PNNL-12160 Rev 2

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Facility Effluent Monitoring Plan for Pacific Northwest National Laboratory Balance-of-Plant Facilities

MY Ballinger
TL Gervais

November 2004

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

PNNL-12160, Rev. 2

Environmental Management Services

FACILITY EFFLUENT MONITORING PLAN FOR PACIFIC NORTHWEST NATIONAL LABORATORY BALANCE-OF-PLANT FACILITIES

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Pacific Northwest National Laboratory
Richland, Washington 99352

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Summary

The Pacific Northwest National Laboratory (PNNL) operates a number of Research & Development (R&D) facilities for the U.S. Department of Energy (DOE) on the Hanford Site. Facility effluent monitoring plans (FEMPs) have been developed to document the facility effluent monitoring portion of the Environmental Monitoring Plan (DOE 2000) for the Hanford Site. Three of PNNL's R&D facilities, the 325, 331, and 3720 Buildings, are considered major emission points for radionuclide air sampling, and individual FEMPs were developed for these facilities in the past. In addition, a balance-of-plant (BOP) FEMP was developed for all other DOE-owned, PNNL-operated facilities at the Hanford Site. Recent changes, including shutdown of buildings and transition of PNNL facilities to the Office of Science, have resulted in retiring the 3720 FEMP and combining the 331 FEMP into the BOP FEMP. This version of the BOP FEMP addresses all DOE-owned, PNNL-operated facilities at the Hanford Site, excepting the Radiochemical Processing Laboratory, which has its own FEMP because of the unique nature of the building and operations.

Activities in the BOP facilities range from administrative to laboratory and pilot-scale R&D. R&D activities include both radioactive and chemical waste characterization, fluid dynamics research, mechanical property testing, dosimetry research, and molecular sciences. The mission and activities for individual buildings are described in Appendix A.

Potential radioactive airborne emissions in the BOP facilities are estimated annually using a building inventory-based approach provided in federal regulations. Sampling at individual BOP facilities is based on a potential-to-emit assessment. Some of these facilities are considered minor emission points and thus are sampled routinely, but not continuously, to confirm the low emission potential. One facility, the 331 Life Sciences Laboratory, has a major emission point and is sampled continuously. Sampling systems are located downstream of control technologies and just before discharge to the atmosphere.

The need for monitoring airborne emissions of hazardous chemicals is established in the Hanford Site Air Operating Permit and in notices of construction. Based on the current potential-to-emit, the Hanford Site Air Operating Permit does not contain general monitoring requirements for BOP facilities. However, the permit identifies monitoring requirements for specific projects and buildings. Needs for future monitoring will be established by future permits issued pursuant to the applicable state and federal regulations.

A number of liquid-effluent discharge systems serve the BOP facilities: sanitary sewer, process sewer, retention process sewer, and aquaculture system. Only the latter system discharges to the environment; the rest either discharge to treatment plants or to long-term storage. Routine compliance sampling of liquid effluents is only required at the Environmental Molecular Sciences Laboratory. Liquid effluents from other BOP facilities may be sampled or monitored to characterize facility effluents or to investigate discharges of concern.

Effluent sampling and monitoring for the BOP facilities depends on the inventories, activities, and environmental permits in place for each facility. A description of routine compliance monitoring for BOP facilities is described in the BOP FEMP.

Contents

Page No.

Figures

Tables

Acronyms

ANSI	American National Standards Institute
BCAA	Benton Clean Air Authority
BOP	balance-of-plant
CFR	Code of Federal Regulations
CMS	Chemical Management System
DEPO	deposition code
DMR	Discharge Monitoring Report
DOE	U.S. Department of Energy
DOE/RL	Department of Energy Richland Operations Office
EMP	environmental monitoring plan
EMSL	Environmental Molecular Sciences Laboratory
EPA	U.S. Environmental Protection Agency
FEMP	facility effluent monitoring plan
FUA	facility use agreement
HEPA	high efficiency particulate air
ISO	International Standards Organization
MDA	minimum detectable activity
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOC	notice of construction
NPDES	National Pollutant Discharge Elimination System
ONE	off-normal event
PNNL	Pacific Northwest National Laboratory
POTW	publicly owned treatment works
PS	process sewer
PTE	potential to emit
QA	quality assurance
QC	quality control
R&D	research and development
RIDS	records inventory and disposition schedule
RLWS	Radioactive Liquid Waste System
RPL	Radiochemical Processing Laboratory
RPS	retention process sewer
RQ	reportable quantity
SAR	safety analysis report
SBMS	Standards-Based Management System
SNS	sanitary sewer system

SOP	standard operating procedure
SOW	statement of work
TEDF	Treated Effluent Disposal Facility
WAC	Washington Administrative Code
WDOE	Washington Department of Ecology
WDOH	Washington State Department of Health

1.0 Introduction

It is the policy of the U.S. Department of Energy (DOE) to conduct its operations in an environmentally safe and sound manner and to verify that programs are in place to verify protection of the environment and the public. The Pacific Northwest National Laboratory (PNNL) is committed to providing a safe and healthy working environment for all staff; protecting the general public and the environment from unacceptable environmental, safety, and health risks; and operating in a manner that protects and restores the environment. To implement these policies, effluent monitoring programs at PNNL must meet high standards of quality and credibility.

1.1 Background and Purpose

Facility effluent monitoring plans (FEMPs) were originally prepared to comply with DOE Order 5400.1 (DOE 1988), "General Environmental Protection Programs," which stated the following objective for environmental monitoring programs: "…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 (Section IV-1)."

Plans must be prepared for each site, facility, or process that uses "significant pollutants or hazardous materials" (DOE 1988, Section, IV-2). These requirements were met through the environmental monitoring program conducted for the Hanford Site and described by the DOE Richland Operations Office (DOE/RL) in the Hanford Site Environmental Monitoring Plan (EMP) (DOE 2000).

The EMP identifies and discusses two major activities as specified by DOE 5400.1: effluent monitoring and environmental surveillance. Because the Hanford Site contains a number of facilities with effluent monitoring needs, individual effluent monitoring plans were prepared for those facilities to support the discussion of effluent monitoring in the EMP. DOE Order 5400.1 was superceded in 2003 by DOE O 450.1 "Environmental Protection Program" (DOE 2003), which requires implementation of an environmental management system. Although neither DOE Order 5400.1 nor DOE O 450.1 are specified in PNNL's current contract with DOE, FEMPs for PNNL facilities continue to be maintained as a part of PNNL's International Standards Organization (ISO) 140001 Environmental Management System. The FEMPs describe facility effluent monitoring, which is a sub-component of environmental monitoring at the Hanford Site.

This report supplies information on effluent monitoring in all DOE-owned, PNNL-operated facilities other than the Radiochemical Processing Laboratory (RPL). The RPL has a separate FEMP because of the unique nature of the building and operations. A complete listing of the balance-of-plant (BOP) facilities addressed in this FEMP is provided in Appendix A. Facilities that are used only for administrative purposes (office buildings) are also listed in Appendix A, but are not required to be monitored and are not addressed further. The information provided in this FEMP is current at the time of FEMP issuance.

1.2 Scope

Characterizing the radioactive and nonradioactive constituents in inventories and in waste streams provides the underlying rationale for sampling and monitoring programs. Currently, confirmatory sampling for radionuclide air emissions is required for most of the BOP facilities; only one facility, the 331 Life Sciences Laboratory, is required to be continuously sampled. Routine sampling for air chemical emissions is not required for any of these facilities. However, confirmatory sampling of volatile organic compound emissions from some BOP stacks is conducted periodically to confirm calculations submitted in permit applications or notices of construction. For liquid waste streams, Fluor Hanford performs compliance sampling of process liquid waste streams, and DynCorp performs compliance sampling of sanitary sewer discharges, as required, from the 300 Area (except the Environmental Molecular Sciences Laboratory [EMSL]). PNNL performs compliance sampling for process liquid streams discharged from EMSL and samples contributors to the 331 Building aquaculture system as directed by DOE. No routine liquid-effluent monitoring is required for DOE-owned, PNNL-operated facilities in other areas.

A major activity of the FEMP effort is to identify the liquid and air release pathways (e.g., identify all access points to the various sewers and all radioactive emission release pathways) under normal operations and during process upset conditions. These are verified on as-built drawings that are maintained in PNNL's Key Drawings System. This verification was performed for the following BOP facilities because they have the greatest potential for environmental release based on their radioactive or chemical inventories: 326 Materials Sciences Laboratory, 329 Chemical Sciences Laboratory, and 331 Life Sciences Laboratory.

The method of characterization discussed in this FEMP 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 Description

Facility use and mission may change, and modifications may be made that significantly affect effluent monitoring. Therefore, this section discusses the range of physical descriptions, missions, activities that generate effluents, and effluent pathways for all DOE-owned, PNNL-operated facilities. A listing of the BOP facilities at the time of writing this FEMP is provided in Appendix A along with more detailed information on these facilities.

DOE-owned, PNNL-operated facilities are located primarily in the 300 Area of the Hanford Site (see Figure 2.1) and range from small storage facilities to multilevel high-bay research facilities. About 20 active facilities fall into the BOP category. Of these, a few buildings are used for office or administrative purposes only, about half are Research and Development (R&D) facilities, and the rest are R&D support facilities (e.g., storage, maintenance services, waste operations).

The BOP facilities are operated to support the DOE Office of Science mission, which includes science and technology as well as environmental research. The science and technology mission, for which PNNL is designated as a principal laboratory, is to develop and deploy science and technology to meet immediate cleanup needs and to develop global long-term cleanup solutions. One of the goals is to contribute knowledge and technology to DOE's other core missions, consistent with PNNL's focus on the environmental mission. Activities in individual facilities range from administrative to laboratory and pilot-scale R&D. R&D activities include both radioactive and chemical-waste characterization, fluid-dynamics research, mechanical-property testing, and dosimetry research. R&D work is performed on a project basis, and projects are evaluated for a number of factors, including environmental risk, before being initiated. Activities to take place in specific facilities are evaluated through a preparatory and risk analysis process that includes reviewing the project activities against current building operational boundaries. Appendix A briefly describes the type of work performed in individual active BOP facilities.

Facility use agreements (FUAs) have been prepared for the active BOP facilities. These FUAs describe the mission and activities for work in the individual facilities and specify the limiting boundaries for facility operations. They also describe the physical structure and operating design parameters of the facilities. In addition, facility drawings of BOP facilities are maintained by PNNL's Facilities and Operations directorate, which also manages facility modifications.

2.1 Source Term Definition and Description

The characteristics of releases that could contribute to each effluent stream during normal operating and upset conditions are described in this section. Unconfined contact with ventilation air is the only prerequisite for an inventory to contribute a gas or aerosol source term to the air-effluent stream. Thus, all "passive" inventories stored in open containers, as well as those used in "active" processes; can potentially produce gas or aerosol source terms. The following subsections discuss potential source terms under normal and upset[(a)] conditions.

The building and local 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 BOP facilities under current and foreseen operations. For the purposes of this section, a source term is a description of the nature and location of potential sources of releases of radioactive and/or chemical materials within the building. The release could be to the atmosphere or the sewers due to process activities.

(a) The *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991) states that "provisions for monitoring of airborne emissions during accident situations should be considered." The term "upsets" is used in this document to refer to accidents that might be expected to occur in a facility and for which monitoring should be considered.

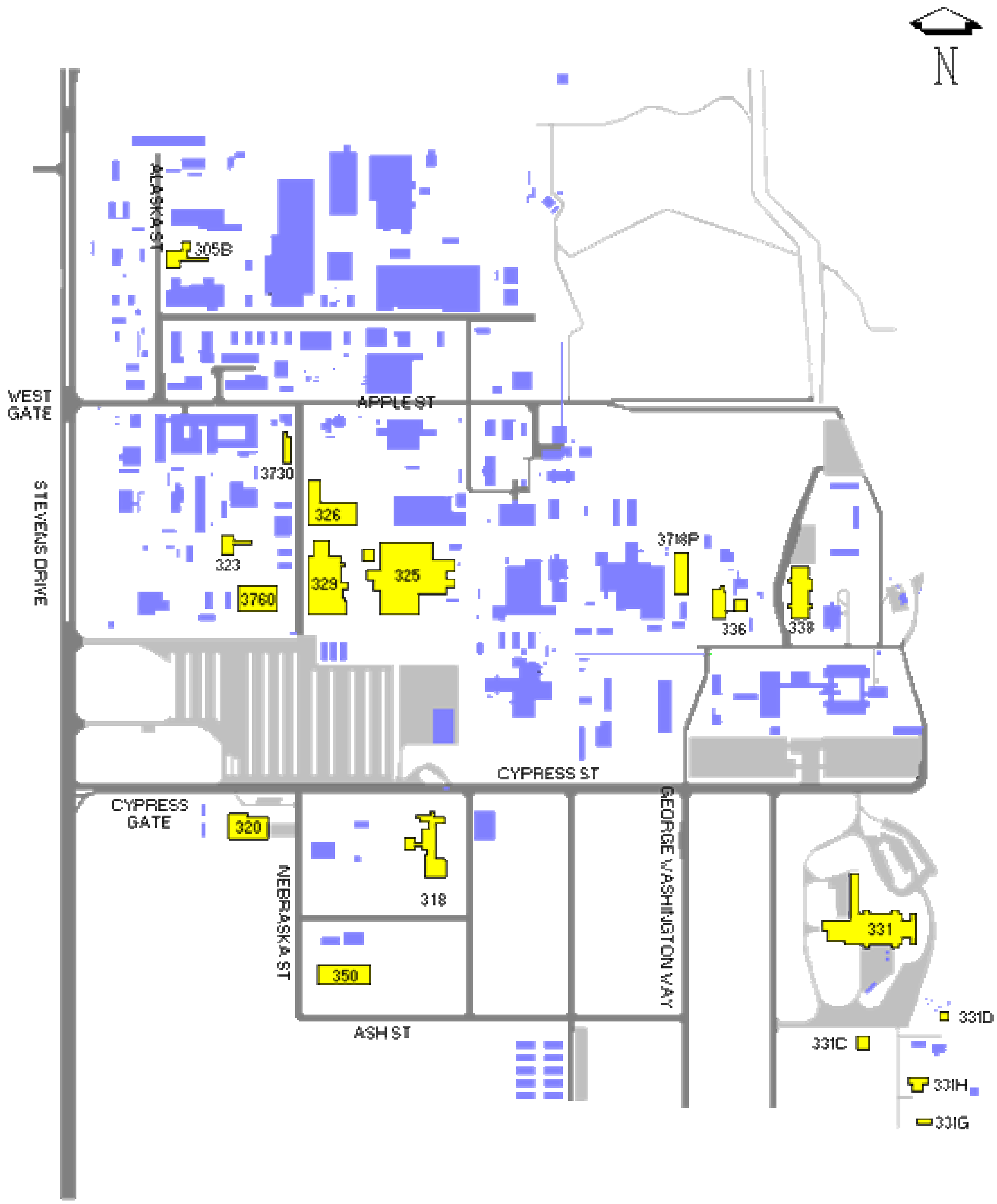

Figure 2.1. Active DOE-owned, PNNL-Operated Facilities in the 300 Area of the Hanford Site

Normal Operations

Under normal operations, most of the R&D BOP facilities have ventilation systems that maintain a negative pressure in the building. Air is drawn into the building through work areas and carried through ducts to one or more emission points. Radionuclide air emissions generated from projects are evaluated on a case-by-case basis to determine compliance with permitting requirements for air emissions.

The need for monitoring airborne emissions of hazardous chemicals is established in the Hanford Site Air Operating Permit. Based on the current potential-to-emit, the permit does not contain general monitoring requirements for BOP facilities. However, the permit identifies monitoring requirements for specific projects and buildings. Monitoring can consist of direct monitoring of emission concentrations, or monitoring of indirect indicators such as process parameters. Needs for future monitoring will be established by future permits issued pursuant to the applicable state and federal regulations (e.g., Washington Administrative Code [WAC] 173-400, "General Regulations for Air Pollution Sources," and WAC 173-460, "Controls for New Sources of Toxic Air Pollutants").

Facilities are equipped with liquid-effluent systems that transport liquid waste streams to centralized treatment facilities. Under normal operations, liquid wastes are generated, designated as regulated or nonregulated, and only discharged to sewer systems after determining that the waste meets the appropriate discharge criteria.

Upset Conditions

Upset conditions for air emissions include failure of the building ventilation system, resulting in air emissions following a different pathway or inadvertent or unusual generation of airborne materials resulting in unexpected emissions. Section 3.3.2 discusses upset conditions that have been classified as off-normal events. Unplanned releases of hazardous or radioactive materials inside facilities are the predominant type of upset condition that should be considered in facility monitoring.

Upset conditions for liquid effluents are similar in that a failure (break in the piping, pump malfunction) may occur, causing effluents to be spilled, or material may be inadvertently discharged to a sewer system, resulting in unexpected effluents. Very few of these types of upsets have actually occurred (see Section 3.3.2); however, liquid-effluent monitoring is performed as needed to respond to these events.

2.1.1 Chemical

Chemical storage and usage are well dispersed throughout the BOP facilities and consist of bulk materials (solvents, acids/bases), small-volume chemicals, and standards used in conducting laboratory experiments. All chemicals within each facility are inventoried and tracked via an electronic database.

Of the more than a thousand different chemicals in the BOP facilities, only a fraction have the potential for exceeding the reportable quantities (RQs) specified by the U.S. Environmental Protection Agency (EPA) (40 CFR 302.4). RQs are the amounts that, if released to the environment from a facility, require notification to the National Response Center. All chemicals, their locations, and quantities are tracked using PNNL's Chemical Management System (CMS). Each of the BOP facilities has an FUA that provides the capabilities and limitations on chemical usage for the facility.

Many of the laboratories contain satellite accumulation areas for liquid and solid hazardous wastes. An active inventory of the waste contents is maintained. Liquid and solid wastes are disposed of in accordance with guidelines described in PNNL's Standards-Based Management System (SBMS). The SBMS is available electronically on the Internet via http://sbms.pnl.gov/ch00d010.htm. The SBMS subject areas on waste management and effluent control are listed under the subject-area category "Waste Management."

2.1.2 Radionuclide

Radioactive material storage and usage are dispersed throughout many BOP facilities and include a large number of isotopes. These materials are found in several forms, including solid, liquid, particulate, and gas. Some of these materials may be heated during R&D activities, producing vapors.

A current inventory for each building is assessed yearly to determine radiological-air-emission monitoring. This inventory list is a combination of the following three lists:

- Inventory estimates provided by staff responsible for any radioactive materials not included in the next two bullets.

- Composite Radioactive Material Inventory, which contains data on sealed sources that are assigned to custodians and accounted for by PNNL's Safety and Health Department. This database also contains data on radioactive materials covered under the State of Washington Radioactive Material License.

- Nuclear Materials Inventory, which is the inventory of special nuclear material that is maintained in a material balance area and assigned to a material balance area custodian.

This assessment methodology is documented in Ballinger et al. (2003). In addition, Appendix A provides information on the types of radionuclides found in each active BOP facility.

2.2 Identification of Effluent Pathways

The term "point-of-discharge," as used in this section, refers to the point at which the effluent leaves PNNL's 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, the Washington State Department of Health (WDOH), and the Washington State Department of Ecology emission control and monitoring requirements.

Except for the 331 Building aquaculture system, liquid effluents originating in all BOP facilities remain in a controlled system at the "point-of-discharge" from the facility. At these points, the responsibility for the effluent stream, including its ultimate disposition, passes from PNNL to the site operations contractors: Fluor Hanford for the process sewer in the 300 Area, DynCorp for the sanitary sewer in the 300 Area, the City of Richland for the 700 Area, and EMSL.[a] As such, these contractors are responsible for monitoring and controlling environmental discharges of liquid effluents. However, PNNL is responsible for characterizing effluents originating in its facilities and for exercising appropriate control over the discharge of these effluents. In addition, because of an industrial wastewater permit, PNNL is responsible for sampling the process sewer discharges at EMSL before they are batch discharged to the City of Richland Publicly Owned Treatment Works (POTW).

Wastewater from the aquaculture system is discharged directly to the Columbia River, and these discharges were permitted as part of the Hanford Site National Pollutant Discharge Elimination System (NPDES) Permit (EPA 1981) until the permit was reissued in 1999. At that time, it was determined that the discharge was exempt based on low production rates.

2.2.1 Gaseous and Aerosol Emission Pathways

As-built ventilation drawings, which have been identified as "key drawings," were prepared for the 326, 329, and 331 Buildings. Any facility modification that changes building flow paths 1) must receive prior concurrence from the building manager (per SBMS) and 2) requires updating of the appropriate drawing before project close-out. The PNNL SBMS[b] subject area, "Creating or Modifying Engineering Calculations, Drawings, and Specifications," provides the requirements for controlling facility modifications.

The FUAs contain information on ventilation-system capabilities, including control features for air emissions. The most predominant air-emission control is high-efficiency particulate air (HEPA) filtration because work with radioactive materials with particulate emissions is the primary concern for most of the BOP facilities. Potentially radioactively contaminated airflow usually passes through a HEPA filter before exiting the building through a stack or vent.

(a) The 622-R Building in the 600 Area has primarily normal sanitary effluents and is connected to a nearby sanitary system. No monitoring is required for the 622-R Building.

(b) The SBMS provides staff with laboratory-wide standards, procedures, and guidelines for the work they perform. The laboratory develops standards, procedures, and guidelines based on an evaluation of external requirements documents, including orders, directives, and federal, state and local laws, as well as Battelle policy.

Most of the air-emission points in the BOP facilities are part of the ventilation exhaust system. However, vents may be located in elevator shafts and sewer systems. Under normal operations, airborne emissions travel through facility ductwork to one or more emission points from the building. If air emission sampling is required, the sampling system is located downstream of control technologies and before the location at which the air is discharged to the atmosphere. However, some BOP facilities or sections of facilities are passively ventilated, and some do not have an emission point or points. Appendix A contains information on ventilation systems for the active BOP facilities.

2.2.2 Liquid-Effluent Pathways

Liquid effluents are discharged from the BOP facilities via liquid-waste systems. In the 300 Area (except EMSL), these include the sanitary sewer system (SNS), the process sewer (PS) system, the retention process sewer system (RPS), and the aquaculture system. After they exit the buildings, the SNS comes under the control of DynCorp, and the PS and RPS come under the control of Fluor Hanford. Figures 2.2 through 2.4 show the general layout of liquid-effluent systems in the 300 Area.

Radioactive liquid wastes generated under normal operations are collected at individual facilities and then transported to the RPL, where they are discharged to the Radioactive Liquid Waste System tank. The tank contents are then transferred to a tanker for transportation to the 200 Area for disposal on an as-needed basis.

Liquid effluents from the 600 Area (622-A, B, C, and R Buildings) are discharged to a nearby sanitary septic system.[a] Effluents from these facilities are generated primarily from bathrooms and sinks in the 622-R Building, and no wastewater monitoring is required.

Stormwater systems are located on the outside of some BOP facilities and may drain to the soil at various locations around the building. A listing of injection wells and stormwater outfalls for PNNL facilities is maintained by PNNL's Effluent Management Group. The potential for radioactive or chemical contamination to be washed into the soil with stormwater is considered low, and no monitoring is required.

Sanitary Sewer

The 300 SNS receives effluent primarily from restrooms, lunchrooms, change rooms, some cooling processes, and other water uses in which no contamination is believed to be likely. Under normal operating conditions, no regulated materials are present in the SNS effluent. The sanitary wastewater is discharged into the 300 Area SNS, operated by DynCorp under contract with DOE. The 300 Area SNS discharges to the City of Richland POTW under a contract agreement between DOE and the City.

Sanitary effluents from EMSL and the 747-A Building also discharge to the City of Richland POTW and do not require a permit. Liquid effluents from the 622 Building complex are primarily sanitary, and all discharge to a nearby sanitary septic system.

Process Sewer

The PS receives process wastewater (e.g., equipment cooling water, laboratory wastewater) from the 300 Area. In all 300 Area BOP facilities except EMSL, the PS discharges to the 300 Area PS System, which then flows to the Treated Effluent Disposal Facility (TEDF) for treatment before discharge to the Columbia River. EMSL process water is held in effluent tanks that are sampled before discharge to the City of Richland POTW.

