Field	6.45E+00
S	Potassium	8.27E+02
S	Silicon	1.99E+03
S	Sodium	2.32E+03
S	Strontium	8.20E+01
S	Sulfate	1.75E+04
S	Temperature-Field (celsius)	2.71E+01
S	Total Carbon	1.29E+04
S	Total Dissolved Solids	7.40E+04
S	TOX (LDL)	1.27E+02
S	Uranium	6.42E-01
S	Zinc	1.50E+01

Key: S = Sample, E = Extract, B = Blank, T = Trip Blank

300 Area Wastewater-Sample Point 15

ID: 3W0E, S=58085, 05/18/89 09:24
(B=58086,T=58087)

Detected Analytes

.....

Note: Units are PPB unless otherwise indicated.

Key	Analyte	Result
.....		
S	Alkalinity (Method B)	4.40E+04
S	Aluminum	2.33E+02
S	Barium	2.90E+01
S	Boron	1.30E+01
S	Calcium	1.79E+04
S	Chloride	3.20E+03
S	Chloroform	2.00E+01
S	Conductivity-Field (uS)	1.44E+02
S	Fluoride (ISE)	1.87E+02
S	Iron	6.90E+01
S	Magnesium	4.34E+03
S	pH-Field	6.43E+00
S	Potassium	7.81E+02
S	Silicon	2.48E+03
S	Sodium	2.40E+03
S	Strontium	8.50E+01
S	Sulfate	1.74E+04
S	Temperature-Field (celsius)	2.70E+01
S	TOC	4.80E+03
S	Total Carbon	1.26E+04
S	Total Dissolved Solids	7.60E+04
S	TOX (LDL)	1.75E+02
S	Uranium	3.65E-01
S	Zinc	2.50E+01

Key: S = Sample, E = Extract, B = Blank, T = Trip Blank

300 Area Wastewater-Sample Point 15

ID: 3W0E, S=58169, 06/06/89 13:38
(B=58170,T=58171)

Detected Analytes

Note: Units are PPB unless otherwise indicated.

Key	Analyte	Result

S	Beta Activity (pCi/L)	2.66E+00
S	Alkalinity (Method B)	3.42E+04
S	Barium	2.80E+01
S	Beryllium	7.00E+00
S	Boron	1.40E+01
S	Calcium	1.51E+04
S	Chloride	3.90E+03
S	Chloroform	3.30E+01
S	Conductivity-Field (uS)	1.54E+02
S	Fluoride (ISE)	1.77E+02
S	Iron	3.40E+01
S	Magnesium	3.82E+03
S	Manganese	5.00E+00
S	pH-Field	6.40E+00
S	Potassium	8.03E+02
S	Silicon	2.56E+03
S	Sodium	2.39E+03
S	Strontium	7.30E+01
S	Sulfate	1.71E+04
S	Temperature-Field (celsius)	3.24E+01
S	Total Carbon	1.22E+04
S	Total Dissolved Solids	6.87E+04
S	TOX (LDL)	2.22E+02
S	Uranium	2.26E-01
S	Zinc	2.40E+01

Key: S = Sample, E = Extract, B = Blank, T = Trip Blank

300 Area Wastewater-Sample Point 15

ID: 3W0E, S=58254, 07/20/89 09:48
(B=58255,T=58256,E=58257)

Detected Analytes

Note: Units are PFB unless otherwise indicated.

Key	Analyte	Result

S	Beta Activity (pCi/L)	8.51E+00
S	Acetone (VOA)	1.30E+01
T	Acetone (VOA)	1.10E+01
S	Alkalinity (Method B)	5.28E+04
S	Barium	2.20E+01
S	Bis(ethylhexyl) phthalate	2.30E+01
S	Boron	1.20E+01
S	Cadmium	3.00E+00
S	Calcium	1.64E+04
S	Chloride	3.39E+03
S	Chloroform	2.20E+01
S	Conductivity-Field (uS)	1.75E+02
S	Fluoride (ISE)	1.97E+02
S	Magnesium	3.79E+03
B	Methylene chloride	1.32E+02
T	Methylene chloride	1.20E+02
S	pH-Field	5.67E+00
S	Potassium	7.11E+02
S	Silicon	1.74E+03
S	Sodium	2.24E+03
S	Strontium	7.90E+01
S	Sulfate	1.59E+04
S	Total Carbon	1.35E+04
S	Total Dissolved Solids	6.80E+04
S	TOX (LDL)	1.73E+02
S	Uranium	3.28E-01
S	Zinc	1.30E+01

Key: S = Sample, E = Extract, B = Blank, T = Trip Blank

300 Area Wastewater-Sample Point 15

Sample ID 3W0E: 4 UST Samples

Detected Analytes

Note: Units are PPB unless otherwise indicated.