(a) A drywell that services discharges from a 622-R Building kitchen sink and fume hood was identified in 1998. Carboys were installed to suspend discharges to the drywell, and the inactive well was added to the list of miscellaneous streams.

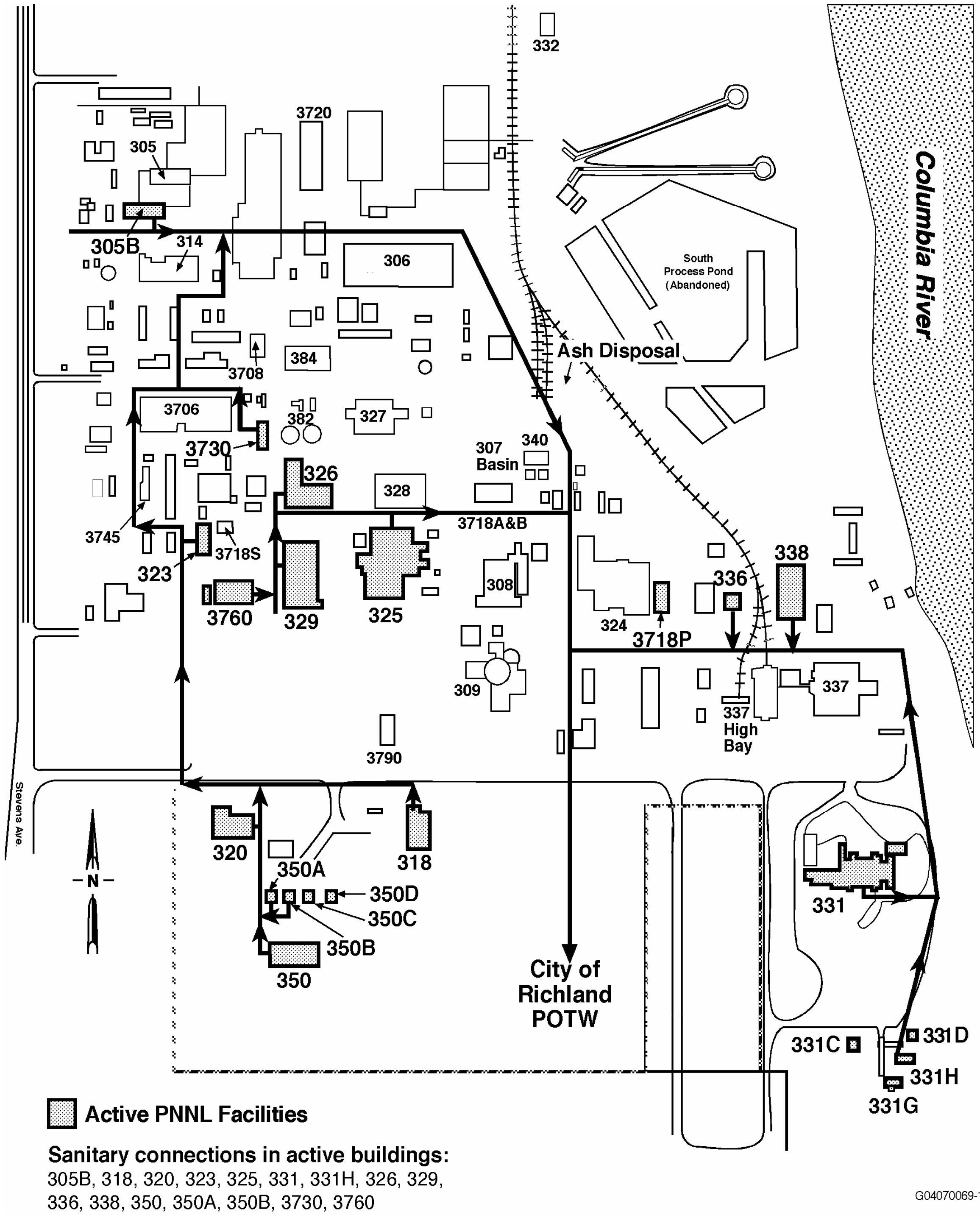

Figure 2.2. Schematic of 300 Area Sanitary Sewer System

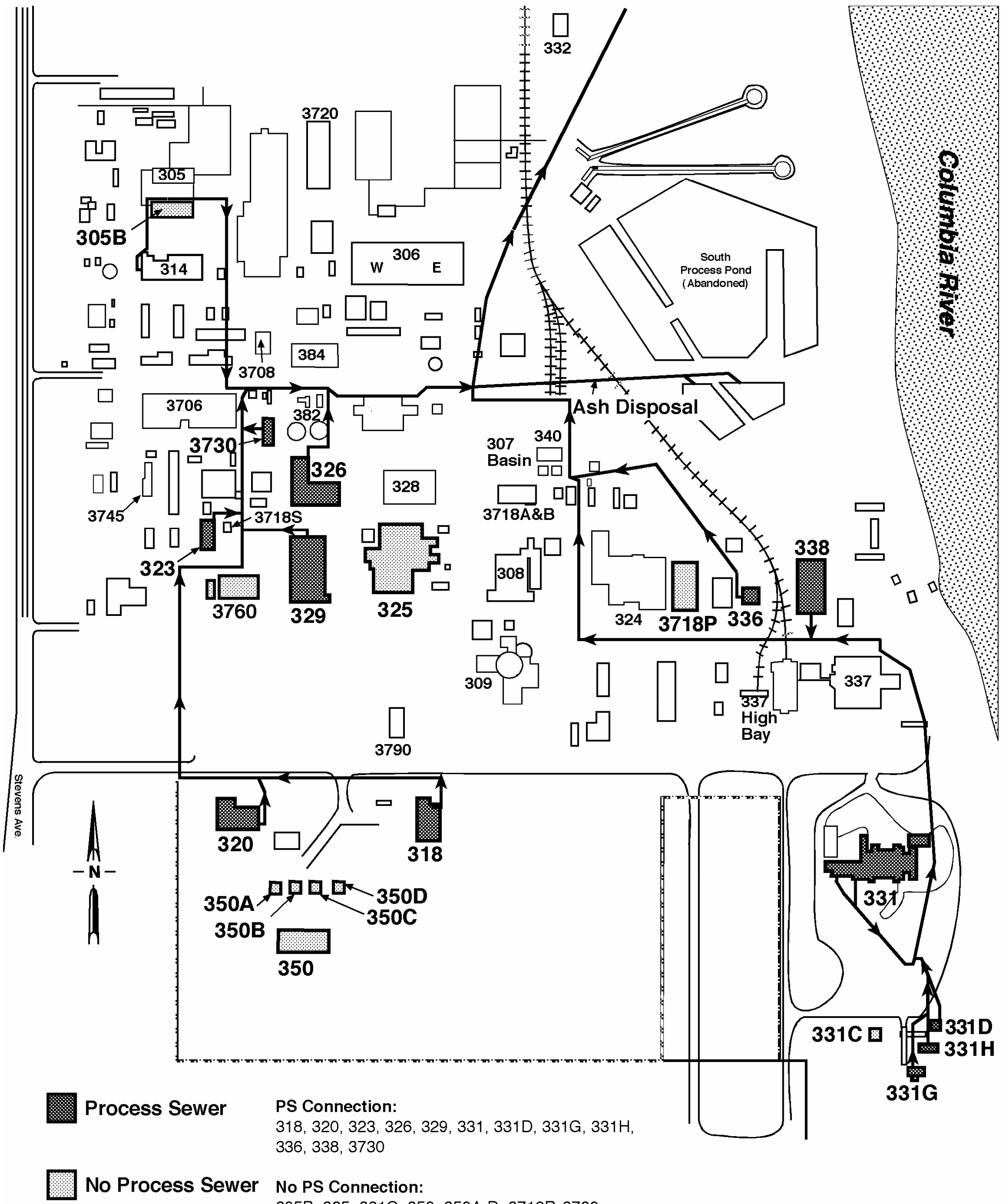

Figure 2.3. Schematic of 300 Area Process Sewer System

Retention Process Sewer

The RPS receives wastewater, such as equipment cooling water, laboratory wastewater, and floor drain water, which is normally free of radioactive contamination but has potential for such contamination in the event of a failure of an engineered barrier or administrative procedure. The only BOP facilities that are connected to the RPS are the 326 and 329 Buildings. RPS piping is routed through a diverter station (operated by Fluor Hanford) inside the facility that provided automatic diversion to the Radioactive Liquid Waste System (RLWS) before 1998 in the event of radioactive contamination being detected. The diverter station consists of a lead-shielded, gamma-radioactivity counting instrument, an automatically operated three-way valve, and associated alarms for diverting liquid flow from the RPS to RLWS if radioactivity in the waste exceeded a preset level of 5000 pCi/L of ^{137}Cs or equivalent. In 1998, the diverters were modified to remove the diversion capability. The diverters will now provide alarm to the 340 Complex if radioactivity in the waste exceeds the preset level. After passing the diverter stations, the liquid wastes from the RPS are subsequently discharged to the 307 Building basins (also operated by Fluor Hanford) in the 340 Complex. If the diverter alarms, the RPS is to be diverted to a dedicated basin at the 340 Complex. If the diverter does not alarm, the effluent is screened at the 307 Building basins for alpha radioactivity before being discharged to the PS. Liquid-effluent sampling systems for the RPS system are in place and maintained in the 326 and 329 Buildings. The system is sampled by PNNL on an as-needed basis.

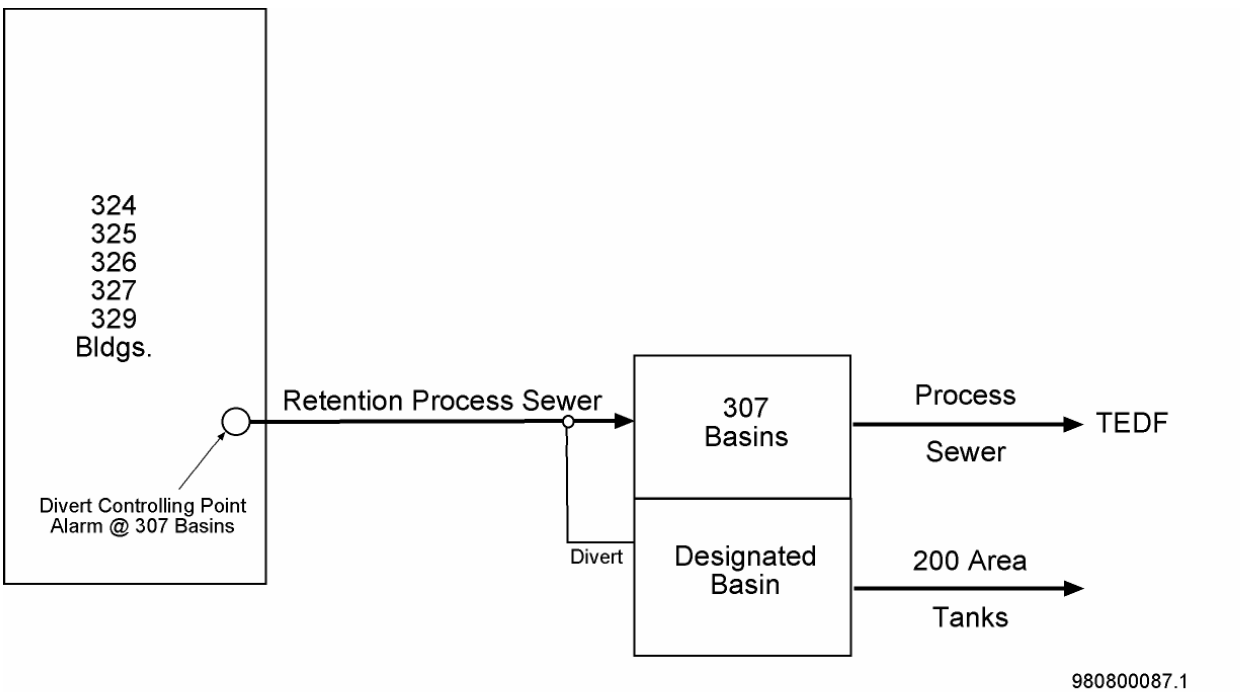

Figure 2.4. Schematic of 300 Area Retention Process Sewer System

Aquaculture System

The aquaculture system was developed to support aquaculture research in the 331 Building, and only the 331 Building is served by this system. The aquatics laboratory uses both river and well water sources for supplying water for fish-rearing activities. Effluents are discharged to the Columbia River. Figure 2.5 is a schematic of the aquaculture discharge system.

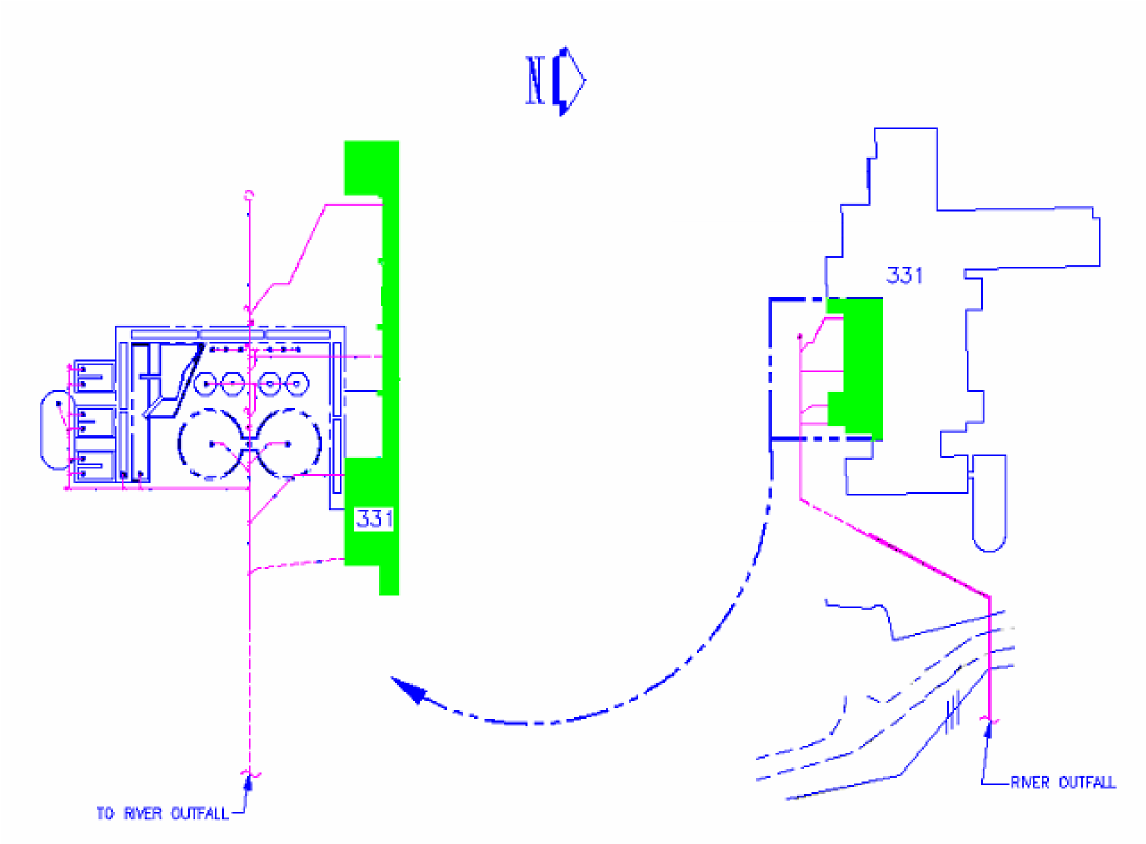

Figure 2.5. Schematic of Aquaculture Discharge System

3.0 Rationale and Design Criteria for Sampling and Monitoring

This section discusses design criteria for the BOP facilities' Effluent Monitoring Program. Criteria are established to verify that effluents are measured according to applicable regulations and guidance and are appropriate for current facility operations.

In this section, the terms "sampling" and "monitoring" are used to distinguish between two types of airborne or liquid-effluent 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 emission rates by means of a detector located in the sample stream. "Monitoring" is a "real-time" measurement.[a]

Airborne or liquid-effluent 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). Effluent sampling may also be performed to characterize waste streams or investigate discharges of concern.

Effluent streams are monitored as a means to provide timely indication of a significant change in emission rate or effluent character. Currently, monitoring is not required at any of the BOP facilities, although liquid-effluent monitoring systems are provided in some BOP facilities (see Appendix A) as a tool to investigate potential problematic discharges.

3.1 Basis for Design Criteria

The following regulations and guidance were considered in effluent sampling and monitoring system design and operation:

- *Regulations on Standards of Performance for New Stationary Sources, Appendix A: Reference Methods.* Environmental Protection Agency, U.S. Code of Federal Regulations, (40 CFR 60, 1971).

- *National Emission Standards for Hazardous Air Pollutants*. Environmental Protection Agency, U.S. Code of Federal Regulations, (40 CFR 61, 1990).

- *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*. American National Standards Institute (ANSI N13.1-1969).[(b)]

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

- *Industrial Wastewater Permit to Environmental Molecular Sciences Laboratory (EMSL)*. CR-IU005. City of Richland. (City of Richland 1997).

- *Richland Pretreatment Program.* (City of Richland Ordinance No. 7-96).

- *Hanford Site Title V Air Operating Permit 00-05-006*, Ecology Publication #00-05-006 (WDOE,

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(a) The AOP regulation also created the concept of "periodic monitoring" which can include indirect measurements or record keeping of indirect parameters that are indicators of emissions. For example, records on periodic combustion tuning and amount of fuel burned may be required for boilers in lieu of exhaust measurements.

(b) American National Standards Institute (ANSI) N13.1 was updated in 1999 and incorporated into federal regulations in 2002. However, the federal regulations apply only to major emission points, and the design of existing sampling systems are grandfathered from the regulation unless they undergo significant modification (as defined in the regulations). The existing sampling systems for BOP facilities are not required to meet the updated ANSI standard design criteria per the date of publication of this FEMP.

WDOH, and BCAA 2000).

- *Radiation Protection Air Emissions*, WAC 246-247 (WAC 1994).
- *General Environmental Protection Program*. U.S. Department of Energy. DOE 5400.1[(a)] (DOE 1988).
- *Radiation Protection of the Public and the Environment*. U.S. Department of Energy. DOE 5400.5 (DOE 1990).
- *General Design Criteria*. U.S. Department of Energy. DOE 6430.1A (DOE 1987).
- *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*. U.S. Department of Energy. DOE/EH-0173T (DOE 1991).

The following are additional requirements for sampling/monitoring at the BOP facilities as prescribed in PNNL operational and programmatic documents:

- *SBMS subject area, Airborne Emissions,* (PNNL 2002, Airborne Emissions)
- *SBMS subject area, Waste, Managing,* (PNNL 2003, Waste, Managing)
- *SBMS subject area, Working With Chemicals* (PNNL, Chemicals, Working With)
- *SBMS subject area, Liquid Effluents,* (PNNL 1998, Liquid Effluents, Managing)
- *SBMS subject area, Engineering Calculations, Drawings, and Specifications, Creating or Modifying,* (PNNL 2002, Engineering Calculations, Drawings, and Specifications, Creating or Modifying)

3.2 Criteria for Radiological-Air-Emission Sampling and Monitoring

Airborne radionuclide emission points at PNNL are classified as either “major” or “minor.” These two categories are defined as follows:

Major emission points	Those emission points where radionuclide emissions could cause an offsite emission dose[(b)] of 0.1 mrem/yr if emission controls were not applied. Major emission points are sampled according to requirements in Subpart H of 40 CFR 61.
Minor emission points	Those emission points that could potentially release radionuclides, but at a level less than that of a “major” point.

All of the BOP facilities, except the 331 Building, are either considered minor emission points or do not have a potential for releasing radionuclides. The 331 Building has a major emission point.

Continuous emission monitoring is required for any emission system where

- a potential of greater than once per year exists for exceeding 20% of the offsite emission dose standard of 10 mrem/yr (credit may be taken for emission control equipment, such as HEPA filters) per DOE (1991)

(a) DOE Order 5400.1 was superceded by DOE O 450.1 in 2003, but was effective at the time the sampling systems were designed and installed.

(b) The annual offsite emission dose 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 were operated without any HEPA filtration or other emission controls. The method for calculating the offsite emission dose 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. Ballinger et al. (2003) provides additional discussion of this assessment method.

- continuous emission monitoring is specified by a Safety Analysis Report (SAR) or operational safety requirement.

None of the BOP facilities meet the above criteria; thus, none are required to have continuous emission monitoring.

3.2.1 Sampling System Performance Criteria

Sampling at each major or minor emission point should provide the capability for detecting an annual radionuclide release quantity resulting in an offsite emission dose of 0.1 mrem/yr (DOE 1991).

All radionuclides anticipated to contribute greater than 10% of the potential to emit (PTE) from the sampled emission point shall be accounted for, either by direct analysis or by inference from an indicator measurement (40 CFR 61, 1990).

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) (1969) and DOE (1991).

3.2.2 Sampling System Design Criteria

Sample extraction location criteria are provided in 40 CFR 60, Method 1, in Appendix A. Method 1 states that "Sampling or velocity measurements 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."

For minor stack sampling, this criterion is desired, but not required.

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. Representative samples shall be withdrawn on a continuous basis at the sampling site following the guidance in ANSI (1969),[a] Appendix A, Section A3.2. ANSI (1969) 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 probes. 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 (1969) and DOE (1991).

3.2.3 Criteria for Sampling-System Operation

PNNL's Effluent Management Group maintains sampling-system configuration drawings for all emission point radionuclide air-sampling systems. This includes calculations of sampling-system efficiencies for particle sizes of 1 micron and 10 microns. A 1-micron particle size is assumed under normal operating conditions because most radionuclide air emissions are HEPA filtered.

Sampling-system operating criteria are based on regulations and guidance documents listed in Section 3.1.

Sampling is performed to verify major or minor stack status during a calendar year for BOP facilities that have a PTE airborne radioactive material. The frequency of collecting samples is based on a graded approach considering the PTE, current and expected activities, and past practices in the facility. All of the BOP facilities are either considered minor for radioactive air-emission sampling or have no potential for radioactive air emissions except for the 331 Building, which has a major emission point. Continuous sampling is conducted at major emission points and at the minor emission points that meet the following criteria:

(a) As noted previously, ANSI N13.1 – 1969 was updated to ANSI/HPS N13.1 in 1999, but existing sampling systems are not required to meet the updated standard unless they undergo significant modifications. Currently (as of publication of this FEMP), all BOP systems are under the 1969 standard.

- Assessment of potential emissions indicates that the point is near the borderline of “minor.” In dose terms, these are emission points for which the potential unmitigated annual offsite dose exceeds 0.01 mrem/yr.
- Radionuclide emissions occur and are highly variable over time such that periodic release measurements do not provide an adequate means for confirming that annual emissions are low.
- Continuous sampling is deemed necessary after considering radionuclide inventory, release history, emission controls, and current activities.
- Sampling is performed as required to comply with permit conditions.

Minor emission points that do not meet the above criteria are sampled either quarterly or annually, depending on their emission potential. Because DOE requires an annual emission report, minor emission points are sampled a minimum of once per year, although hand calculations may be used to estimate emissions for some facilities. The period of sample collection is based primarily on the capacity of the collection media. A current radionuclide air-sampling schedule for BOP facilities is maintained within the Gaseous Effluent Database.

Samples are analyzed in the laboratory according to procedures required by Appendix B, Method 114, “Test Methods for Measuring Radionuclide Emissions from Stationary Sources,” in 40 CFR 61 (1973). Radioanalytical laboratories analyze samples 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 performance criteria in Section 3.2.1 specify an emission detection level of 0.01 mrem/yr offsite emission dose. 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; the sample could be measured for specific radionuclides 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 were applied.

Exhaust-stream flow rates at sampling locations are measured using EPA Method 2 (40 CFR 60). Flow-rate measurements are performed annually or when modifications are made or flows change more than ±10%.

3.3 Historical Sampling Data for Effluent Streams

When required, the effluent streams from the BOP facilities have been sampled over the history of operations. Information from historical sampling and monitoring is provided here (additional detail in Appendix A) to aid in providing a basis for future sampling needs. Historical sampling has been performed for some BOP facilities to measure radioactive air emissions and to characterize liquid effluents. No historic data (before 1998) exist for air-chemical emissions. The following section describes historic sampling data under normal operating conditions for air and liquid-effluent streams. Estimates of the types of releases and release pathways experienced during plant operations under upset conditions are given in Section 3.3.2.

3.3.1 Normal Conditions

Some of the air and liquid-effluent streams have been sampled since some of the BOP facilities started operations. The types and locations of sampling and analytical methods under normal operations are described in this section.

Discussion is generally limited to the past 7 years (1997 to 2003) because this time period is the most relevant to future operations and monitoring needs.

Historical Radioactive-Air-Effluent Sampling

Effluent air from BOP facility emission points has been sampled and monitored downstream of the final HEPA filters for radioactive particles and tritium (326 Building only). Sampling for particulate gross alpha and beta has been provided by the record sampler for facilities that have PTE radionuclides. Data from 1997 to 2003 are presented in Figure 3.1. Total alpha and total beta emissions are historically low and even non-detectable for some facilities and years. Results from EMSL represent uncertainties above background levels since that facility has not used uncontained dispersible radioactive material. PNNL implemented a graded approach to sampling in 1996 that depended on a number of facility factors. Continuous sampling continued to be conducted at all major emission points and for minor emission points that met the following criteria:

- The assessment of potential emissions indicates that the point is near the borderline of "minor." In dose terms, these are emission points for which the potential unmitigated annual offsite dose exceeds 0.01 mrem/yr.
- Radionuclide emissions occur and are highly variable over time such that periodic release measurements do not provide an adequate means for confirming that annual emissions are low.
- Continuous sampling is deemed necessary after considering radionuclide inventory, release history, emission controls, and current activities.

BOP facilities with potential radiological air emissions that were minor, but did not meet the above criteria, were sampled on a less frequent basis, either quarterly or annually, depending on their emission potential.

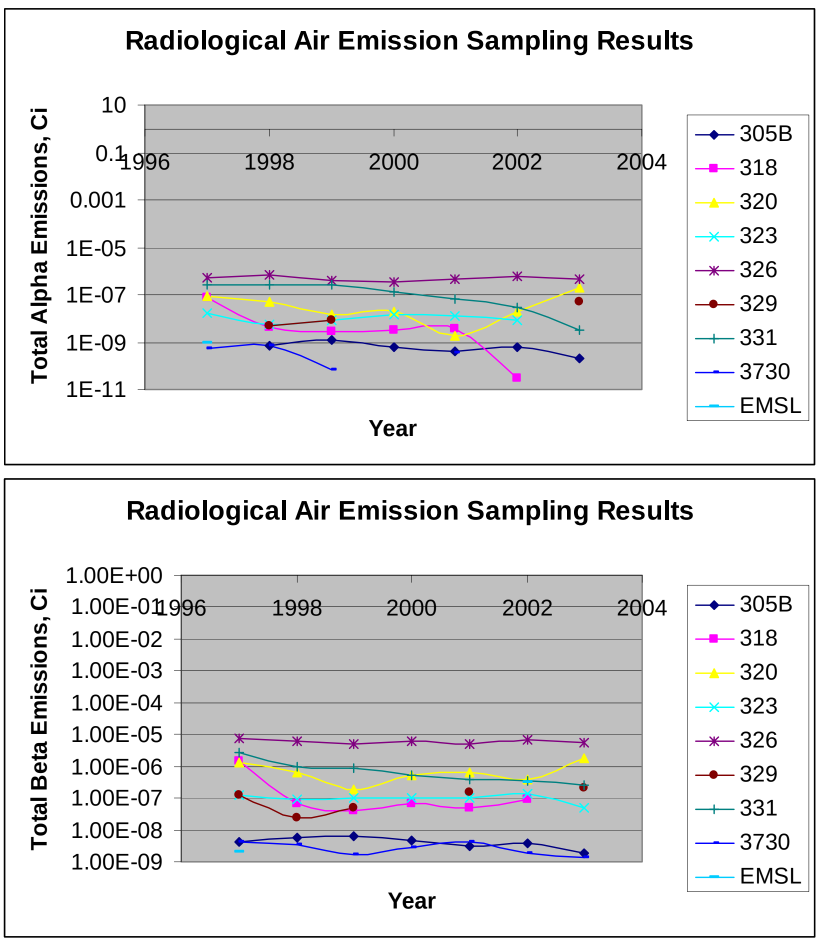

Figure 3.1. Results from Sampling for Radioactive Air Emissions from BOP Facilities

Historical Liquid-Effluent Monitoring

Liquid waste streams in the BOP facilities have been served by the systems as described in Section 2.2.2. Most of the BOP facilities are located in the 300 Area. Liquid-effluent streams from PNNL facilities in other areas have not been monitored and are not currently required to be monitored. Therefore, this section focuses on the 300 Area liquid-waste systems.

Table 3.1 summarizes the type of historical monitoring/sampling for each liquid waste system. As noted in the table, historically, 300 Area sanitary liquid waste was sampled at the SNS system just before the waste entered the SNS septic tanks. Before 1997, sanitary wastes were discharged to a 300 Area septic tank/trench system. In 1997, the 300 Area SNS was connected to the City of Richland POTW. A brief description of the sampling and analysis program before connection to the City of Richland POTW is given in the *Westinghouse Hanford Company Effluent Report for 300, 400, and 1100 Area Operations* (McCarthy 1990).

Table 3.1. Summary of Historical Liquid Monitoring/Sampling

System	Notes
SNS	No sampling or monitoring at BOP Facilities. Sampled as composite with other 300 Area SNS before 1997 and sampled as required by contract with City of Richland POTW after 1997 hook-up. Current sampling is performed by the 300 Area infrastructure contractor as required.
PS	Sampling of 306-W Building Process Sewer (PS), 320 Building PS, 326 Building PS, and 331 Building PS conducted as part of PNNL's 1994 and 1995 sampling campaign to characterize liquid wastes for TEDF. Periodic sampling in recent years to confirm low contaminant levels or investigate concerns.
RPS	Retention Process Sewer (RPS) for 326 and 329 monitored at diverter station in 326 Building. Sampling at 326 was conducted as part of PNNL's 1994 and 1995 sampling campaign. Periodic sampling in recent years to confirm low contaminant levels or investigate concerns.
Aquaculture	Sampled as required by permit from 1976 to 1999; some sampling after 1999 as directed by DOE.
RLWS	Historically sampled at 340 Building before transport to the 200 Area tanks.
EMSL	Process wastewater sampled at effluent tank pit before discharge to City of Richland POTW.

Historically, the 300 Area PS was discharged to trenches. Samples of the composite liquid waste from all 300 Area PS lines were taken before the liquid was discharged to the 300 Area process trenches (McCarthy 1990). In December 1994, a treatment facility, the 300 Area TEDF, was brought into operation to replace the trenches. Around that time, PNNL conducted a sampling campaign to characterize the waste streams from the primary PNNL R&D facilities. Results of this campaign are documented in Thompson et al. (1997). Sampling and analysis for radioactive and nonradioactive constituents occurred at the following BOP waste streams as a result of the campaign: 306-W Building PS, 320 Building PS, 326 Building PS and RPS, and 331 Building PS.

Only two BOP facilities, the 326 and 329 Buildings, have RPS systems. The RPS from both buildings is routed to a diversion station (located at the 326 Building) equipped with a radioactivity monitor that measured gamma activity and an automatically operated three-way valve that diverted flow to the RLWS if radioactivity above a preset level was detected in the waste stream. Diverter alarms were annunciated in various locations in each facility when diversion occurred, and a sample was taken automatically. Data from the monitor were not recorded. Diversion of these RPS streams rarely occurred; only a few diversions took place from 1991 to the present.

Normally, the RPS passed through the diverter stations and subsequently (after reaching the 307 Building Basins and being analyzed for gross alpha contamination) into the 300 Area PS lines. As previously described, this stream was discharged to trenches before December 1994 and to the 300 Area TEDF after that date.

The 331 Building aquaculture system outfall was sampled and monitored as required by the NPDES Permit (EPA 1981) from 1976 to 1999. Data were reported in monthly discharge monitoring reports as required by the permit. When the Hanford site-wide NPDES was reissued in 1999, the aquaculture outfall was exempted based on a determination that the aquaculture activities are well under production thresholds established for aquatic animal-production facilities specified in 40 CFR 122 Appendix C. Although sampling is no longer required by regulations or permit, some sampling of the aquaculture has continued as a best-management practice at the direction of DOE.

The RLWS, deactivated in 1998, served liquid waste streams diverted from the RPS. Waste diverted to the RLWS lines were discharged to the 340 Building. The composite water in the holding tanks at the 340 Building was 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.

EMSL started operations in 1997, and sampling of the process wastewater was initiated at that time. Monthly discharge monitoring reports were sent to the City of Richland as required by permit.

Sampling and monitoring results have normally demonstrated low levels (ppb) of pollutants in wastewater from PNNL BOP facilities. Occasional results have exceeded criteria, and appropriate follow-up actions were taken.

3.3.2 Off-Normal Events

Off-normal or upset conditions can potentially result in releases to the environment. PNNL's Off-Normal Event (ONE) Reporting Program identifies, categorizes, and tracks off-normal events of concern. A listing of ONEs identified since 1996 was analyzed to determine the types of events that should be considered in facility effluent sampling and monitoring planning. This analysis, which included all PNNL-operated facilities, resulted in the following general categories of events with implications for effluent sampling or monitoring:

- unplanned releases of hazardous or radioactive materials inside facilities
- small laboratory fires
- unexpected hazardous material or radioactive contamination found in sinks
- unplanned disruptions of facility exhaust systems.

The greatest number of events was from unplanned releases of hazardous or radioactive materials inside the facility. The consequences to the environment for these events were minor because they could be cleaned up with no adverse effects. Also, radioactive releases are in locations where the air is routed through HEPA filters before exhausting to the outside and thus are mitigated by control technology. Using a generic analysis for gross alpha and gross beta on radioactive-air-emission samples as opposed to isotope-specific analysis provides more robust sampling that can help detect unusual radioactive releases. Small laboratory fires may also cause unexpected air emissions from the facility.

For contamination found in sinks or traps, liquid-effluent sampling is performed at the time the contamination is found. The sampling aids in quantifying the release, determining potential effects, or evaluating the impact on future effluents. At EMSL, spills may trigger isolation of the receiving tank and special sampling.

Unplanned disruptions to the facility exhaust flow may interrupt air-emission sampling periods. For BOP facilities, the purpose of radioactive air-emission sampling is to confirm the low air emissions. Thus, interruptions are not considered critical, and the sampling period can be adjusted or a discrepancy report completed to identify and correct for the effect on the measurements taken. Sampling for air chemical emissions or liquid effluents is periodic, and loss of power or sampling equipment malfunctions is also not considered critical. Similar adjustments can be made in the measurement data.

3.4 Sampling-System Descriptions

3.4.1 Radiological-Air-Sampling System

Airborne radionuclide emissions are sampled at BOP emission points as identified in the sampling plan maintained in the Gaseous Emissions Database. Ventilation flow rates from these emission points are measured yearly at a minimum and range from 300 to 70,000 cfm.

To support the development of a stack-emission measurement program for the BOP facilities, knowledge of the types and quantities of radionuclides potentially present in the ventilation exhaust is necessary. An index of emission potential is used by PNNL 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 61 (1989), 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 Ballinger et al. (2003).

Radionuclide-air-sampling systems in BOP facilities range from multi-nozzle probes to single tubes. The samplers generally consist of a probe that projects into the stack or vent and a sample transport line that extends from the probe assembly to where a sample collection filter is located.

Stack-particulate-emission samples are withdrawn from the stack and through the sampling system by means of the building vacuum system or portable pump. The sampling rate is controlled using a control valve located downstream of the particulate sampling filter. Sample flow is measured by a rotameter upstream of the control valve. Figure 3.2 is a schematic of a typical BOP-air-sampling system. Stack velocities are measured on an annual frequency using Method 2 in 40 CFR 60 or when modifications are made or flows change more than ± 10%.

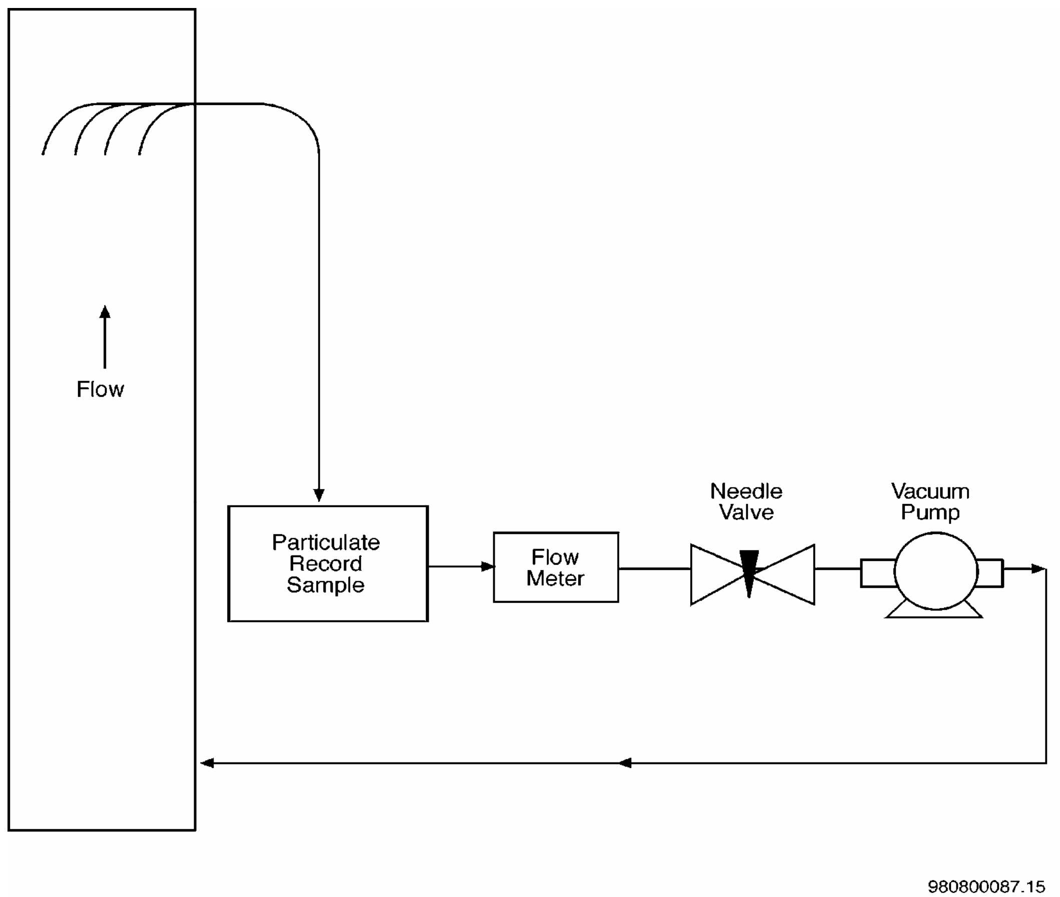

Figure 3.2. Schematic of Typical Air-Sampling System

Transport efficiency of the sample through the stack particulate sampling system has been calculated using the deposition (DEPO) code and assuming small particles (1-micron aerodynamic diameter) at nominal sampler and stack flow rates.[(a)] A 10-μm particle-size calculation is also performed to represent unfiltered emissions.

Airborne particles are collected on a 47-mm-diameter membrane filter (Gellman Versapor). The filter has an estimated retention efficiency for 0.3-micron particles of greater than 91% at face velocities of 180 fpm.

The sample-collection filter is used for a nominal 2-week continuous sampling period. The sample filter may be replaced more frequently depending on filter loading. The sample filter is stored for 7 days after being removed

(a) Loss calculations were performed using DEPO Version 2.0 (Wong 1991) originally and Version 4.0 later for updates. A 1-micron polydisperse aerosol was assumed for the calculations based on the assumption that building operations and controls (HEPA filters) are "normal."

from the sampler to permit the decay of radon and thoron daughter radionuclides. The filter is then analyzed for gross alpha and gross beta radioactivity.

Each sample is screened individually for gross alpha and gross beta activity. A subcontracted analytical laboratory analyzes samples using methods described in Chapter 4.0. Sample-analysis results are evaluated as described in Section 3.6. For the 331 Building, samples are collected over a 6-month period (semi-annual), combined, and analyzed for a group of specific radionuclides that may be adjusted as needed following each annual inventory assessment.

3.4.2 Criteria for Air Chemical-Emission Sampling

Air chemical-emission sampling for the BOP facilities is not required but is performed as a best management practice to document emissions of and confirm the methods used to routinely calculate emissions. Criteria typically consist of EPA Standard Methods or alternate methods accepted by the agency. The following elements are in place to verify that sampling for air chemical emissions meet required criteria:

- Measurement equipment is procured, acceptance tested, calibrated, and maintained according to an effluent monitoring quality assurance plan (see Section 5) to verify that sampling equipment has the capability to perform required measurements.
- Test plans and procedures are developed for measurements taken by PNNL’s Effluent Management Group to verify that measurements meet requirements.

3.4.3 Liquid-Effluent Sampling

The only BOP facility with required routine liquid-effluent sampling is EMSL. Process water from EMSL laboratories is discharged to tanks that must be sampled before discharge to the City of Richland POTW. An industrial wastewater permit was issued to EMSL (City of Richland 1997) before startup and provides the sampling criteria for the stream. The permit also gives discharge limits and reporting criteria. PNNL’s Effluent Management Group performs liquid-effluent sampling at EMSL according to permit criteria. This group also administers a discharge approval process and prepares required monitoring reports in support of the EMSL permit. The following elements are in place to verify that EMSL liquid-effluent sampling takes place as required and that sampling criteria are met:

- The EMSL process sewer system is designed to provide for holdup of wastewater before discharge (holding tanks in effluent pit).

- The process sewer effluent tanks system is designed with a mixing capability (sparging system) to verify a well-mixed sample.

- PNNL’s Effluent Management Group has sampling procedures in place that specify sampling constituents, frequency, hold times, preservatives, and other sampling criteria.

- EMSL staff have procedures in place to support sampling (e.g., tank isolation, process effluent tank mixing, approval for discharge).

- PNNL’s Effluent Management Group has contracts with analytical laboratories to provide for required analysis.

Figure 3.3 provides a diagram of the EMSL liquid-effluent tanks and sampling system.

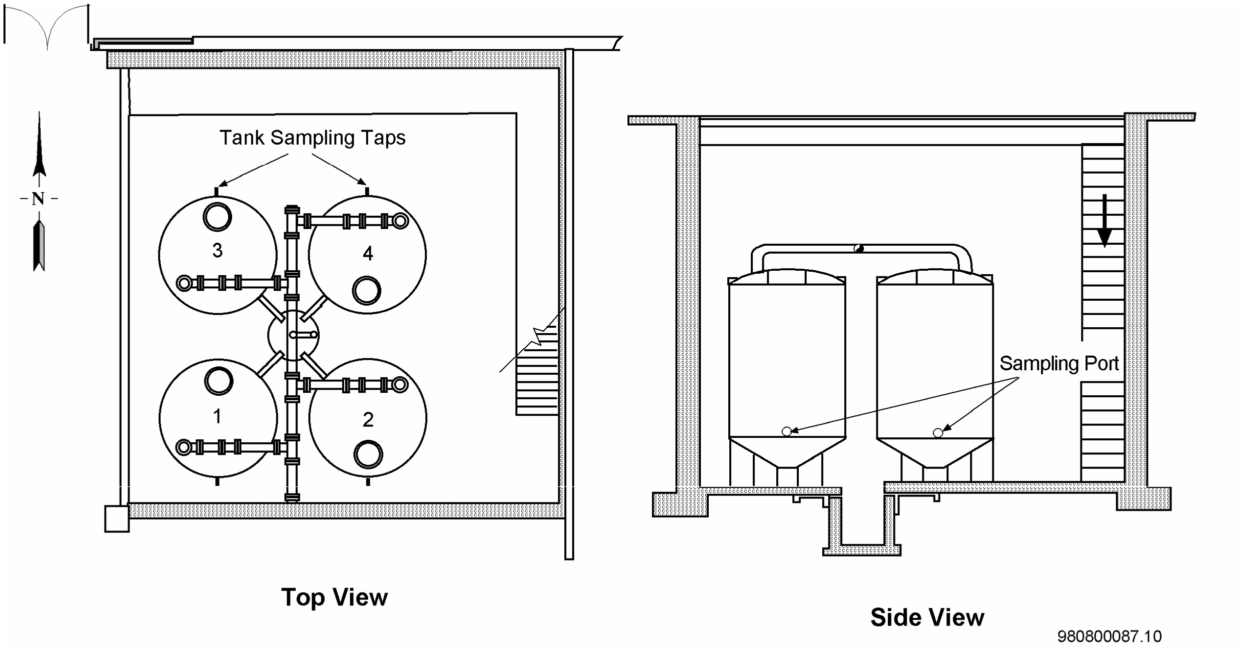

Figure 3.3. EMSL Process Sewer Tanks

Other BOP facilities have liquid-effluent sampling systems (320, 326, 329, 331 Buildings) that are used to characterize facility effluents, when needed, and to investigate potential discharges of concern. The primary criteria for these sampling systems are:

- Sampling capability is sufficient to obtain grab and composite samples for effluent characterization data.
- Characterization sampling must verify that a valid sample is obtained and that the sample can be analyzed for almost any chemical or parameter.
- Sampling and monitoring equipment is sufficient to enable periodic verification of effluent characteristics as needed.
- Sampling and monitoring equipment provides the capability to investigate potential discharges of concern.

The liquid-effluent sampling systems installed have the capability to take grab or flow-composite samples and are equipped with refrigeration cabinets to verify preservation temperatures. In addition, PNNL's Effluent Management Group has sampling procedures in place and a contract with an analytical laboratory to verify that sampling requirements are met. Figures 3.4 and 3.5 provide the locations and general schematic of the BOP liquid-effluent sampling and monitoring systems for the 320, 326, and 329 Buildings. The streams are monitored for flow, pH, and conductivity.

The aquaculture system serves the 331 Aquatics Research Laboratory that draws on both river and well water sources for supplying water for fish-rearing activities. Wastewater from these operations is discharged to an outfall structure located East of the 331 Building outside the fence-line of the 300 Area. This discharge was previously known as Outfall 013A of the Hanford Site NPDES permit (WA-000374-3), but was exempted when the permit was revised in 1999.

PNNL continues to sample the aquaculture system through an agreement with DOE as a best-management practice. Sampling is performed at a concrete monitoring station and flume enclosure located approximately 11 feet upstream of the outfall headwall.[(a)] The monitoring station consists of a 10-inch flume insert, a flow meter, and a refrigerated

(a) The area between the headwall and the river consists of riprap overgrown with plants and vegetation, sloping down-gradient for approximately 58 meters before final discharge to the Columbia River.

sampler. This sampler may be operated in composite, time-proportional, and flow-proportional sample-collection mode.