Analyte	N	Average	Minimum	Maximum	90% CI
*****	..	*****	*****	*****	*****
Alpha Activity (pCi/L)	1	1.3E+00			
Beta Activity (pCi/L)	3	4.5E+00	2.5E+00	8.5E+00	8.3E+00
Acetone (VOA)	1	1.3E+01			
Alkalinity (Method B)	4	4.4E+04	3.4E+04	5.3E+04	5.0E+04
Aluminum	1	2.3E+02			
Barium	4	2.7E+01	2.2E+01	3.0E+01	3.0E+01
Beryllium	1	7.0E+00			
Bis(ethylhexyl) phthalate	1	2.3E+01			
Boron	3	1.3E+01	1.2E+01	1.4E+01	1.4E+01
Cadmium	1	3.0E+00			
Calcium	4	1.7E+04	1.5E+04	1.8E+04	1.8E+04
Chloride	4	3.4E+03	3.2E+03	3.9E+03	3.7E+03
Chloroform	4	2.3E+01	1.7E+01	3.3E+01	2.9E+01
Conductivity-Field (uS)	4	1.6E+02	1.4E+02	1.7E+02	1.7E+02
Fluoride (ISE)	4	1.8E+02	1.7E+02	2.0E+02	1.9E+02
Iron	2	5.1E+01	3.4E+01	6.9E+01	1.1E+02
Magnesium	4	4.1E+03	3.8E+03	4.5E+03	4.4E+03
Manganese	1	5.0E+00			
pH-Field	4	6.2E+00	5.7E+00	6.4E+00	6.5E+00
Potassium	4	7.8E+02	7.1E+02	8.3E+02	8.2E+02
Silicon	4	2.2E+03	1.7E+03	2.6E+03	2.5E+03
Sodium	4	2.3E+03	2.2E+03	2.4E+03	2.4E+03
Strontium	4	8.0E+01	7.3E+01	8.5E+01	8.4E+01
Sulfate	4	1.7E+04	1.6E+04	1.7E+04	1.8E+04
Temperature-Field (celsius)	3	2.9E+01	2.7E+01	3.2E+01	3.2E+01
TOC	1	4.8E+03			
Total Carbon	4	1.3E+04	1.2E+04	1.3E+04	1.3E+04
Total Dissolved Solids	4	7.2E+04	6.8E+04	7.6E+04	7.5E+04
TOX (LDL)	4	1.7E+02	1.3E+02	2.2E+02	2.1E+02
Uranium	4	3.9E-01	2.3E-01	6.4E-01	5.4E-01
Zinc	4	1.9E+01	1.3E+01	2.5E+01	2.4E+01

300 Area Wastewater-Sample Point 15, Special

ID: 3W1E, S=58313, 09/03/89 10:18
(B=58314,T=58315,E=58316)

Detected Analytes

.....

Note: Units are PPB unless otherwise indicated.

Key	Analyte	Result
.....		
S	Beta Activity (pCi/L)	2.18E+00
S	Alkalinity (Method B)	4.70E+04
S	Barium	2.90E+01
S	Boron	1.20E+01
S	Calcium	1.72E+04
S	Chloride	3.50E+03
S	Chloroform	3.20E+01
S	Conductivity-Field (uS)	1.33E+02
S	Fluoride (ISE)	2.11E+02
S	Magnesium	4.15E+03
B	Methylene chloride	6.00E+00
T	Methylene chloride	2.50E+01
S	pH-Field	5.75E+00
S	Potassium	7.06E+02
S	Silicon	1.72E+03
S	Sodium	2.40E+03
S	Strontium	8.60E+01
S	Sulfate	1.62E+04
S	Temperature-Field (celsius)	3.50E+01
S	Total Carbon	1.36E+04
S	Total Dissolved Solids	7.20E+04
S	TOX (LDL)	1.61E+02
S	Uranium	1.80E-01
S	Zinc	2.60E+01

Key: S = Sample, E = Extract, B = Blank, T = Trip Blank

Appendix E

Ventilation System Flow Pathways