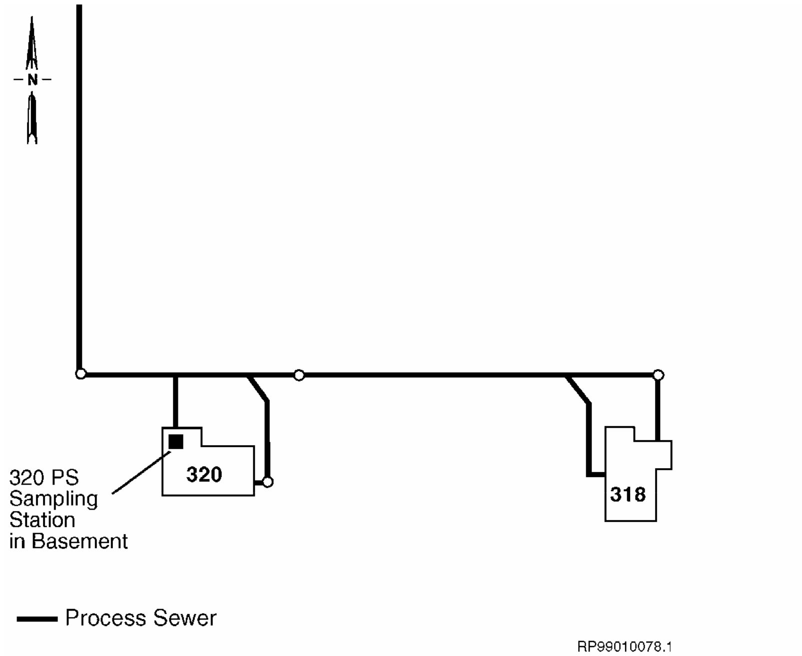

Figure 3.4. Location of the 320 Building Liquid-Effluent Sampling and Monitoring System

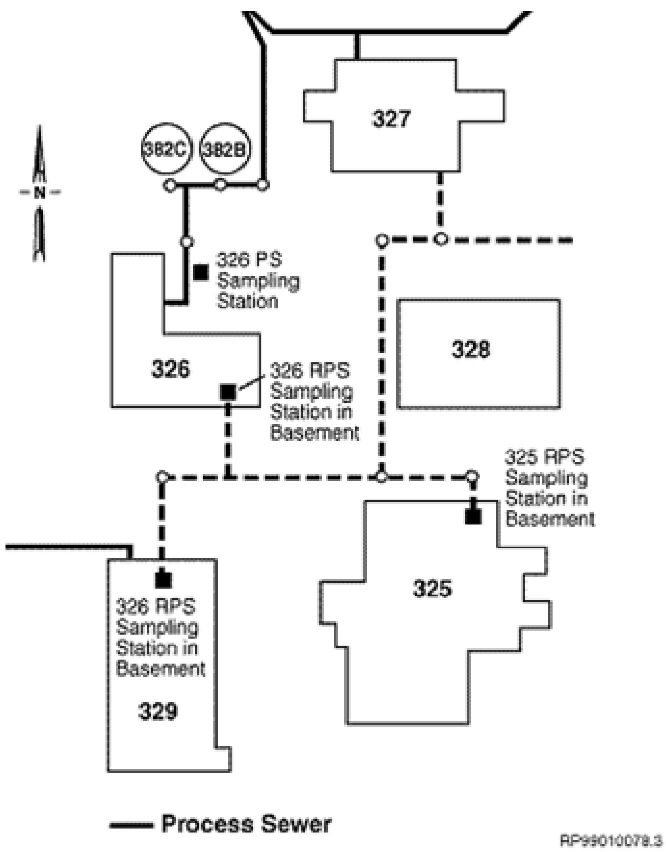

Figure 3.5. Location of the 326 and 329 Buildings Liquid-Effluent Sampling and Monitoring Systems

3.5 Sampling System Performance

3.5.1 Radiological-Air-Sampling System Description

Performance criteria for sampling are provided in Section 3.2.1. One criterion concerns measurement sensitivity and the other concerns measurement bias. The criterion for bias is based on conformance of the system to design and operational guidance in ANSI (1969) and DOE (1991). System description information is consistent with the design and operational guidance; thus, the bias criterion is met.

Sensitivity criteria for sampling are stated in terms of detectable offsite dose. Per performance criteria in Section 3.2.1, radionuclides shall be detectable at emission levels, resulting in an annual, committed effective dose equivalent of 0.01 mrem/yr.[a] Total alpha activity and total beta activity are measured to screen for other radionuclides in the stack exhaust.

The sensitivity of particulate radionuclide sampling is proportional to the collection efficiency of the sampler, the fraction of the emission quantity collected by the sampler, and the level at which the radionuclide can be detected in the collected sample. These values vary, depending on the emission point flow rate and sampling system design. Minimum detection levels required by the analytical laboratory were based on the worst-case facility. (The RPL required the lowest detection level because of the high stack flow rate.) Using the MDAs of 1 pCi/sample alpha and 38 pCi/sample beta required of the laboratory, the detectable annual release from each of the BOP minor emission points sampled is shown in Table 3.2. Supporting calculations for Table 3.2 can be found in Appendix B. These detectable Ci of gross alpha and gross beta released are all below the values of 5E-5 Ci alpha (based on ^{239}Pu) and 2E-3 Ci beta (based on ^{137}Cs), which would result in a 0.01 mrem/yr dose. Thus, the BOP facility stack sampling systems exceed the minimum criteria for detection of radionuclides in emissions.

Table 3.2. Detectable Activity from BOP Minor Emission Points

Emission Point	Detectable Annual Release (Ci)	
	Gross Alpha	Gross Beta
EP-305B-01-S	9.2E-09	3.5E-07
EP-318-01-S	1.0E-08	3.8E-07
EP-320-01-S	4.2E-07	1.6E-05
EP-320-02-S	1.1E-08	4.2E-07
EP-320-03-S	1.2E-08	4.5E-07
EP-320-04-S	1.1E-08	4.2E-07
EP-323-01-S	1.2E-07	4.6E-06
EP-326-01-S	5.2E-07	2.0E-05
EP-329-01-S	5.9E-07	2.2E-05
EP-331-01-V	5.9E-07	2.2E-05
EP-3730-01-S	5.1E-09	1.9E-07
EP-3020-01-S	1.4E-07	5.3E-06

3.6 Handling of Sampling Data

Routine compliance sampling of facility effluents for DOE-owned, PNNL-operated facilities is performed for radiological-air emissions and liquid-effluent discharges. In addition, periodic sampling or monitoring data on effluents and emissions may be collected to verify, characterize, or investigate effluents. This sampling is performed by PNNL's Effluent Management Group. Sampling data are handled according to the following general requirements:

- Chain-of-custody forms are generated for each sample to track the sample from collection through disposal. These forms contain the place, date, and time of sampling; who performed the sampling and measurements; the

(a) The determination of minimum sampler capability is based on a series of worst-case assumptions for exposure scenarios, resulting in calculations of upper-bound doses. Thus, the methods used here to evaluate system capability are not appropriate for assessing actual releases. A realistic assessment of the significance of a sample reading can be made only by considering the actual operational and environmental conditions at the time of the release.

signature, name, date, and time of transfers; and any applicable special instructions on storage and preservation or reference to a statement of work (SOW) for specific instructions. For field measurements where the measurement is taken immediately (within 15 minutes) and the sample is not transferred, the chain-of-custody information can be documented in a logbook.

- Data are validated to detect potential quality problems in analytical data. Data are reviewed for 1) results that indicate detectable sample activity or chemical concentration, 2) results above any predefined action level, and 3) results that are unexpected.

- Discrepancies, anomalies, unusual data, or data above action levels are investigated and the resolutions documented using a discrepancy report.

- Manipulation of measurement data into a format that will be reported to DOE or regulatory agencies or that will be used as a basis for regulatory decisions is documented to verify traceability. Technical reviews are performed on calculations involving sampling data to verify accuracy.

- Sampling-data records are maintained according to regulatory requirements that are specified in the effluent management project records inventory and disposition schedule (RIDS).

These general requirements and management-specific data obtained from each activity performed by PNNL's Effluent Management Group (e.g., radiological-air-emission sampling, air chemical-emission sampling, liquid-effluent compliance sampling) is documented in an internal group quality assurance plan.

3.7 Calibration and Maintenance of Equipment

Sampling and monitoring equipment, including rotameters, are maintained and calibrated according to schedules determined when the equipment is installed or purchased. (Some equipment is user-calibrated before each use.) Calibration and preventative maintenance of installed facility effluent sampling and monitoring equipment are tracked by PNNL maintenance services. PNNL's Effluent Management Group supports calibration and maintenance by helping develop calibration and maintenance procedures, obtaining vendor information on recommended calibration and maintenance or on equipment functions, working with building managers to identify needed repairs, and performing inspections of sampling systems when needed to verify proper functioning. The PNNL SBMS subject areas, *Service Request Process* (PNNL 2000) and *Calibration* (PNNL 2002), provide requirements and guidance pertinent to calibrations and maintenance.

4.0 Laboratory Analyses

This section provides information on the analytical laboratories and procedures used to analyze samples collected in support of the PNNL Effluent Monitoring Program. As stated in previous sections, these samples may contain radioactivity or chemicals or chemical parameters associated with airborne effluents and liquid discharges.

Section 3.4 describes the types of samples collected throughout the BOP facilities. The laboratories and procedures used to perform sample analyses are described in the following sections.

4.1 Analytical Procedures

Analytical procedures for alpha and beta particulate radioactivity, isotopic analysis, and chemical contaminants are provided in this section. A wide variety of radionuclides may be found in BOP airborne emissions. These radionuclides are detectable using procedures described in this section. Analyses are performed by the PNNL Radiochemical Science and Engineering Group. All analytical work associated with radionuclide sampling is performed according to required methods per PNNL contract and SOW with the analytical laboratory. The SOW is prepared to meet the quality assurance (QA) requirements from 40 CFR 61. Chemical analyses for air-emission or liquid-effluent samples may be performed by an independent laboratory subcontracted by PNNL, or by analytical services within PNNL, depending on a number of factors (e.g., certification requirements, cost, turn-around time, sampling frequency).

4.1.1 Determination of Alpha and Beta Activity on Particulate Air Filters

Particulate-air-filter samples from the BOP sampling systems are collected and initially delivered to a counting laboratory operated by PNNL's Radiological Control Group. The samples are held at the laboratory to allow for adequate decay of radon daughter radionuclides.

Following the hold time for radon daughter decay, each particulate filter is delivered to the Radiochemical Science and Engineering Group. Analytical services are performed according to documented requirements in a SOW.

Samples are received, logged in, classified, and analyzed according to procedures documented as standard operating procedures (SOPs).

The particulate alpha and beta analysis method is documented in the analytical laboratory's SOPs. 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 SOW, required detection levels are 1-pCi/sample alpha and 38-pCi/sample beta activity on a single (2-week sample) filter for Type I and Type II errors of 0.05. Section 3.5 addresses the performance capability of the particulate emission sampling program in terms of detectable offsite dose.

4.1.2 Isotopic Analysis

The record particulate filters analyzed for alpha and beta, as discussed in Section 4.1.1, may be further analyzed for ^{90}Sr, ^{137}Cs, ^{241}Am, ^{243}Am, ^{238}Pu, $^{239/240}$Pu, ^{241}Pu, and other isotopes as appropriate. These analyses are performed by analytical staff on particulate samples composited on a semi-annual basis.

Table 4.1 lists the analytical laboratory's composite preparation and analysis methods used for the above isotopes. As specified in the SOW, Table 4.1 also lists required detection levels.

Before digesting the particulate filters for isotopic analysis, the filters are grouped on a semiannual basis in preparation for gamma-scan analysis. The semiannual groups of samples are transferred to a standard geometry container for counting on the gamma detectors. Intrinsic germanium (high-purity germanium) detectors are used to detect isotopes with gamma ray energies between 60 and 2000 KeV.

Table 4.1. Isotopic Separation and Analysis Methods

Method	Minimum Detectable Activities (pCi/sample)
Air Filter Preparation and Compositing	-NA-
Gamma Analysis Sample Preparation, All Matrices	38[a]
Electrodeposition Procedure for the Actinides	-NA-
Strontium Determination for 6-Month Filter Composites	38
Isotopic Plutonium Determination for 6-Month Filter Composites	1
Isotopic Americium/Curium Determination for 6-Month Filter Composites	0.7

(a) Based on ^{137}Cs, will depend on isotope.

Following the gamma scan, the semiannual groups are digested, and the elements of interest are separated from other elements and the sample matrix by chemistry. The ^{90}Sr content is determined by the chemical separation and counting of a daughter element, ^{90}Y. The strontium is separated from other elements chemically, and then ^{90}Y is permitted to grow into equilibrium with the ^{90}Sr. The ^{90}Y is then separated and processed to determine the chemical recovery and counted on a low-background beta proportional counter. The quantity of ^{90}Sr is then determined based on the quantity of the daughter ^{90}Y produced.

Plutonium is separated from other elements and the sample matrix by adsorption on an anion exchange column. The plutonium is then processed chemically and electroplated or coprecipitated on rare earth fluorides. Isotopic concentrations of the deposited material are determined by alpha spectrometry. Following the removal of the plutonium, the sample matrix is further processed chemically 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 are determined by alpha spectrometry.

4.1.3 Liquid-Effluent Samples

Liquid-effluent samples are collected from the EMSL liquid-effluent tank pit as necessary to empty the tanks. For some measurements (pH, conductivity), the analysis is performed in the field using procedures developed by PNNL's Effluent Management Group. For other measurements (chemical constituents), EMSL liquid waste samples are shipped to an analytical laboratory contracted by PNNL and certified as required by permit.

Liquid-effluent samples are collected from the 331 aquaculture outfall on a periodic basis as a best-management practice. Aquaculture liquid waste samples are shipped to an analytical laboratory contracted by PNNL. Analytical work is performed according to required methods per the PNNL contract and SOW with the laboratory.

Nonroutine liquid-effluent samples may also be collected from EMSL or other PNNL facilities. Desired analyses for non-routine samples may be performed in the field, at the PNNL Effluent Monitoring Laboratory, or shipped to another PNNL analytical laboratory or a commercial analytical laboratory offsite. Analytical procedures may vary depending on the sampling concern. Analyses needed to determine compliance or to support compliance decisions are performed using methods accepted by the appropriate regulatory agency.

4.1.4 Air Chemical Emission Samples

Volatile organic compound emissions are collected in triple absorbent carbon traps. The samples are analyzed by thermal desorption into a gas chromatograph and mass spectrometer using analysis and quality control procedures consistent with EPA method TO-15. NIST traceable gas mixture standards are used for calibration.

4.2 Procedures

PNNL's Effluent Management Group maintains documented technical and operation procedures for all aspects of effluent monitoring. The SBMS subject area, Procedures, Permits, and Other Work Instructions (PNNL 2002), contains the requirements for preparing, reviewing, and approving these procedures. Effluent Management Group procedures incorporate all required elements of the subject area.

Sampling procedures include the identification of applicable staff, the identification of possible hazards encountered while collecting samples, emergency contacts, any applicable prerequisites to performing the work, and work instructions. The work instructions address areas such as equipment operation, sample-collection media to be used, amount of sample to be collected, and sample preservatives (as needed).

Effluent management staff maintain documented chain-of-custody procedures for all samples. Procedures include provisions for transfer of samples between operational staff, to and from regulated storage areas, and to the analytical laboratory. Both PNNL and any offsite analytical services contractor may implement chain-of-custody within the laboratory.

The analytical laboratory maintains documented and approved chain-of-custody procedures for the preliminary analyses of particulate emission samples and for record analysis of particulate air filters. Radiological-air-emission samples are stored for 18 months before being discarded.

5.0 Quality Assurance Requirement

5.1 Quality Assurance Plan

A number of quality assurance plans were developed to address QA for the different types of effluent monitoring activities performed by PNNL, including: radiological air, chemical air, and liquid-effluent sampling and monitoring. These plans were integrated into one effluent management QA plan in 1997. This plan addresses QA for all PNNL effluent-management activities and is updated on a periodic basis not to exceed 2 years. The QA program described by the plan is based on the following general requirements and guidance:

- DOE Order 414.1A, *Quality Assurance* (DOE 1999)
- 10 CFR 830.120 *Quality Assurance*
- PNNL Quality Guidance *General Quality Assurance Planning* (PNNL 2004) (http://wwwi.pnl.gov/safety/quality/guidance/general.stm)
- EPA QA/R-5 *EPA Requirements for Quality Assurance Project Plans* (EPA 2001)
- American National Standards Institute/American Society for Quality Control (ANSI/ASQC) E4-1994, *American National Standard Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* (ANSI/ASQC 1994).
- DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991).

In addition, QA requirements specified in permits and regulations, including 40 CFR 61, for PNNL effluent sampling or monitoring activities are incorporated into the QA Plan.

6.0 Program Implementation Procedures

The Hanford Site EMP (DOE 2000) documents the effluent monitoring and environmental surveillance programs for the Hanford Site.

6.1 Interface with the Near-Facility Environmental Monitoring Program

The EMP divides the effluent monitoring coverage into two areas, the FEMPs and the Near-Facility Environmental Monitoring Program. The FEMPs cover the monitoring of effluents at the facility. PNNL's effluent management program maintains implementation procedures for all PNNL facility-monitoring activities. These procedures meet PNNL's requirements for technical and operating procedures (SBMS subject area, Procedures, Permits, and Other Work Instructions [PNNL 2002]) and verify that facility effluent sampling and monitoring is conducted compliantly. The Near-Facility Environmental Monitoring Program monitors air, surface water, groundwater, soil, sediment, vegetation, and biota around site facilities to evaluate the adequacy of effluent control at various facilities at the Hanford Site.

6.2 Interface with the Operational Environmental Surveillance Program

Environmental surveillance of the 300 Area and the surrounding onsite and offsite areas is performed by the PNNL Hanford Site Surface Environmental Surveillance Project and the PNNL Site-Wide Groundwater Monitoring Project. These projects are 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 DOE (2000).

7.0 Reporting

This section describes the compliance reporting and notification requirements related to facility effluent monitoring. It also identifies the requirements and provides an overview of the procedural steps for the notification, investigation, and reporting of all environmental off-normal events for PNNL operations.

7.1 Routine Effluent-Monitoring Reports

On a periodic basis, effluent-monitoring data are gathered by PNNL on specific DOE/RL facilities for compilation and reporting to DOE and the various regulatory agencies.

The following effluent-monitoring reports are submitted to regulatory agencies:

Airborne Effluent

- An annual National Emission Standards for Hazardous Air Pollutants (NESHAP) air emissions report for the Hanford Site that provides the required annual emissions measurements and climatological data; it is submitted to EPA and WDOH for the Hanford Site radioactive airborne emissions.
- The Annual Radioactive Effluent and Onsite Discharge Data Report is submitted to DOE-Headquarters, EPA, and WDOH through the DOE/RL after compilation by EG&G Idaho.
- Semiannual reports providing updates of compliance-related activities under the Hanford Site Air Operating Permit (WDOE, WDOH, and BCAA 2000) are submitted to WDOE.
- The annual Compliance Certification is provided to WDOE as to the continuous or intermittent compliance of activities under the Hanford Site Air Operating Permit.
- An annual Nonradioactive Inventory of Emissions Report is submitted to WDOE summarizing emissions from the primary sources of emissions on the Hanford Site.

Liquid Effluent

- The City of Richland is provided a monthly discharge monitoring report (DMR) for discharges to the city sanitary sewer system from EMSL (City of Richland 1997).
- The Washington Department of Ecology (WDOE) is provided an annual report on significant discharges of hydrotest, maintenance, or construction wastewater discharged to ground as required by Permit ST-4508 (WDOE 1997).
- WDOE is provided an annual inventory of miscellaneous liquid-effluent discharges to ground as required by WDOE Consent Order DE 91NM-177 (WDOE 1991).

Other

- WDOE is provided with a monthly status report of all reportable spills from the previous month through DOE/RL.

7.2 Nonroutine Notifications and Reports

A number of reports, including notification reports, are required with respect to effluent monitoring activities.

- An NOC must be provided to WDOH and/or WDOE and/or the Benton Clean Air Authority (BCAA), depending on emissions type, whenever a new emission unit is to be created, or if there is to be significant modification to an existing emission unit.
- A Notice of Transient or Abnormal Conditions must be provided to WDOH as soon as practicable in accordance with Hanford Site Air Operating Permit requirements. A Notification Follow-up report may also be requested in addition to the initial notification.
- A Report of Closure shall be submitted to WDOH whenever an emission unit covered under WAC 246-247 (WAC 1994) ceases emission.

- A Notification of Renovation/Demolition Activities Involving Asbestos must be provided to BCAA any time work involving renovation or demolition activities in a facility with asbestos is planned.

7.3 Event Notification and Reporting

"Events" or conditions may adversely affect DOE or contractor personnel, the public, property, the environment, or the DOE mission. Staff who discover an event that requires mitigation must notify the Battelle single-point-of-contact to begin the response and mitigation process. Managers who are notified of events within their domain participate in the recovery, evaluation, analysis, and corrective action of the event. These processes are described in a PNNL SBMS subject area, Event Reporting (PNNL 2003). This subject area provides the procedures for implementing the Event Reporting Program Description and identifies the process for staff and management who perform specific duties related to the discovery, notification, analysis, and reporting of occurrences.

8.0 References

10 CFR 830.120. 1994. "Quality Assurance," *U.S. Code of Federal Regulations*, U.S. Department of Energy.

40 CFR 60. 1971. "Regulations on Standards of Performance for New Stationary Sources, Appendix A: Test Methods." *U.S. Code of Federal Regulations*, U.S. Environmental Protection Agency.

40 CFR 61. 1973. "Test Methods for Measuring Radionuclide Emissions from Stationary Sources, Appendix B: Test Methods." *U.S. Code of Federal Regulations*, U.S. Environmental Protection Agency.

40 CFR 61. 1989. "Test Methods for Measuring Radionuclide Emissions from Stationary Sources, Appendix D: Methods for Estimating Radionuclide Emissions." *U.S. Code of Federal Regulations*, U.S. Environmental Protection Agency.

40 CFR 61. 1990. "National Emission Standards for Hazardous Air Pollutants." *U.S. Code of Federal Regulations*, U.S. Environmental Protection Agency.

40 CFR 302.4. 1997. "Reportable Quantities." *U.S. Code of Federal Regulations*, U.S. Environmental Protection Agency.

ANSI N13.1-1969. 1969. *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*. American National Standards Institute, NY.

ANSI N42.18. 1980. *Specifications and Performance of Onsite Instrumentation for Continuously Monitoring Radioactivity in Effluents.* American National Standards Institute, NY.

ANSI/ASQC-E4. 1994. *American National Standard Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs*. American National Standards Institute/American Society for Quality Control, NY.

Ballinger MY, MJ Sula, TL Gervais, and DL Edwards. 2003. *Assessment of Unabated Facility Emission Potentials for Evaluating Airborne Radionuclide Monitoring Requirements at Pacific Northwest National Laboratory2003*. PNL-10855, Rev. 2, Pacific Northwest National Laboratory, Richland, WA.

City of Richland Ordinance 7-96. 1996. *Richland Pretreatment Program*. Richland, WA.

City of Richland. 1997. *Industrial Wastewater Permit to Environmental Molecular Sciences Laboratory (EMSL).* CR-IU005. City of Richland, Richland, WA.

DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

McCarthy MJ. 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, WA.

Pacific Northwest National Laboratory (PNNL). 1998. "Liquid Effluents, Managing." In: *Standards Based Management System Subject Area* [Online]. Available at: http://sbms.pnl.gov/standard/0q/0q00t010.htm.

Pacific Northwest National Laboratory (PNNL). 2000. "Service Request Process." In: *Standards Based Management System Subject Area* [Online]. Available at: http://sbms.pnl.gov/standard/97/9700t010.htm.

Pacific Northwest National Laboratory (PNNL). 2002. "Airborne Emissions." In: *Standards Based Management System Subject Area* [Online]. Available at: http://sbms.pnl.gov/standard/0g/0g00t010.htm.

Pacific Northwest National Laboratory (PNNL). 2002. "Calibration." In: *Standards Based Management System Subject Area* [Online]. Available at: http://sbms.pnl.gov/standard/79/7900t010.htm.

Pacific Northwest National Laboratory (PNNL). 2002. "Engineering Calculations, Drawings, and Specifications, Creating or Modifying." In: *Standards Based Management System Subject Area* [Online]. Available at: http://sbms.pnl.gov/standard/91/9100t010.htm.

Pacific Northwest National Laboratory (PNNL). 2002. "Procedures, Permits, and Other Work Instructions." In: *Standards Based Management System Subject Area* [Online]. Available at: http://sbms.pnl.gov/standard/74/7400t010.htm.

Pacific Northwest National Laboratory (PNNL). 2003. "Event Reporting." In: *Standards Based Management System Subject Area* [Online]. Available at: http://sbms.pnl.gov/standard/27/2700t010.htm.

Pacific Northwest National Laboratory (PNNL). 2003. "Waste, Managing." In: *Standards Based Management System Subject Area* [Online]. Available at: http://sbms.pnl.gov/standard/0f/0f00t010.htm.

Pacific Northwest National Laboratory (PNNL). 2004. "General Quality Assurance Planning." PNNL web page Available at: http://wwwi.pnl.gov/safety/quality/guidance/general.stm.

Thompson CJ, MY Ballinger, EG Damberg, and RG Riley. 1997. *Characterization and Monitoring of 300 Area Facility Liquid Waste Streams During 1994 and 1995*. PNNL-11552, Pacific Northwest National Laboratory, Richland, WA.

U.S. Department of Energy (DOE). 1987. "General Design Criteria." DOE 6430.1A, Washington D.C.

U.S. Department of Energy (DOE). 1988. "General Environmental Protection Program." DOE 5400.1, Washington D.C.

U.S. Department of Energy (DOE). 1990. "Radiation Protection of the Public and the Environment." DOE 5400.5, Washington D.C.

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

U.S. Department of Energy (DOE). 1999. "Quality Assurance." DOE 414.1A, Washington D.C.

U.S. Department of Energy (DOE). 2000. *Environmental Monitoring Plan, United States Department of Energy, Richland Operations Office*. DOE/RL-91-50, Rev. 3, U. S. Department of Energy, Richland WA.

U.S. Department of Energy (DOE). 2003. "Environmental Protection Program." DOE O 450.1, Washington D.C.

U.S. Environmental Protection Agency (EPA). 1980. *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans.* QAMS-005/80, Washington D.C.

U.S. Environmental Protection Agency (EPA). 1981. *National Pollutant Discharge Elimination System Permit*. NPDES WA-000374-3, Washington D.C.

U.S. Environmental Protection Agency (EPA). 2001. *EPA Requirements for Quality Assurance Project Plans*, EPA-QA/R-5, Washington, DC.

Washington Administrative Code (WAC). 1994. "Controls for New Sources of Toxic Air Pollutants." WAC 173-460, Olympia, WA.

Washington Administrative Code (WAC). 1994. "General Regulations for Air Pollution Sources." WAC 173-400, Olympia, WA.

Washington Administrative Code (WAC). 1994. "Radiation Protection - Air Emissions." WAC 246-247, Olympia, WA.

Washington State Department of Ecology (WDOE). 1991. *Consent Order in the Matter of the Compliance by United States Department of Energy with Chapter 70.105 and 90.48 RCW and the Rules and Regulations of the Department of Ecology*. DE 91NM-177E, Olympia, WA.

Washington State Department of Ecology (WDOE). 1997. *State Waste Discharge Permit for the Discharge of Hydrotest, Maintenance, and Construction Discharges*, ST-4508, Olympia, WA.

Washington State Department of Ecology (WDOE), Washington State Department of Health (WDOH), and Benton Clean Air Authority (BCAA). 2000. *Hanford Site Title V Air Operating Permit 00-05-006*. Ecology Publication #00-05-006.

Appendix A

Information on Current Balance-of-Plant Facilities

A.1.0 General Balance-of-Plant Information

This appendix provides information on the mission, physical description, activities, radiological and chemical inventories, required facility monitoring, and history of measured emissions for all Department of Energy-owned, Pacific Northwest National Laboratory-operated facilities, except those with an individual facility effluent monitoring plan (Radiochemical Processing Laboratory) or that are primarily office or administrative. Table A.1 provides a summary of the current balance-of-plant (BOP) facilities, locations, and uses. Table A.2 provides historic data on the potential dose for unabated radioactive airborne emissions from BOP facilities based on radionuclide inventories for the past 5 years. The methodology is described in Ballinger et al. (2003).

Table A.1. Current Active BOP Facilities

Building	Title	Area	Use
305-B	Hazardous Waste Storage Building	300	R&D Waste Operations
318	Radiological Calibrations Laboratory	300	R&D
318 Trailer 4	Office Trailer	300	Offices and “dry lab” space
320	Analytical and Nuclear Research Laboratory	300	R&D
323	Mechanical Properties Laboratory	300	R&D
326	Materials Sciences Laboratory	300	R&D
329	Chemical Sciences Laboratory	300	R&D
331	Life Sciences Laboratory I	300	R&D
331C	Facility Storage Building	300	Storage
331D	Biomagnetic Effects Laboratory	300	Storage
331G	Interim Tissue Repository	300	R&D
331H	Aerosol Wind Tunnel Research Facility	300	R&D
336	High Bay Testing Facility	300	R&D
338	Prototype Engineering Laboratory	300	R&D
350	Plant Operations and Maintenance Facility	300	Maintenance Services
350-A	Paint Shop	300	Maintenance Services
350-B	Warehouse	300	Storage
350-C	Storage Building	300	Storage
350-D	Oil Storage Facility (Waste Handling Facility)	300	Storage
3020	Environmental Molecular Sciences Laboratory (EMSL)	300	R&D
3718-P	General Storage Warehouse	300	Storage
3730	Gamma Irradiation Facility	300	R&D
3760	Office Building	300	Administrative
622-A	Elevator Control Building	600	Service
622-B	Pilot Balloon Release Building	600	R&D
622-C	Storage Building	600	Storage
622-R	Meteorology Laboratory	600	R&D
747A	Whole Body Counter	700	Service
747A Trailer 1	Office Trailer	700	Office
100, 300, and 600 Area Lysimeters	Lysimeter Plots	100, 300, 600	Field R&D
614, EMS 100, 300, 400	Environmental Monitoring Stations	100, 300, 400, 600	Environmental Monitoring
361	Air Monitoring Station	300	R&D

Table A.2. Potential to Emit for BOP Facilities (mrem/yr)

Building	1999	2000	2001	2002	2003	PIC
305-B	6.2E-02	3.6E-02	1.4E-04	N/A[b]	N/A[b]	4
318	1.8E-06	2.3E-06	1.8E-07	1.8E-07	1.2E-07	4
320	7.1E-04	7.8E-04	6.1E-03	7.8E-03	1.0E-03	3
323	2.5E-05	3.4E-05	2.4E-04	2.4E-04	2.0E-05	4
326	5.5E-05	4.7E-05	6.4E-04	6.2E-04	6.0E-04	3
329	3.5E-03	3.7E-03	2.9E-02	3.3E-02	3.3E-02	3
331	2.8E-02	6.7E-02	2.4E-01	2.4E-01	6.6E-02	2
3020	0	1.1E-11	2.1E-10	0[a]	0[a]	4
3730	2.8E-04	3.4E-04	2.4E-03	2.4E-03	3.0E-04	3
747-A[a]	0	0	0	0	0	N/A

(a) Sealed sources only; no potential emissions.
(b) Waste with radiological content no longer stored at 305B.

Potential impact categories (PICs) were developed for PNNL facilities that have potential radioactive airborne emissions following guidance in ANSI/HPS N13.1—*Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stack and Ducts of Nuclear Facilities*. This guidance allows for a graded approach in sampling for emissions based on the potential to emit (PTE). Table A.2 also gives the assigned PNNL PIC for each facility.

A variety of chemicals are used in many of the BOP facilities, and a chemical inventory is maintained using PNNL's Chemical Management System (CMS). 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 CMS data include the reportable quantity (RQ) of the chemical. RQs are obtained from 40 CFR 302 (EPA 1997) and are the amounts that, if released to the environment from a facility, require notification to the National Response Center. DOE/RL-91-50, Rev. 2 (DOE 2000) originally established commitments to prepare facility effluent monitoring plans for any facility with the potential to release any chemical in quantities greater than RQs. Although it is unlikely that RQ quantities of chemicals could be released from any PNNL facility, the chemical loading of many facilities is variable, and RQ amounts of chemicals could be present in the facility, depending on ongoing research and support activities. In the following section, those facilities with the potential for having chemicals that exceed RQ are identified.

A.2.0 Building-Specific Information

The following sections provide a generic description of the mission, physical structure, radiological and chemical inventories, and emissions history for each active BOP facility.

A.2.1 305-B Building

Mission and Activities: This building is used to receive, store, and prepare shipments of dangerous waste generated by Hanford Site programs. These wastes are primarily generated in support of research and development (R&D) activities. Wastes are brought to the 305-B Building and segregated by compatibility for storage in the unit until enough waste is accumulated to fill a labpack or bulking container, usually a 30- to 55-gallon drum. When a sufficient number of shipping containers of waste has accumulated, they are manifested for shipment, generally to permitted offsite recycling, treatment, or disposal facilities. Dangerous wastes are stored in the high bay; radioactive mixed waste was stored on both the first floor and in the basement of the original wing of the building but has not been processed or stored in the building since 2002. The building is a permitted treatment, storage, and disposal facility (TSDF).

Physical Description: This approximately 10,000-square-foot building consists primarily of high-bay dry laboratory space with associated storage space and an administrative office wing. A fume hood is available for repackaging activities, and a high-efficiency particulate air (HEPA) filter was used on the hood to mitigate potential releases of radioactive materials when waste with radioactive content was processes in the building. A sampling system is available to sample particulate material emitted from the hood as required. Figure A.1 is a simplified drawing of the ventilation and air-emission sampling systems. Sampling-system configuration drawings have been developed and are maintained in PNNL's Key Drawings System.

The 305-B Building is connected to the 300 Area sanitary sewer system (SNS), but processing and storage areas do not have any sewer-system access points. In addition, the 305-B Building has a sump connected to the process sewer (PS). However, the sump pump has been electrically disconnected, and no discharges are provided to the PS.

Radiological Inventory: The 305-B Building was previously used to process and store waste with radioactive content, but has not been used for radioactive waste since 2002. See Table A.2.

Chemical Inventory: A number of different chemicals may be present in the 305-B Building, depending on the waste materials generated from PNNL R&D activities. A few chemicals may be present above their RQ values. However, these chemicals are likely to be in more than one container, and many containers have reduced concentrations. Due to these factors and engineered and administrative controls, there is little potential to release RQ amounts of chemicals to the environment.

Emission History: Monitoring for radioactive air emissions from the 305-B Building was initiated in 1996 when an NOC was obtained for repackaging work performed in the fume hood. Table 3.1 shows the estimated emissions since 1997. Because the 305-B Building does not have sewer access points from the processing and storage areas, wastewater from the building has not been monitored.

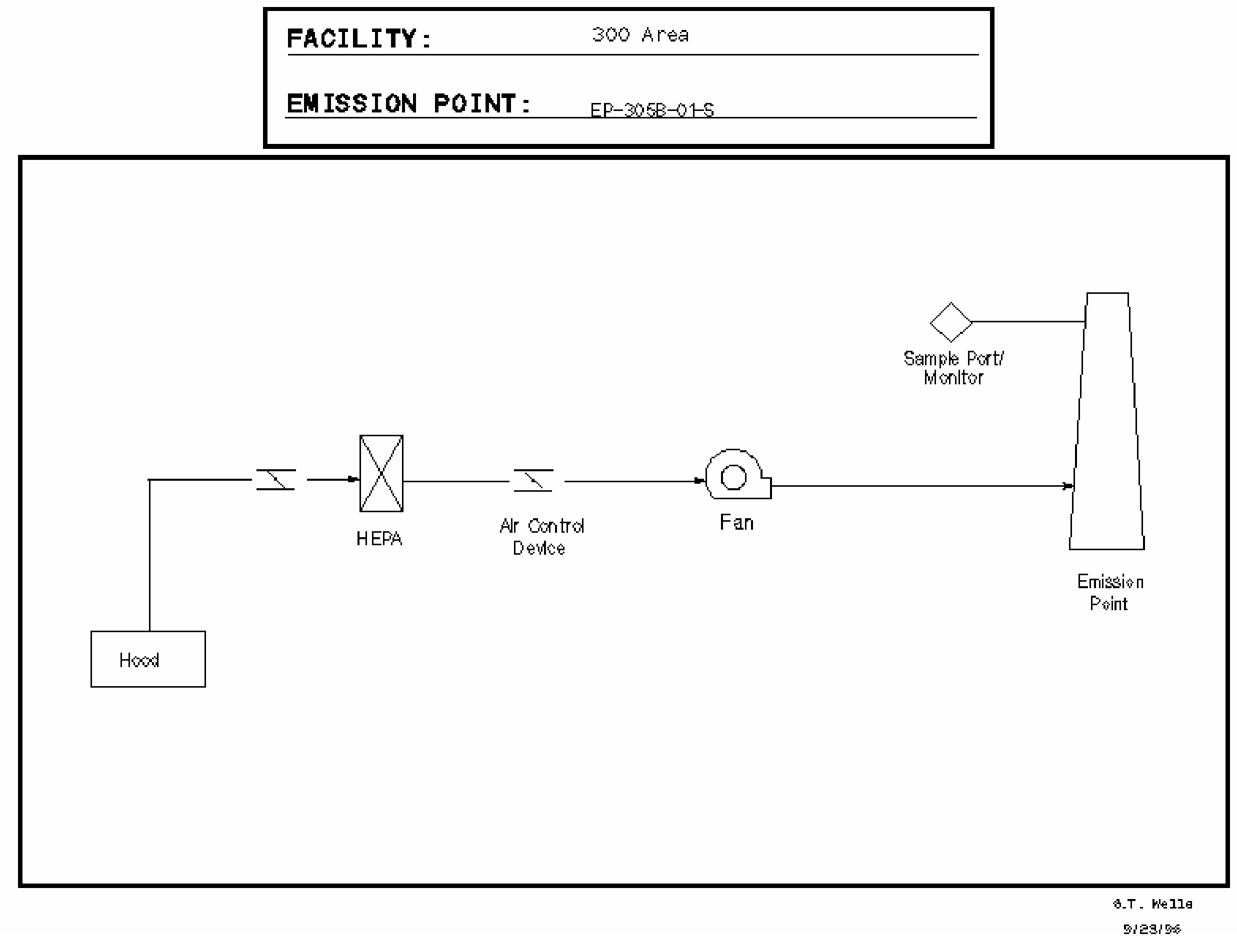

Figure A.1. 305-B Building Simplified Ventilation System Drawing

A.2.2 318 Building

Mission and Activities: The 318 Building is primarily used to provide technical services in internal dosimetry, external dosimetry, instrument calibration, repair, and testing for 1) protecting the health of workers and the public, and 2) providing liability protection for government and industrial customers. Additionally, workplace measurements are applied to R&D to better understand and determine occupational exposures.

An area of the building is used to support the Department of Energy's National Nuclear Security Administration (DOE/NNSA) Radiological Assistance Program (RAP). The regional RAP team stages and maintains equipment and performs team training in the building.

CH2MHill project staff occupy laboratory space in the facility to perform tank farm contractor evaluations for analytical air-sampling equipment.

Physical Description: The 318 Building contains about 37,000 square feet of floor space in a two-story building with a basement. The basement area contains an X-ray room and control room, a high-exposure room, and a mechanical equipment room. The first floor contains a low-scatter room, laboratories, and a small computer room. The second floor contains offices, a lunchroom, and a mechanical equipment room.

Fume hoods are provided in the building for airborne emissions. Exhaust air is not equipped with HEPA filtration. The building has one emission point and an isokinetic radioactive-air-sampling system that samples for particulate material. Figure A.2 is a simplified drawing of the ventilation and air-emission sampling systems. Sampling system configuration drawings have been developed and are maintained in PNNL's Key Drawings System.

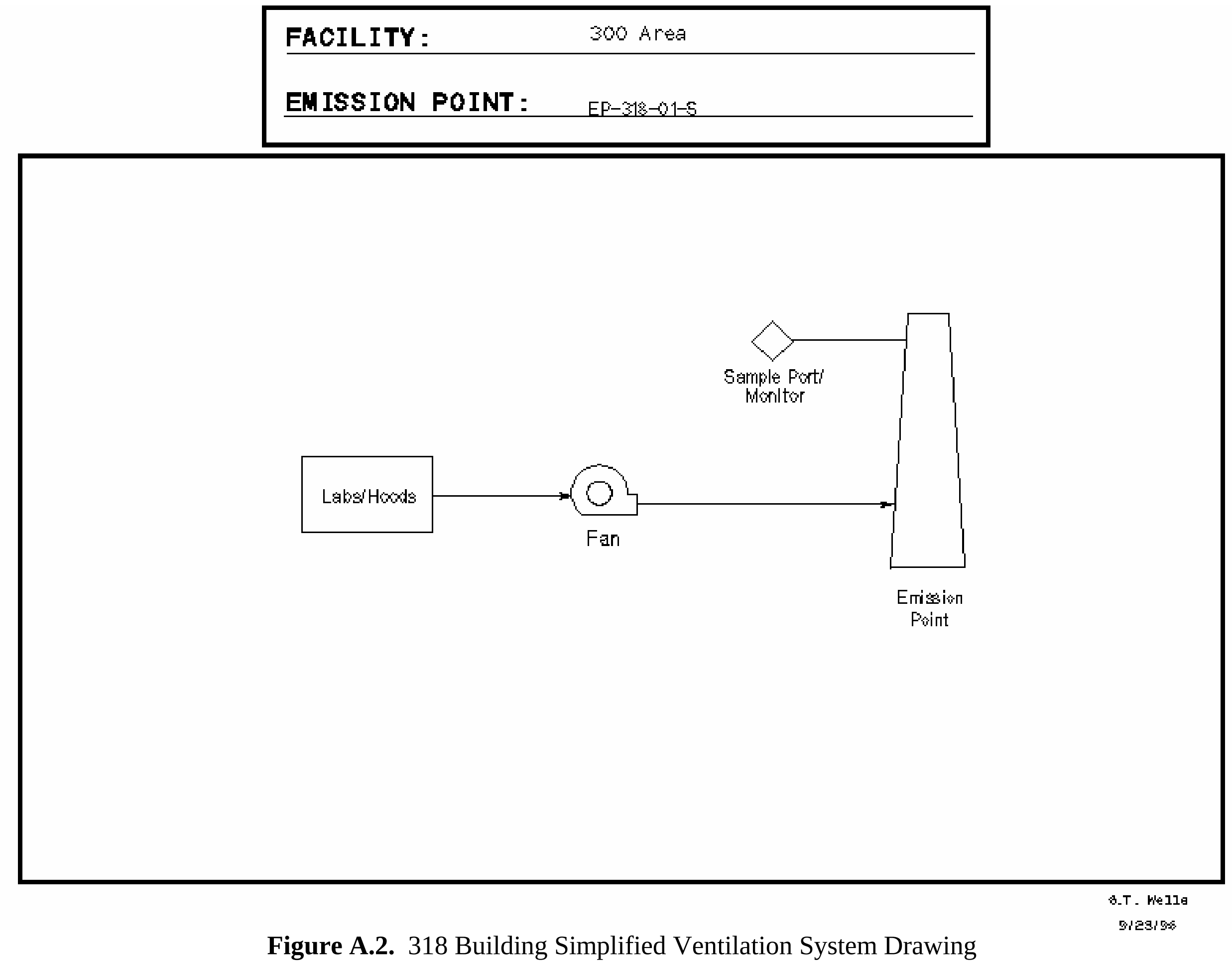

Figure A.2. 318 Building Simplified Ventilation System Drawing

The building is served by the 300 Area PS and SNS; the SNS serves the restrooms and lunchrooms, and the PS serves process areas. No liquid-effluent sampling system exists for the facility.

Radiological Inventory: Most of the radiological inventory is in the form of sealed sources, although very small quantities of radon and thoron gases are emitted during some calibrations. Also, microcurie or less quantities of various radioactive materials may also be present in the form of check sources, dispersible solids, or liquids. Potential emissions from the building are very low, and the facility is considered PIC 4 (see Table A.2).

Chemical Inventory: A variety of types and forms of chemicals are used in the 318 Building in small laboratory-scale quantities.

Emission History: Radioactive-air-emissions have been and continue to be measured. Radionuclide-air-emission data since 1997 are shown in Table 3.1.

Liquid effluents from the 318 Building have not been sampled. With few dispersible radioactive materials and minor quantities of hazardous chemicals, the potential for effluent release to the PS or SNS is considered low.

A.2.3 320 Building

Mission and Activities: Research activities conducted in the 320 Building involve special-purpose separation and analytical chemistry techniques that allow measurement of low-level and ultra-trace levels of material in environmental samples. Working with samples containing low/trace levels requires special building features, such as a clean zone. A class 10000 clean zone allows for contamination-free preparation and analysis of samples containing extremely low levels of indicator radionuclides and trace organic compounds. Special instrumentation that is used for sample analysis includes various mass spectrometers, electron-beam microscopes, X-ray diffraction, and radiation counters.

Physical Description: The 320 Building consists primarily of two floors, one at ground level and a basement. A self-contained addition was added consisting of four laboratories and eight offices attached at both levels to the west end of the older building. Three small equipment rooms are located in the new addition with one large equipment room in the older portion using the southeast corner of the basement. Half of the older-portion ground-level laboratory space is "clean zone" modular rooms with HEPA filtered supply air. The total square footage for the building is about 31,000.

The 320 Building has three registered emission points, and each emission point has a particulate sampling system.[a] All emission points are HEPA filtered. Figures A.3 through A.5 are simplified drawings of the ventilation and air-emission sampling systems. Sampling-system configuration drawings have been developed and are maintained in PNNL's Key Drawings System.

The 320 Building is served by the 300 Area PS and SNS; the SNS serves the restrooms and lunchrooms, and the PS serves process areas. The building is equipped with a liquid-effluent sampling system on the PS that includes the capability for continuously monitoring pH, conductivity, and flow, as well as the capability for obtaining flow-composite samples.

Radiological Inventory: The 320 Building contains small quantities (millicuries or less) of radioactive materials in various forms. The PTE for the building is currently about 0.001 mrem/year, and the facility is considered a PIC 3.

Chemical Inventory: A variety of types and forms of chemicals are used in the 320 Building. A few chemicals may be present above their RQ values. However, these chemicals are likely to be in more than one container, and many containers have reduced concentrations. Because of these factors and engineered and administrative controls, there is little potential to release RQ amounts of chemicals to the environment.

Emission History: Radioactive air emissions have been and continue to be measured. Radionuclide-air-emission data since 1997 are shown in Table 3.1.

This building is equipped with a liquid-effluent sampling system for the PS and was sampled during the sampling campaign conducted by PNNL's effluent management staff in 1994 and 1995 (Thompson et al. 1997). No continued liquid-effluent sampling is required for this facility. Previous sampling results show generally low concentrations (parts per billion) of pollutants, less than the sewer system waste acceptance criteria. Additional sampling in 1998 and 2000 confirm the low concentrations of pollutants (McCarthy and Ballinger 2000, Appendices A and B).

[a] A fourth emission point, EP-320-03-S was deregistered with WDOH in 2004.

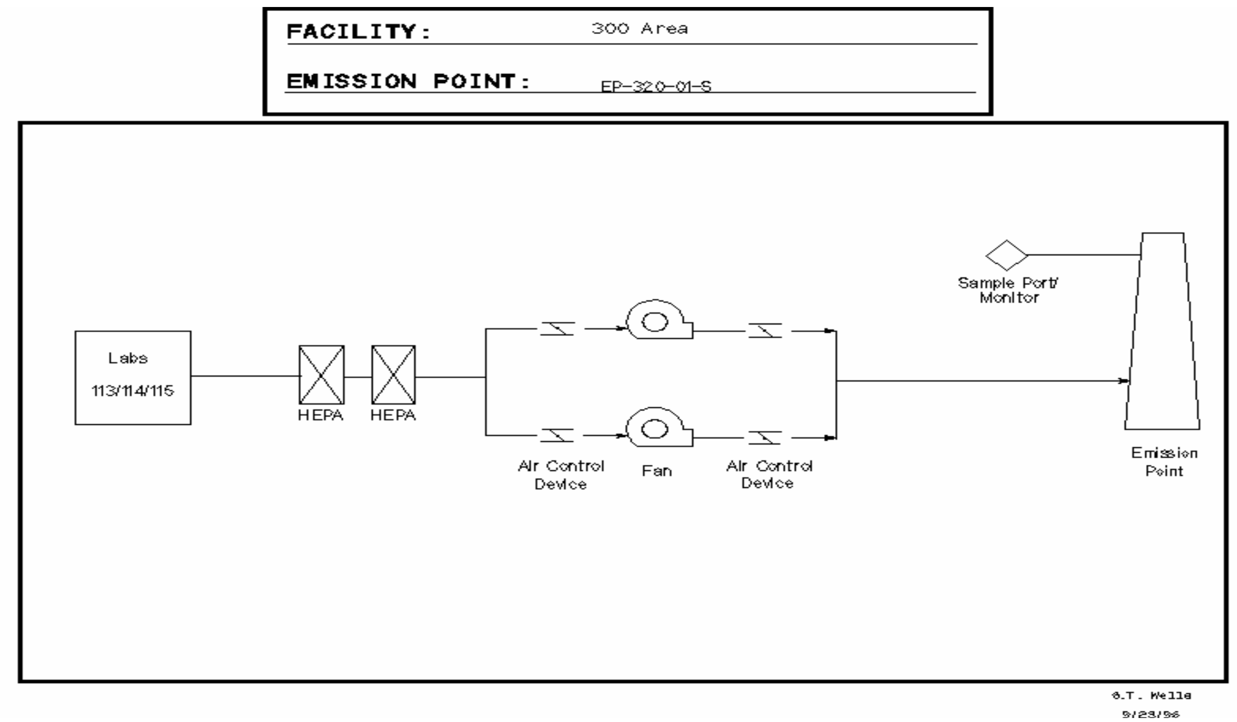

Figure A.3. EP-320-01-S Simplified Ventilation System Drawing

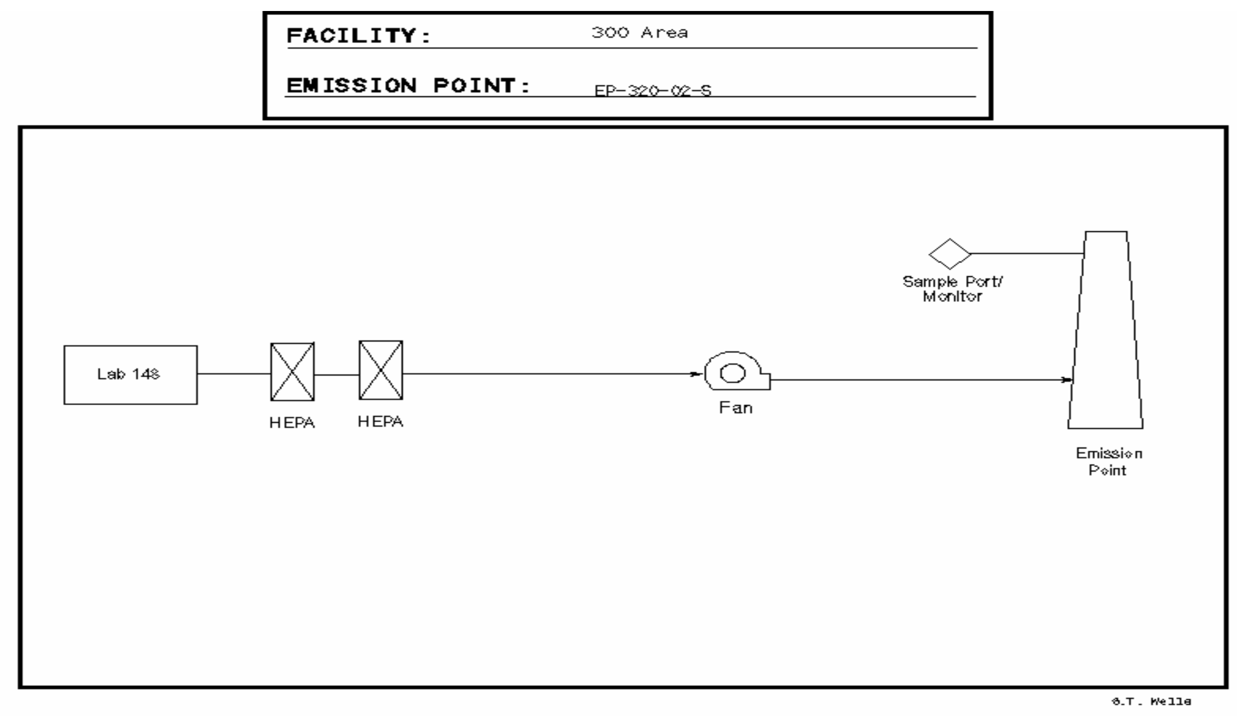

Figure A.4. EP-320-02-S Simplified Ventilation System Drawing

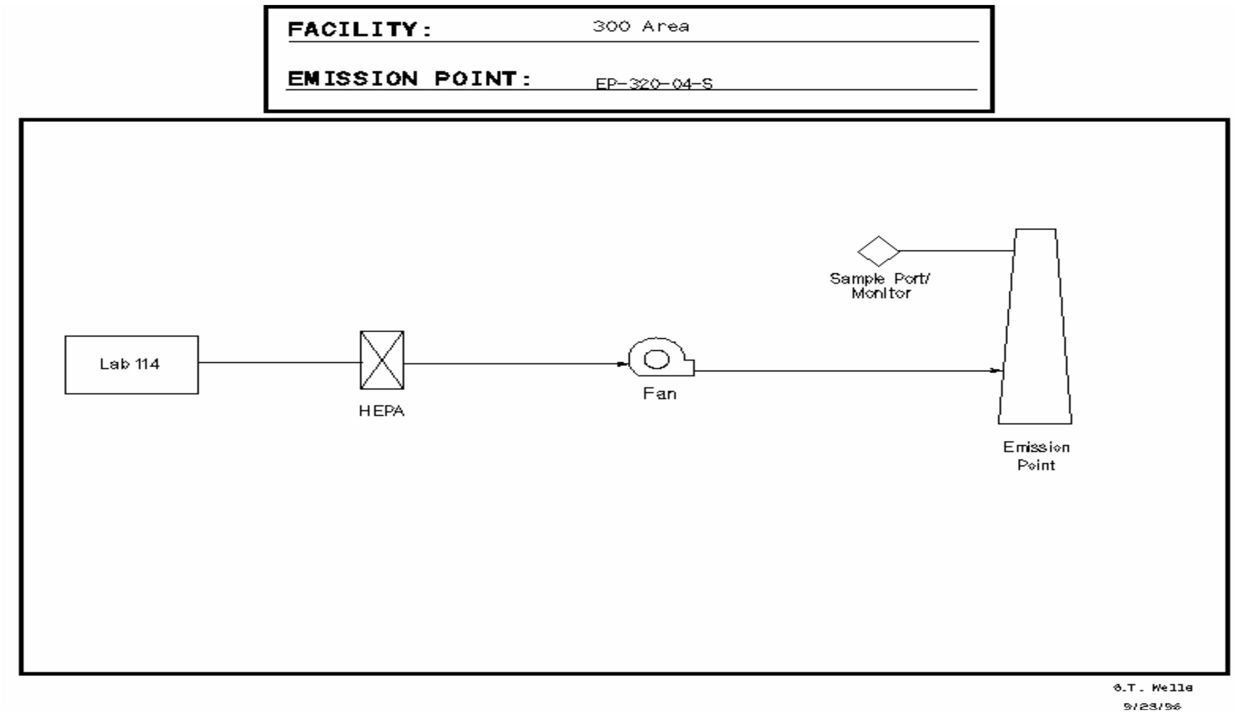

Figure A.5. EP-320-04-S Simplified Ventilation System Drawing

A.2.4 323 Building

Mission and Activities: Work in the 323 Building includes research into the development and characterization of structural materials. The activities conducted in this building are in support of the mechanical-property (tensile and compression) testing mission for both radioactive and nonradioactive material as well as autoclave testing for high-temperature corrosion and stress-corrosion studies. Tests are conducted in a small hot cell. Tested materials are in the solid form and contain activation products resulting from irradiation in a reactor.

Physical Description: The 323 Building is a one-story, rectangular-shaped, metal-frame structure built on a concrete foundation and floor slab. The roof is pitched, and the exterior of the building is made of insulated metal siding. The building has about 4,200 square feet of floor space. Exhaust air is HEPA filtered and sampled for radioactive particles before being emitted from the building. Figure A.6 is a simplified drawing of the ventilation and air-emission sampling systems. Sampling-system configuration drawings have been developed and are maintained in PNNL's Key Drawings System. The building is serviced by the 300 Area SNS and PS and is not equipped with any liquid-effluent sampling or monitoring systems.

Radiological Inventory: Curie quantities of radioactive materials in solid form are stored and tested in the 323 Building hot cell. The PTE for the building is currently about 2E-5 mrem/yr, and the facility is considered PIC 4 (see Table A.2).

Chemical Inventory: A variety of types and forms of chemicals are used in the 323 Building in small laboratory-scale quantities.

Emission History: Radioactive air emissions have been and continue to be measured. Radionuclide-air-emission data since 1997 are shown in Table 3.1.

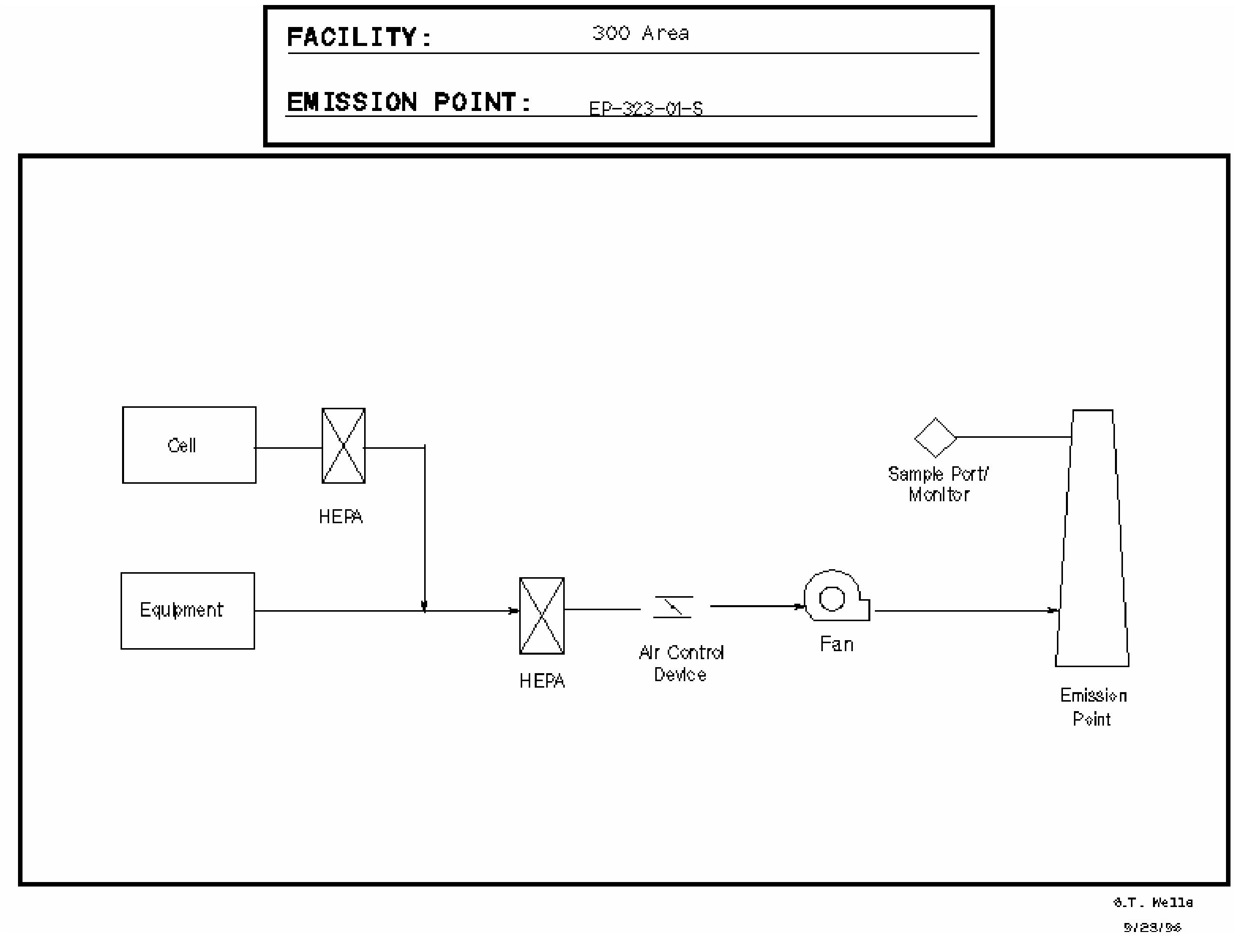

Figure A.6. 323 Building Simplified Ventilation System Drawing

A.2.5 326 Building

Mission and Activities: The following types of research activities are conducted within the facility: development and calibration of fiber optic chemical sensors, electrical and mechanical engineering support for nuclear instrumentation development and fabrication, design and engineering of special-purpose radiation detectors and sampling systems, and operation of a continuous glass fiber draw capability to produce the highest quality neutron-sensitive scintillating glass fiber, which is an enabling technology for a new class of solid-state radiation detectors.

Other uses of the building include the following:

- An analytical group performs analytical biology and chemistry research, including developing mass spectrometry for bacterial identification, capillary electrophoresis, and other analytical separations for a wide variety of applications. The group laboratories are designed for biosafety level II research in culturing and analyzing microorganisms that will be used for several projects, including developing a rapid screening method based on mass spectrometry to identify biosafety level 2 pathogens in human blood products with minimal sample size and handling.

- Fundamental research of supercritical fluids is conducted to understand supercritical fluid solvation and chemistry mechanisms and processes.

- Research into the development and characterization of structural materials is performed.

- Research on fusion and fission reactor systems, lightweight transportation materials for automotive applications, and high-temperature materials for multiple applications.

- Materials characterization for the materials processing and manufacturing development programs. Analytical methods include corrosion, electrochemistry, stress corrosion cracking, and microstructural analysis.

- Work is conducted using laser flash thermal diffusivity testing, thermal expansion testing, physical-property characterization of low-level radioactive materials, physical vapor deposition coating development and characterization, thermal, electrical, mechanical system integration and testing, and ceramic joint development, characterization, and testing.

Physical Description: The 326 Building has two-stories and a basement. The framework is bolted-steel and exterior walls are fluted steel-insulted panels. Floors are reinforced concrete finished with vinyl asbestos tile with access trenches for utility distribution under the main floor. The building has about 63,000 square feet of floor space and is equipped with glove boxes, fume hoods, and hot cells. Exhaust air is HEPA filtered and sampled for radioactive particles before exiting through a single emission point from the building. Figure A.7 is a simplified drawing of the ventilation and air-emission sampling systems. Ventilation- and sampling-system configuration drawings have been developed and are maintained in PNNL's Key Drawings System.

The 326 Building is served by the 300 Area PS, retention process sewer (RPS), and SNS. The SNS serves the restrooms and lunchrooms, the PS serves process areas, and the RPS serves process areas with a greater potential to discharge radioactive materials. As-built drawings of the building's liquid-effluent systems have been developed and are maintained in PNNL's Key Drawings System. The building is equipped with a liquid-effluent sampling system on the PS and RPS that includes the capability for continuously monitoring pH, conductivity, and flow, as well as the capability for obtaining flow-composite samples.

Radiological Inventory: Radioactive material is primarily from samples that may be in the form of solid, powder, fragments, and monoliths. The materials include solid samples containing activation products resulting from irradiation in reactors and spent-fuel powders/fragments. A wide range of radionuclides may be present. The current PTE for the building is about 6E-4 mrem/year, and the facility is considered PIC 3.

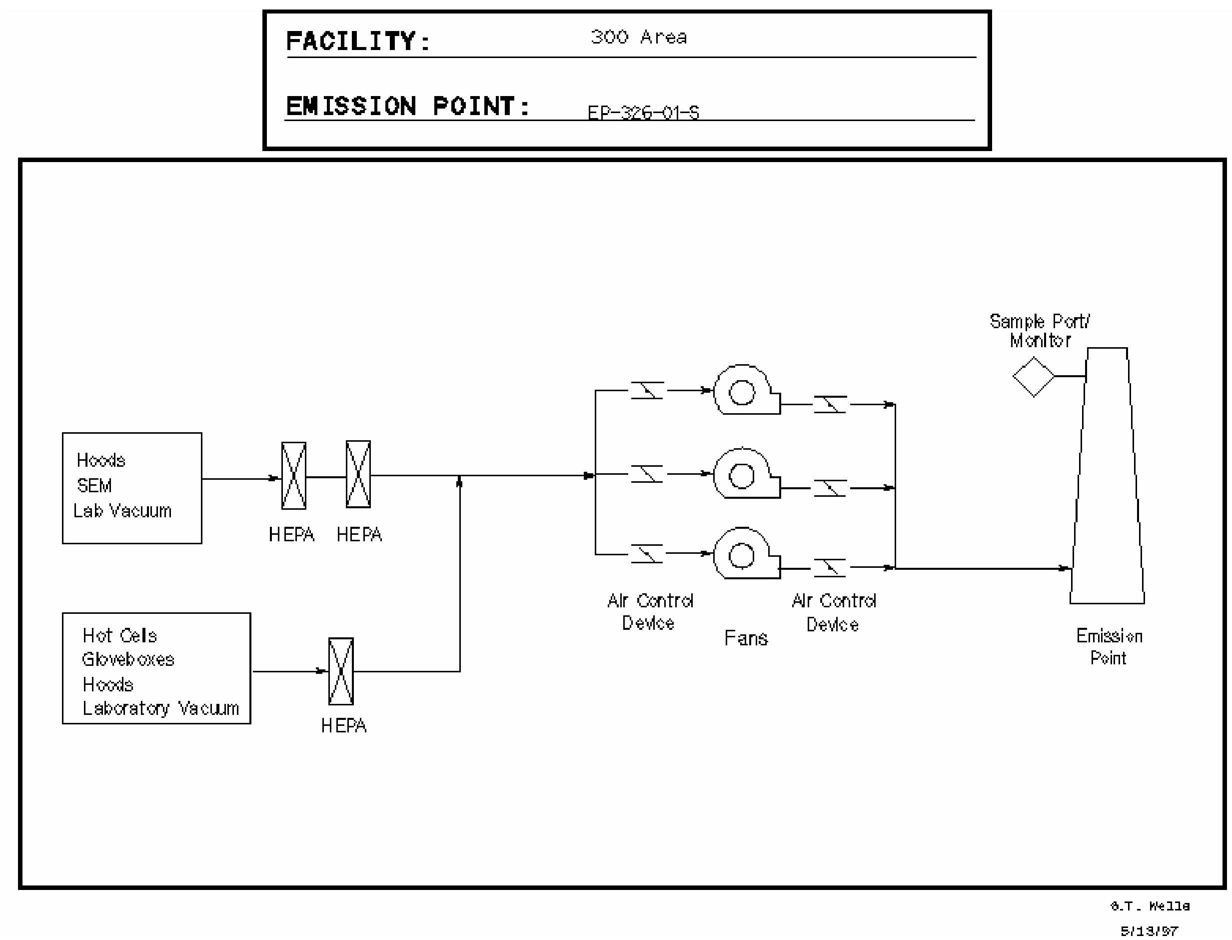

Figure A.7. 326 Building Simplified Ventilation System Drawing

Chemical Inventory: A variety of types and forms of chemicals are used in the 320 Building. A few chemicals may be present above their RQ values. However, these chemicals are likely to be in more than one container, and many containers have reduced concentrations. Because of these factors and engineered and administrative controls, there is little potential to release RQ amounts of chemicals to the environment.

Emission History: Radioactive air emissions have been and continue to be measured. Radionuclide-air-emission data since 1997 are shown in Table 3.1.

The 326 Building is equipped with liquid-effluent sampling systems for both the PS and RPS and was sampled during the sampling campaign conducted by PNNL's effluent management staff in 1994 and 1995 (Thompson et al. 1997). No continued liquid-effluent sampling is required for this facility. Previous sampling results show low concentrations (ppb) of pollutants, generally less than the sewer system waste-acceptance criteria. Additional sampling in 1998 and 2000 confirm the low concentrations of pollutants (McCarthy and Ballinger 2000, Appendices A and B).

A.2.6 329 Building

Mission and Activities: Activities in the 329 Building are primarily involved in the R&D of special purpose radiation-detection and sampling systems, the development of electronics to enhance gamma and neutron detector performance, and the associated software to support operation of these unique systems. In addition, gamma-detection equipment is used for radioisotope quantification that may involve chemical separations. Solid, liquid, and gas samples are analyzed in the specialized laboratories and counting rooms. Research activities principally support the Hanford environmental mission and other key DOE missions of national and international importance.

Staff in the building also conduct research activities involving special-purpose separation and analytical chemistry techniques that allow measurement of low-level and ultra-trace levels of radiological and non-radiological contaminants in environmental samples and other media. A wide range of standard analytical instrumentation is used in the conduct of these activities.

Physical Description: The 329 Building has about 40,000 square feet of floor space on two floors. The building contains general electronics, low-level radiochemistry, and analytical-chemistry laboratory space as well as associated offices and storage space on the first floor. The second floor is primarily mechanical and electrical rooms. Exhaust air is HEPA filtered and sampled for radioactive airborne particles before exiting the building at a single emission point. Figure A.8 is a simplified drawing of the ventilation and air-emission sampling systems. Ventilation and sampling-system configuration drawings have been developed and are maintained in PNNL's Key Drawings System.

The building is served by the 300 Area PS, RPS, and SNS. The SNS serves the restrooms and lunchrooms and is also tied into one corridor of the building (C-section), and the RPS serves process areas in the other two corridors (A- and B- sections). The PS serves the equipment room. In addition, as-built drawings of the building's liquid-effluent systems have been developed and are maintained as Key Drawings. The building is equipped with a liquid-effluent sampling system on the RPS that includes the capability for continuously monitoring pH, conductivity, and flow as well as the capability for obtaining flow-composite samples.

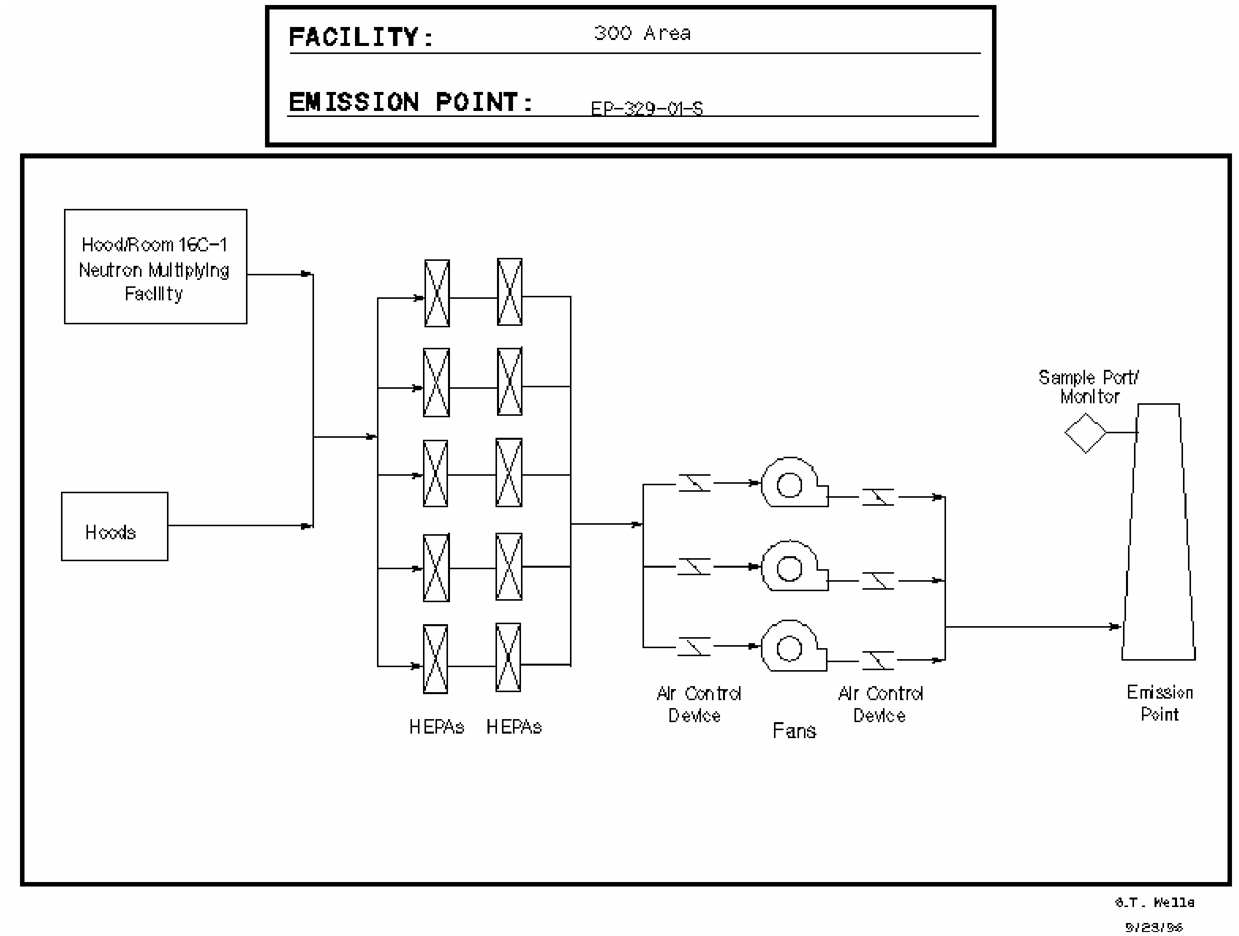

Figure A.8. 329 Building Simplified Ventilation System Drawing

Radiological Inventory: A variety of radionuclides may be present in the building. Inventories are generally in small quantities (microcurie to millicurie) and can be in solid, liquid, powder, or sealed source form. In addition, larger quantities (kilogram or greater) of uranium and thorium may be present as fuel rods or pellets or powder. Some plutonium may also be present. The current PTE for the building is about 0.03 mrem/year, and the facility is considered PIC 3.

Chemical Inventory: A variety of types and forms of chemicals are used in the 329 Building. A few chemicals may be present above their RQ values. However, these chemicals are likely to be in more than one container, and many containers have reduced concentrations. Because of these factors and engineered and administrative controls, there is little potential to release RQ amounts of chemicals to the environment.

Emission History: Radioactive air emissions have been and continue to be measured. Radionuclide-air-emission data since 1997 are shown in Table 3.1. Limited periodic total hydrocarbons and speciated volatile organic compound emissions measurements have been made in the last few years. These measurements have indicated that the resulting ambient air concentrations are less than the Acceptable Source Impact Levels listed in WAC 173-460 New Sources of Toxic Air Pollutants.

This building is equipped with liquid-effluent sampling and monitoring (pH, conductivity, and flow) systems for the RPS, but was not sampled during the sampling campaign conducted by PNNL's effluent management staff in 1994 and 1995 (Thompson et al. 1997). The 329 Building was undergoing extensive remodeling during the campaign, and R&D work was not being conducted in the RPS wings. Sampling in 1998 and 2000 indicated that concentrations of contaminants were low and below the waste acceptance criteria for the Treated Effluent Disposal Facility (McCarthy and Ballinger 2000, Appendices A and B).

A.2.7 331 Building

Mission and Activities: Staff in the building conduct experimental studies to understand molecular and cellular processes resulting from insult by physical and chemical agents. This work is to provide data that serve as a basis for precise cross-species and low-dose extrapolation of health risks and to supply information to understand disease mechanisms as well as levels and effect. They conduct basic and applied research concerning microorganisms and/or their processes in various environments. Research emphasis is currently in subsurface microbiology, including the physiology and ecology of subsurface microorganisms, degradation of organic contaminants and bioremediation, enzymatic reduction of metals, and biogeochemical cycling of nutrients. They conduct research programs investigating macromolecular structure and dynamics and probing the consequences of observables on molecular function. The structures under study include nucleic acid sequences chosen to model radiation (or chemically) damaged DNA; RNAs and their various complexes, epidermal cells and mammary cells to study the effects of tumor formation, transient species generated via oxidative processes in biological systems; metalloproteins that can concentrate or detoxify pollutants from the environment; and clays, oxides, and metals supported on oxide surfaces with or without adsorbates. An outcome this research-program activity is the development of instrumentation and analytical methods that are applied in an innovative manner to facilitate a new level of understanding of structure and function that can be applied to other important research initiatives.

Other staff in the building develop comprehensive environmental monitoring programs and advanced scientific and technological solutions for long-term stewardship of waste sites. This includes work activities that provide an integrated approach to characterizing and monitoring aquatic and terrestrial ecosystems through the development and deployment of new technologies and methods. Research focuses on the impacts of water-use practices on fisheries and wildlife and the response of the aquatic ecosystems to engineered structures and to natural and man-induced stresses. In addition, activities are conducted to provide capabilities in nuclear process engineering, radiomaterials characterization, and radiochemical separations and processing, with natural linkages in process modeling, inorganic materials, and chemical separations.

Physical Description: The 331 Building physical structure consists primarily of two laboratory floors with a mechanical-electrical service floor sandwiched in between. The administrative office area is a three-story building with a two-story addition on the northeast side of the building.

The 331 Building has a 400-ton compressor unit on the roof and a 200-ton compressor for zone cooling in the equipment room (Room 100). The ventilation system is capable of maintaining 15 to 20 air changes per hour in the animal quarters and 4 changes per hour in the office spaces. HEPA filtration is provided in areas where work with radioactive materials is performed. As shown in Figure A.9, these areas include the inhalation suite on the first floor, fume hoods in the animal rooms on the third floor, and glove boxes and fume hoods in Rooms 101 through 107.

Utility services for the 331 Building include hot, cold, process, sanitary, and deionized water; sanitary sewer, PS, and aquaculture system; cage washers; compressed air; laboratory vacuum; steam; and electrical (two 2000 kVA transformers provide normal power, and one 500 kVA transformer provides emergency power). Safety/emergency equipment installed in the building includes safety showers, eyewash stations, fire extinguishers, fire alarms and suppression, and storage cabinets for flammables.

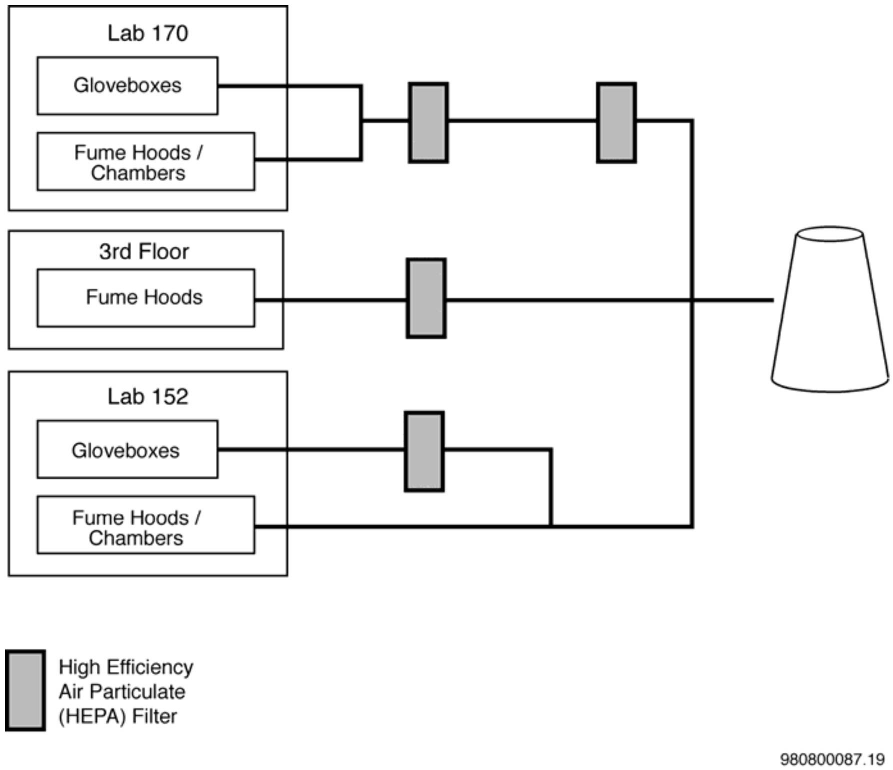

Figure A.9. 331 Simplified Ventilation Diagram

Radiological Inventory: Radioactive-material storage and usage are dispersed throughout the 331 Building and include a large number of isotopes. These materials are found in several forms, including solid, liquid, particulate, and gas. Some of these materials may also be heated during testing, producing vapors. The current PTE for the building is close to 0.01 mrem/year, and work activities in the building have the capability of causing the PTE to exceed 0.01 mrem/yr. Thus, the building is considered PIC 2, and the primary emission point from the building is registered as a major emission point for radiological air emissions.

Chemical Inventory: A variety of types and forms of chemicals are used in the 320 Building. A few chemicals may be present above their RQ values. However, these chemicals are likely to be in more than one container, and many containers have reduced concentrations. Because of these factors and engineered and administrative controls, there is little potential to release RQ amounts of chemicals to the environment.

Emission History: Radioactive air emissions have been and continue to be measured. The primary exhaust system was registered as a minor emission point previous to 1998, but movement of activities from another building to the 331 Building in 1998 increased the PTE, and the emission point was changed to a major emission point requiring continuous sampling. Radionuclide-air-emission data since 1997 are shown in Table 3.1.

Limited periodic total hydrocarbons and speciated volatile organic compound emissions measurements have been made in the last few years. These measurements have indicated that the resulting ambient air concentrations are less than the Acceptable Source Impact Levels listed in WAC 173-460 New Sources of Toxic Air Pollutants, and well within the 331 Bldg permit limits.

This building is equipped with liquid-effluent sampling and monitoring (pH, conductivity, and flow) systems for the PS and was sampled extensively during the sampling campaign conducted by PNNL's effluent management staff in 1994 and 1995 (Thompson et al. 1997). Additional sampling in 1998 confirmed initial sampling results that concentrations of contaminants were low and below the waste acceptance criteria for the Treated Effluent Disposal Facility (McCarthy and Ballinger 2000, Appendix A).

Previous to May 5, 1999, the discharge point from the 331 aquaculture system was permitted under the Hanford Site Wide National Pollutant Discharge Elimination System (NPDES) Permit WA-000374-3. In an April 2, 1999, letter, the U.S. Environmental Protection Agency reissued the NPDES Permit WA-002591-7 and subsequently withdrew permit WA-000374-3. The revised permit exempts Outfall 013 (Building 331 Aquatic Laboratory) from the permit requirements. This permit exemption is based upon a determination that the operation is well under the production thresholds established for aquatic animal production facilities specified in 40 CFR 122 Appendix C. The new permit was effective May 5, 1999.

Although no longer required by permit, sampling and monitoring of the aquaculture system outfall continues to be conducted (per Contract No. DE-AC06-76RL01830) as needed to verify that discharges to the Columbia River remain within applicable limits.

A.2.8 331C Building

Mission and Activities: The 331-C Building, previously known as an Animal Care Facility Storage, is used as general warehouse space to store government standard furniture and research equipment for future use. This facility also has a satellite accumulation area for hazardous waste and a storage area outside for low-level waste. Some maintenance staff have office space in the building.

Physical Description: The 331-C Building is a Butler building, 100 ft by 50 ft, erected on a concrete slab south of the 331 Building. All 5,000 ft^2 is considered storage or common space. The building is heated with electric space heaters, but has no forced air ventilation. No process water supply or liquid-effluent piping or drains are provided. Electrical service is provided with a 125-amp main power supply. Safety/emergency equipment installed in the building includes fire extinguishers, fire alarm, and suppression systems.

Radiological Inventory: 331C has a staging area that may be used to store equipment for which it may be difficult to survey all interior spaces for radioactivity. This equipment may be labeled as potentially contaminated for this reason although there is likely to be little or no radioactive contamination present. For purposes of calculating PTE, the radioactive inventory is considered to be insignificant.

Chemical Inventory: Small quantities of chemicals used for grounds maintenance may be present in the facility.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.9 331D Building

Mission and Activities: The 331-D Building, which was used in the past as a biomagnetic effects laboratory, is used by crafts for storage of equipment and chemicals used in facility and 300 Area mechanical systems.

Physical Description: The 331-D building is a semi-high bay, prefabricated, metal Butler building erected on a concrete slab to the southeast of the 331 Building. The structure is approximately 42 ft by 32 ft and was originally built as an animal-waste-treatment facility. It was converted in 1977 to a biomagnetic effects laboratory where electromagnetic field studies were conducted on rats (Gerber 1992) and currently is used primarily by PNNL's Effluent Management Group to store effluent sampling and monitoring equipment and also by 300 Area maintenance services to store bulk chemicals used in various mechanical systems throughout the 300 Area. It has three large rooms, one of which is equipped with a sink, cabinets, and a counter top. This room, with about one-third of the floor space, is considered wet and dry laboratory. The other two rooms, which constitute the remaining two-thirds of the 1300-ft^2 total floor space, are considered storage.

Building heat is supplied with three small ceiling-mounted electric space heaters and cooled with two 24,000-BTU, wall-mounted air-conditioning units. No forced air ventilation is provided. Building services include water supply, PS, and electrical (112.5 kVA main transformer/480 V, 208 V, and 120 V available). Safety/emergency equipment installed in the building includes an eyewash station and fire extinguishers.

Radiological Inventory: None. Radiological materials are not permitted within this facility.

Chemical Inventory: Chemicals used for crafts (e.g., grease, oil, solvents) may be present in the facility.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.10 331G Building

Mission and Activities: The 331G Building is used for research to develop and evaluate radioactive material detectors. Field test experiments require a clear range with radioactive material targets at known distances. The radioactive material detectors are tested for range and effectiveness. The 331G Building is also used for storage of electronic equipment and radioactive sealed sources. The equipment and the source may be moved to the exterior of the building when in use.

Physical Description: The 331-G Building is a 60-ft by 20-ft concrete block structure on a concrete slab located to the extreme southeast of the 331 Building. The building was originally built to house laboratory animals (primarily swine) while they were giving birth, but is now used in support of animal research. Almost all of the 1200 ft^2 are considered dry laboratory.

The 331-G Building has two emission points. Ventilation from a laboratory fume hood is exhausted through a roof stack, and the balance of the 331-G room air is exhausted through a stack located north of the facility. A single HEPA filter is installed at each stack. Figure A.10 shows a simplified architectural building plan and existing stack locations.

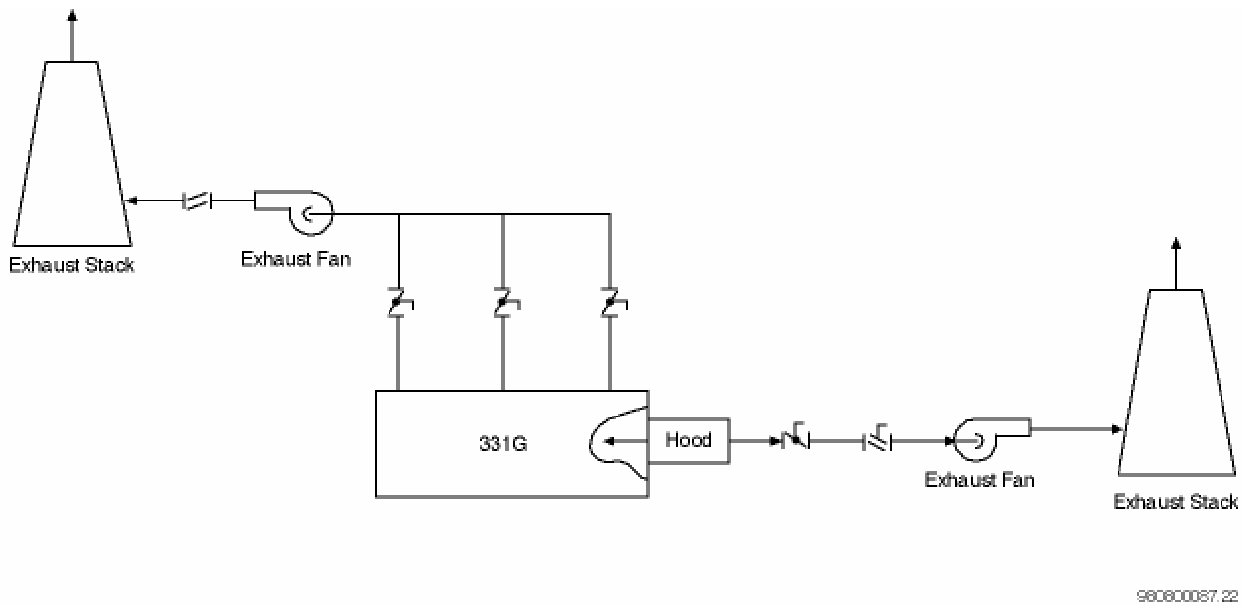

Figure A.10. 331-G Simplified Ventilation Diagram

Radiological Inventory: Sealed radioactive sources are stored in the facility.

Chemical Inventory: Small quantities of chemicals are allowed in the facility, but work activities do not normally require chemicals.

Emission History: The building has been monitored in the past for radioactive air emissions when used previously for animal or archiving activities. However, no sampling or monitoring is currently required or performed for either radioactive or chemical emissions.

A.2.11 331H Building

Mission and Activities: In the Aerosol Wind Tunnel Research Facility (331-H Building), research is conducted to evaluate the effects and changes in plants, animals, and the surface geologic materials occurring as a result of airborne deposition of windblown materials, chemical constituents, or wind erosion and the transport, fate, and effects of biological constituents (e.g., bacteria, fungi, pollen).

Physical Description: The 331-H Building is a one-story concrete block structure on concrete foundations and a concrete slab southeast of the 331 Building. The building has a flat, built-up roof covered with gravel. A metal lean-to is attached to the northwest corner of the building to provide additional research space. A little over half of the 3600-ft^2 floor space is considered dry or wet laboratory; the remainder is considered common space.

Building heat is supplied with electric resistant heat coils and a ceiling-mounted electric space heater and is cooled with a 15-ton air conditioner. Outside air is drawn into the building through a roof-mounted heat pump and exhausted through a two-stage HEPA filter to a stack. The wind tunnel draws air from the room and exhausts it with the room exhaust through the HEPA filters to the stack. Building services include compressed air, laboratory vacuum, process water, sanitary sewer, PS, and electrical (150 kVA main transformer plus 55 kW propane-fueled emergency generator with 227/480 V). Safety/emergency equipment installed in the building includes safety shower and eye-wash stations, fire extinguishers, fire alarm, and fire-suppression systems.

Radiological Inventory: Sealed radioactive sources may be present in the facility.

Chemical Inventory: A variety of types and forms of chemicals may be used in the 331H Building, depending on the research study. A few chemicals may be present above their RQ values. However, these chemicals are likely to be in more than one container, and many containers have reduced concentrations. Because of these factors and engineered and administrative controls, there is little potential to release RQ amounts of chemicals to the environment.

Emission History: The building has been monitored in the past for radioactive air emissions. However, no sampling or monitoring is currently required or performed for either radioactive or chemical emissions.

A.2.12 336 Building

Mission and Activities: The primary mission of the 336 Building is to perform engineering and analysis of multiphase flow experiments related to multiphase flow phenomena, and to experimentally address issues related to Hanford waste retrieval, transport, and disposal. A multi-scale tanks system ($^1/_4$, $^1/_{12}$, and $^1/_{25}$ scale of double shell tanks) and ancillary equipment are used to accommodate the full technology-development cycle for retrieval technologies, such as pulsed-air. Additional studies are performed to enhance or better understand existing technologies, such as aerosol generation, during sluicing and performance correlations for mixer pumps. A 3-in. slurry test loop is used to test the performance of candidate instruments for monitoring slurry transport through pipes. An adjacent simulant development and measurements laboratory supports the high-bay testing and instruments that provide a wide range of physical properties important to waste retrieval and transport.

Physical Description: The 336 Building provides staff with a three-story-high bay and a 20-foot-diameter circular pit, approximately 50-feet deep. The approximately 4,000-square-foot building houses a series of tanks up to about a 25,000-gallon capacity. The southwest corner of the building provides two supporting laboratories.

The ventilation system has a nominal capacity of 10 air changes per hour. The building is not equipped with exhaust-air filtration or sampling systems.

The building is served by the 300 Area PS and SNS; the SNS serves the restrooms, and the PS serves process areas. The building does not have a liquid-effluent sampling system.

Radiological Inventory: None. Radiological materials are not permitted within this facility.

Chemical Inventory: A variety of types and forms of chemicals are used in the building.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.13 338 Building

Mission and Activities: The work in the building includes the development and qualification effort of a materials development process conducted in the north end of the building. The second activity in the facility is focused on assembling and testing equipment. This work is all performed with non-radioactive materials, and a portable X-ray machine may be used. The third activity demonstrates developing neutron detection instruments and capabilities and is permitted to use sealed radioactive sources.

Work activities are also performed to provide scientific and engineering expertise on fluid dynamics, heat transfer, related transport phenomena, and liquid-solid systems ranging from dilute slurries to wet solids.

Other work is conducted with equipment consisting of a rolling mill, heat treating furnaces, and brake shear. This capability supports various aluminum, light metal, and advanced metal composites materials development projects. Staff conducts work in the development and testing of prototypic waste retrieval end effectors. This consists of a robotic gantry. The robotically controlled system has four degrees of freedom. Integrated with the gantry is a 10,000-psi, 25-gpm high-pressure water pump and controls (housed in a shed outside 338), a 200-hp pneumatic conveyance system, and associated piping and instruments.

Physical Description: The building has about 18,000 square feet of floor space on one floor consisting of office, high-bay, and support space. The building also has a large basement area. The exhaust air is not HEPA filtered or sampled before exiting the building, and no air-emission filtration or sampling systems are in place.

The building is served by the 300 Area PS and SNS; the SNS serves the restrooms, and the PS serves process areas. The building does not have a liquid-effluent sampling system.

Radiological Inventory: None. Radiological materials are not permitted within this facility.

Chemical Inventory: A variety of types and forms of chemicals are used in the building.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.14 350 Building

Mission and Activities: The 350 Building is primarily offices and shop areas used by PNNL's Crafts Services Department.

Physical Description: The 350 Building is a single-story structural steel building with about 16,000 square feet of floor space. It contains craft shops, change rooms, restrooms, a lunchroom, and offices. The craft shops have a dust-collection system, and the air is filtered before being recirculated into each respective shop. The building is not equipped with HEPA filtration or a sampling system for airborne emissions. The building is served by the 300 Area SNS and does not have a liquid-effluent sampling system.

Radiological Inventory: None. Radiological materials are not permitted within this facility.

Chemical Inventory: Chemicals in the building are typical of those used in construction and crafts. A few chemicals may be present above their RQ values. However, these chemicals are likely to be in more than one container, and many containers have reduced concentrations. Because of these factors and engineered and administrative controls, there is little potential to release RQ amounts of chemicals to the environment.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.15 350-A Building

Mission and Activities: The 350-A Building is used as a paint shop with storage space for paints and similar products and a paint spray booth.

Physical Description: The 350-A Building has about 1,400 square feet of floor space. No HEPA filter or sampling system exists for airborne emissions. The building is served by the 300 Area SNS and does not have a liquid-effluent sampling system.

Radiological Inventory: None. Radiological materials are not permitted within this facility.

Chemical Inventory: The chemical inventory consists of paints, solvents, and similar materials. A few chemicals may be present above their RQ values. However, these chemicals are likely to be in more than one container, and many containers have reduced concentrations. Because of these factors and engineered and administrative controls, there is little potential to release RQ amounts of chemicals to the environment.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.16 350-B Building

Mission and Activities: The 350-B Building is used as a small warehouse that houses parts and materials required to perform maintenance.

Physical Description: The 350-B Building has about 2,100 square feet of floor space for storage. Ventilators are provided to remove excess summer heat, but no filtration or sampling systems exist for airborne emissions. The building is connected to the 300 Area SNS and does not have a liquid-effluent sampling system.

Radiological Inventory: None. Radiological materials are not permitted within this facility.

Chemical Inventory: Some flammable/combustible liquids or corrosive liquids may be present in the building.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.17 350-C Building

Mission and Activities: The 350-C Building is a small storage building used to store miscellaneous building lumber and carpenter supplies.

Physical Description: The 350-C Building is a prefabricated metal building on a concrete slab floor with a large roll-up door. It has about 200 square feet of floor space for storage, and does not have ventilation, water, sewer, or sampling capabilities.

Radiological Inventory: None. Radiological materials are not permitted within this facility.

Chemical Inventory: None. Storage of chemicals in the building is not allowed.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.18 350-D Building

Mission and Activities: The 350-D Building is a small storage building used to stage used oils and other waste products before ultimate disposal. The building includes a < 90-day storage area for polychlorinated biphenyl waste.

Physical Description: The 350-D Building has about 1,000 square feet of floor space for storage. No filtration or sampling systems exist in the building for airborne emissions. No sewer system connections or liquid-effluent sampling systems are provided.

Radiological Inventory: None. Radiological materials are not permitted within this facility.

Chemical Inventory: Some oils and other chemicals are stored in the building, and a few may be present above their RQ values. However, these chemicals are likely to be in more than one container, and many containers have reduced concentrations. Because of these factors and engineered and administrative controls, there is little potential to release RQ amounts of chemicals to the environment.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.19 3020 Building (EMSL)

Mission and Activities: The EMSL is a national focal point for molecular-science research with an emphasis on the long-term environmental management mission of the DOE. The EMSL is operated as a DOE collaborative user research facility where scientists and engineers from the academic community, industry, and other government laboratories pursue and collaborate on scientific issues. The EMSL provides integrated laboratory, computer, and seminar functions in a single facility and contains basic, multidisciplinary research programs involving chemical, biological, materials, and computational sciences. R&D activities are undertaken in EMSL to advance the understanding of molecular sciences and to apply the advanced understanding gained to a broad spectrum of environmental restoration and waste management missions. The facility design is based on state-of-the-art research and communications and computer equipment, and it provides a laboratory configuration that facilitates the theory-experiment interface with flexibility to accommodate future advanced research and computer equipment as well as applied technology activities.

Physical Description: EMSL consists of experimental laboratories (dry, wet, and filtered), theory laboratories, laboratory support offices, conference rooms, computer graphics rooms, administrative support offices, a library, lunch/interaction areas, support/crafts shops, storage, and a seminar area. EMSL has about 200,000 square feet of floor space.

The EMSL experimental laboratories are arranged in five clusters. Each of the five laboratory clusters has separate once-through ventilation and emissions exhaust systems for chemical hoods. A separate HEPA-filtered exhaust system is also provided that is equipped with a particulate sampling system for measuring radioactive air emissions. All of the five emission points are equipped with ports through which air-chemical emissions can be sampled. Figure A.11 is a simplified drawing of the HEPA-filtered exhaust and air-emission sampling systems. Ventilation and sampling-system configuration drawings have been developed and are maintained in PNNL's Key Drawings System.

EMSL is equipped with two sewer systems: a sanitary system that serves restrooms, lunchrooms, and mechanical room areas, and a process system that serves laboratories. The process system discharges to large tanks in a tank pit. The tanks are equipped with sampling and monitoring systems so that process effluent batches can be sampled and measured before discharge. Figure A.12 shows the process collection tanks. Ultimately, liquid effluent from the process tanks discharges to the sanitary sewer, which discharges to the City of Richland Publicly Owned Treatment Works. EMSL has an industrial wastewater permit with the City of Richland to govern the discharges of process effluent. As-built drawings of the liquid-effluent distribution and sampling systems have been developed and are maintained in PNNL's Key Drawings System.

Radiological Inventory: The EMSL radiological inventory consists of a number of sealed sources and contained radioactive samples brought into the facility for analysis only. This inventory has a PTE of zero for normal activities, and the facility is considered a PIC 4 (see Table A.2).

Chemical Inventory: A variety of types and forms of chemicals are used in the EMSL. A few chemicals may be present above their RQ values. However, these chemicals are likely to be in more than one container, and many containers have reduced concentrations. Because of these factors and engineered and administrative controls, there is little potential to release RQ amounts of chemicals to the environment.

Emission History: EMSL began operations in 1997, so previous historic data do not exist. Sampling for radioactive airborne emissions began in December of 1997. Radionuclide air-emission data since 1997 are shown in Table 3.1. Since no dispersible radioactive material was introduced into the building in 1997, the emitted radioactivity is indicative of background levels (naturally occurring materials and worldwide fallout).

Total organic carbon in air emissions was measured in 1998 in compliance with an NOC and demonstrated that emissions were below the 0.24-lb/hr permitted emission limit. Limited periodic speciated volatile organic compound emissions measurements have been made in the last few years. These measurements have indicated that the resulting ambient air concentrations are less than the Acceptable Source Impact Levels listed in WAC 173-460 New Sources of Toxic Air Pollutants and well with in the EMSL permit limits.

Compliance sampling of liquid effluents also began in 1997 after EMSL started operations. These data are reported on monthly discharge monitoring reports to the City of Richland.

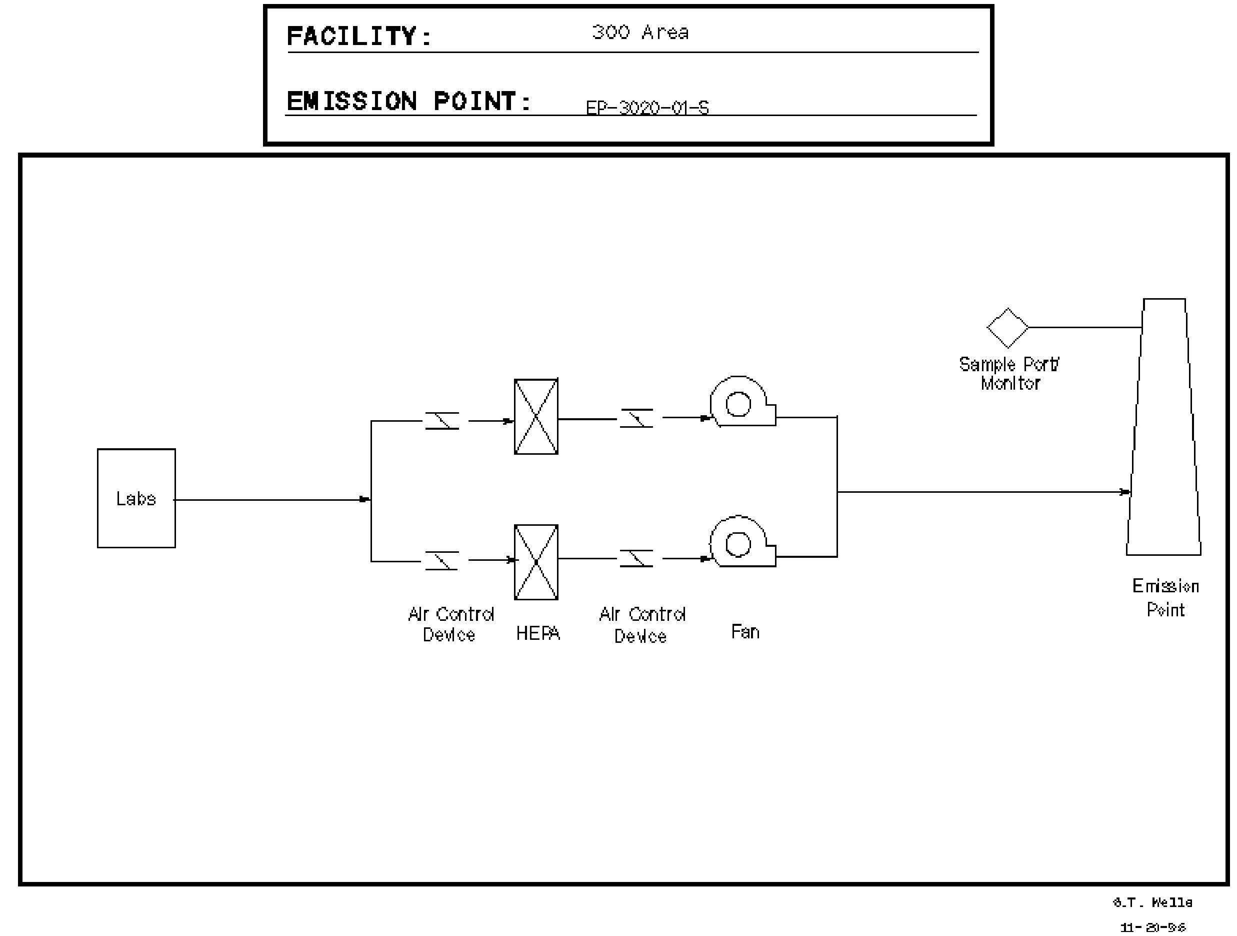

Figure A.11. EMSL Simplified Ventilation System Drawing

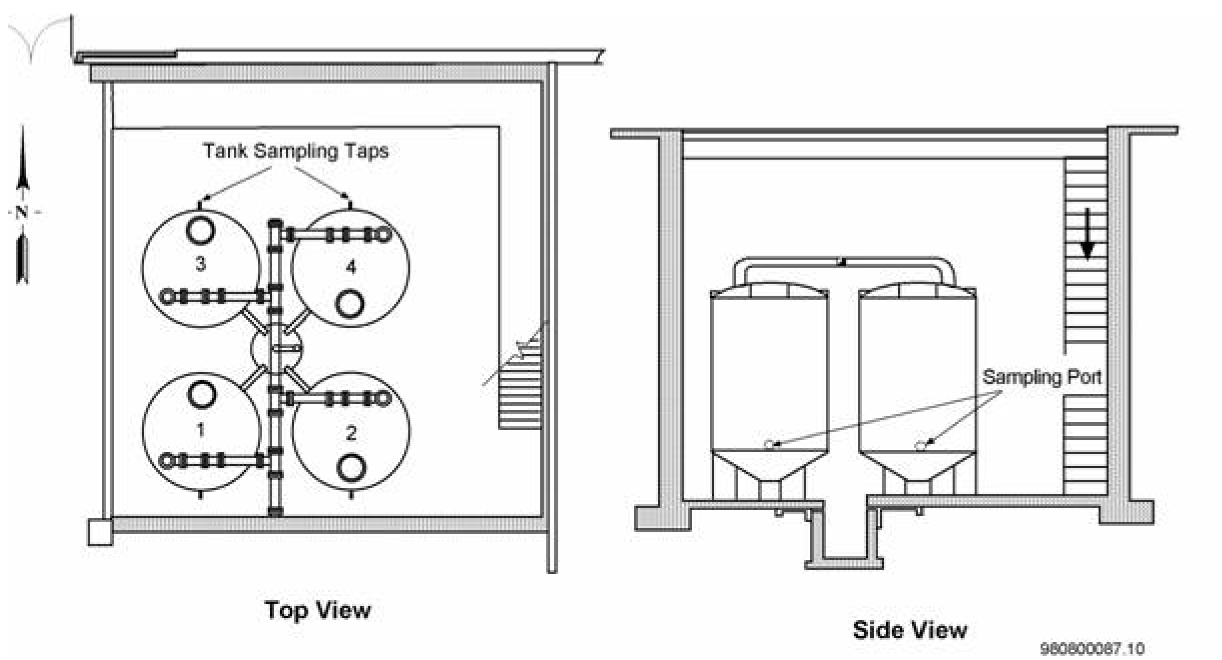

Figure A.12. EMSL Process Sewer Tanks

A.2.20 3718-P Building

Mission and Activities: The 3718-P Building is used as general warehouse space for furniture, filters, and research equipment designated for future use.

Physical Description: The 3718-P Building consists primarily of general warehouse space with 12,000 square feet of floor space. Heaters are available to prevent freezing of the fire sprinkler system. No filtration or sampling system exists for the building. The building is not equipped with process water or sewer systems.

Radiological Inventory: None. Radiological materials are not permitted within this facility.

Chemical Inventory: The 3718-P Building was not designed for storage of chemicals or hazardous materials. Small quantities of hazardous materials may be present in the building for maintenance or repair purposes.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.21 3730 Building

Mission and Activities: The Gamma Irradiation Facility located in the 3730 Building plays an important role in a wide range of programs. It is used to analyze Hanford waste tank solutions, corrosion and stress-corrosion cracking studies, and the evaluation of various types of probes under irradiated conditions. The effect of gamma radiation on the degradation of materials such as adhesives, grout, and polymers is also examined in the facility.

In addition, activities conducted in this facility are in support of materials characterization and the evaluation of radioactive materials, including measuring the density of materials and the receiving, sorting, and shipping of radioactive materials.

Physical Description: The 3730 Building is a one-story concrete block structure of approximately 4,000 square feet and equipped with a hot cell. Exhaust air from the hot cell is HEPA filtered and sampled for radioactive airborne particles before exiting a single emission point. Figure A.13 is a simplified drawing of the ventilation and air-emission sampling systems. Sampling-system configuration drawings have been developed and are maintained in PNNL's Key Drawings System.

The building is served by the 300 Area PS and SNS; the SNS serves the restrooms and lunch rooms, and the PS serves process areas. No liquid-effluent sampling system exists for the building.

Radiological Inventory: Curie quantities of radioactive materials in solid form are stored and tested in the building. The current PTE for the building is about 3E-4 mrem/yr, and the facility is considered PIC 3 (see Table A.2).

Chemical Inventory: A variety of types and forms of chemicals are used in the building.

Emission History: Radioactive air emissions have been and continue to be measured. Radionuclide-air-emission data since 1997 are shown in Table 3.1.

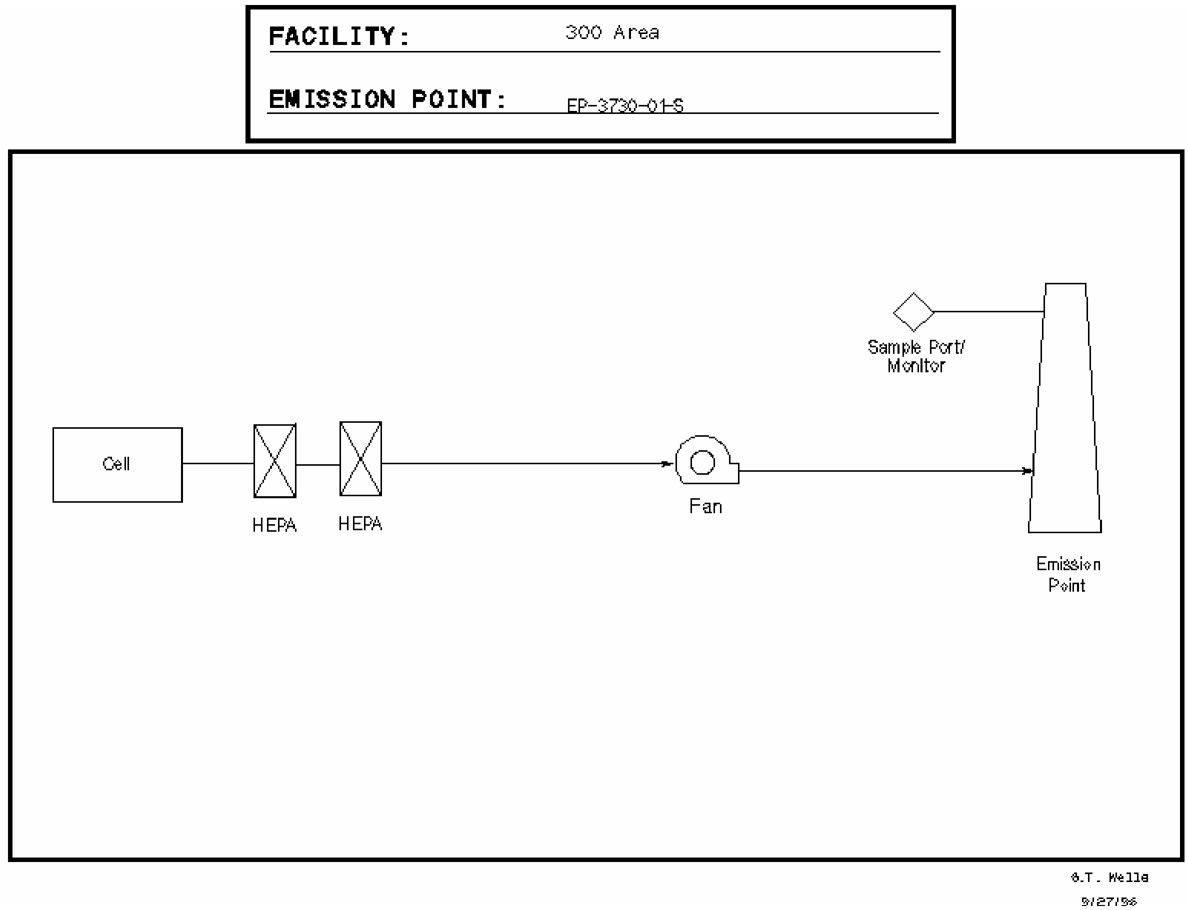

Figure A.13. 3730 Building Simplified Ventilation System Drawing

A.2.22 622-A Building

Mission and Activities: The 622-A Building provides housing and protection for the hoisting equipment and electrical controls for the elevator in the adjacent meteorological tower.

Physical Description: The 622-A Building is a small concrete block building with 170 square feet of floor space. The building is not equipped with a ventilation system, water supply, liquid-effluent system, or air or liquid sampling systems.

Radiological Inventory: None. Radiological materials are not permitted within this facility.

Chemical Inventory: Chemicals such as oils and grease may be present to support elevator equipment maintenance and repair.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.23 622-B Building

Mission and Activities: The 622-B Building provides space to store, inflate, and track weather balloons.

Physical Description: The 622-B Building is a small concrete block building with about 150 square feet of floor space. The building is not equipped with a ventilation system, liquid-effluent system, or air or liquid sampling systems.

Radiological Inventory: None. Radiological materials are not permitted within this facility.

Chemical Inventory: This building was not designed for storage of chemicals or hazardous materials. Small quantities may be present for maintenance or repair purposes.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.24 622-C Building

Mission and Activities: The 622-C Building is used for general storage of equipment.

Physical Description: The 622-C Building is a steel storage building with about 1,200 square feet of storage space and a roll-up door. The building is not equipped with ventilation systems, liquid-effluent systems, or air or liquid sampling systems.

Radiological Inventory: This building does not normally contain radioactive materials.

Chemical Inventory: This building was not designed for storage of chemicals or hazardous materials. Small quantities of hazardous materials may be present for maintenance or repair purposes.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.25 622-R Building

Mission and Activities: The scope of work conducted in these buildings is to design and conduct studies of atmospheric processes that affect the distribution of energy and mass within the atmosphere. The 622R space is used to store, prepare, and test equipment that is used for measuring meteorological, air quality, atmospheric radiation, and remote sensing before deployment at various field sites.

The Hanford Meteorology Station (HMS) is also operated from this suite of buildings and meteorology towers. This includes weather forecasting and observing; data collecting, processing, and archiving; and instrument calibration and maintenance. The HMS provides technical support to activities on the Hanford Site that could be severely affected by adverse meteorological conditions so they can operate in as safe and efficient a manner as possible.

Physical Description: The single-story, concrete block building has about 9,000 square feet of office and laboratory space. Central ventilation is provided, but the building is not equipped with HEPA filtration or a sampling system for airborne emissions. The building is currently connected to an SNS in the 600 Area. No liquid-effluent sampling system is provided.

Radiological Inventory: The building may contain some sealed sources, but does not currently have a radiological inventory.

Chemical Inventory: Chemicals in the building primarily consist of small quantities of laboratory chemicals.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist. In the past, a septic-tank system was used for sanitary sewer, and this tank is still connected. However, the primary path for liquid effluents is to pump waste to a nearby SNS.

A.2.26 747-A and TR1 Buildings

Mission and Activities: The In Vivo Radioassay and Research Facility (IVRRF) is a state-of-the-art facility designed expressly for *in vivo* measurement of radioactive material. The IVRRF primarily provides routine *in vivo* counting services to the contractors at the Department of Energy's Hanford Site and for other non-DOE clients.

Physical Description: The 747-A Building is a one-story, concrete block building that contains dry laboratory and office space. The adjacent trailer, 747-TR1, contains offices, dry laboratories, and common space used to support activities conducted within the 747-A Building. The 747-A Building and the adjacent trailer have about 2,000 and 1,600 square feet, respectively. The 747-A Building has a central heating, ventilation, and air-conditioning system.

Neither building is equipped with a filtration or air-sampling system. Sanitary sewer hookup is provided to both buildings to support the change room and bathrooms, but the buildings do not have liquid-effluent sampling systems.

Radiological Inventory: The 747-A Building contains a number of sealed sources. These sources do not have a PTE under normal operations.

Chemical Inventory: Chemicals in the 747-A Building are limited to small quantities of flammable/combustible or corrosive liquids.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.27 Lysimeters

Mission and Activities: The 100, 300, and 600 Area lysimeters are used to study the filtration of contaminants through the soil.

Radiological Inventory: Sealed sources may be used at the lysimeter sites to aid in research measurements.

Chemical Inventory: Chemicals are not stored at the lysimeter sites.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.28 Environmental Monitoring Stations

Mission and Activities: Environmental monitoring stations are positioned at strategic locations around the Hanford Site to aid in sample collection to determine the effects of Hanford Site releases on the environment.

Physical Description: The environmental monitoring stations consist of small enclosures with 50 to 150 square feet of concrete pad as a foundation. No ventilation, water, or sewer systems are provided.

Radiological Inventory: None.

Chemical Inventory: No chemicals are stored at the environmental monitoring stations.

Emission History: N/A. No monitoring or sampling of facility effluents has been required, and no historic data exist.

A.2.29 361 Building

Mission and Activities: The 361 Building is used in support of Comprehensive Test Ban Treaty (CBTB) studies. The objective of the CTBT program is to monitor ambient air for the presence of radionuclides that would result from the detonation of nuclear weapons. The 361 Building is used for R&D of the air-monitoring equipment as well as a training facility for personnel that may use these systems worldwide. Ambient air is sampled and then routed to the detection instruments. After the analysis is complete, then the air is exhausted through stacks that are on the roof of the building.

Physical Description: The 361 Building measures 12 feet by 33 feet and is constructed of prefabricated concrete. It was purchased and erected in 1999. Two small stacks are located at the top of the building. These stacks are not registered with the state.

Radiological Inventory: Sealed Sources for instrument calibrations.

Chemical Inventory: None

Emission History: N/A. No monitoring or sampling of facility effluents has been required.

Appendix B

Supporting Calculations

Table B.1. Supporting Calculations—Sampling Data from Calendar Year 2003

Facility	Emission Point	Sampler Flow, CFM	Stack Flow CFM	Detectable Release		Penetration Efficiency	Transp. Factor
				Alpha, Ci	Beta, Ci		
EMSL	EP-3020-01S	1.7	6900	1.4E-07	5.3E-06	90 - 105	0.9
305B	EP-305B-01-S	3.5	1000	9.2E-09	3.5E-07	96 - 117	0.96
318	EP-318-01-S	1.6	480	1.0E-08	3.8E-07	93 - 101	0.93
320	EP-320-01-S	2.4	30200	4.2E-07	1.6E-05	92 - 108	0.92
320	EP-320-02-S	1.7	510	1.1E-08	4.2E-07	83 - 97	0.83
320	EP-320-03-S	1.2	370	1.2E-08	4.5E-07	81 - 90	0.81
320	EP-320-04-S	1.4	410	1.1E-08	4.2E-07	81 - 101	0.81
323	EP-323-01-S	1.5	4100	1.2E-07	4.6E-06	70 - 97	0.7
326	EP-326-01-S	3.3	52,600	5.2E-07	2.0E-05	94 - 110	0.94
329	EP-329-01-S	2.7	47100	5.9E-07	2.2E-05	92 - 108	0.92
331	EP-331-01-V	3.4	61800	5.9E-07	2.2E-05	95 - 117	0.95
3730	EP-3730-01-S	1.5	240	5.1E-09	1.9E-07	97 - 102	0.97
Sampler and stack flows are averages for 2003.							
MDA alpha	1	pCi/sample					
MDA beta	38	pCi/sample					
Yr Fraction	0.04	2-wk sample					
Lab Corr Factor	0.85						
Op Factor	1						
Transp. Factor	as given						
Media Factor	0.99						
Detectable Release =		(MDA/Yr fraction) × (stack flow/sample flow) × 1E-12					
		Lab Corr. factor × Op. Factor × Transport Factor × Media Factor					
EMSL = Environmental Molecular Sciences Laboratory MDA = Minimum Detectable Activity							