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Revision 6

B Plant Documented Safety Analysis

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

P.O. Box 1600
Richland, Washington 99352

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2	Complete Revision per HNF EDC-08-36354	EN Dodd 1/31/08 ☒
3	Complete Revision per PRC-EDC-09-42421. Changes include removal of the FHA to a separate document and updating contractor identification from FH to CHPRC.	EN Dodd 2/18/10 ☒
3A	Page change revision per ECR-10-000850. The major change is incorporating accident analyses consistent with JCO CHPRC-00870, untilizing the correct solubility class.	EN Dodd 4/27/11 ☒
4	Complete Revision per ECR-12-001170. The major changes are deleting the building as a Design Feature and reclassifying it as defense-in-depth important to safety, providing an explicit description of the facility boundary, and deleting the TSR Adminstrative Control on adding inventory to the facility.	LI Covey 1-29-13 ☒
5	Complete Revision per ECR-14-000787. Major changes include eliminating the waste inventory control by updating the staged waste fire accident analysis to provide more margin in the assumed MAR. The hazards analysis (HA) in Appendix A and scenario descriptions in Chapter 3 were updated to provide consistency between the HA and Chapter 3, i.e. frequencies, bounding scenarios and SMPS were updated. References updated and technical edits made.	AJ Olsen 7-16-14 ☒
6 RS	Complete Revision per ECR-15-001013. The major channges to Rev. 6 of the B Plant DSA include incorporating Margin of Safety discussion, Step Out Criteria in Section 4.6, updating the fire protection section to exclude KA 11-5, analysis and disposition of WESF grouting activities in Appendix A, and updating the hazards analysis table in Appendix A and Chapter 3 with SMPs consistent with today's SMP titles.	JJ Hicks 2/9/16 ☒
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B Plant Documented Safety Analysis

Prepared by:
CH2M HILL Plateau Remediation Company
Richland, Washington

June 2015

Executive Summary

The B Plant Facility is a canyon facility adjacent to the Waste Encapsulation and Storage Facility (WESF) in the 200 East Area. The facility was designed to chemically process spent nuclear fuel using the bismuth-phosphate process. The Documented Safety Analysis (DSA) for the B Plant Facility is maintained in accordance with 10 CFR 830, *Nuclear Safety Management*, and as such, is updated on an annual basis, as necessary, to reflect any changes in the facility, the work, or the hazards as they are analyzed in the DSA.

The 2015 annual update to this DSA includes minor updates to reflect planned operations and current support programs. Chapter 2 and the Hazards Analysis in Appendix A were updated to allow borehole (well) drilling activities. Chapter 2 was also updated to reflect current practices in response to deteriorating containers and spills. Minor changes were made to the Technical Safety Requirements in Appendix C to make TSR AC violation recovery actions consistent with the actions in other Central Plateau (CP) Surveillance & Maintenance (S&M) DSAs and to eliminate the general principles of operability since no Limiting Conditions of Operations exist for the facility. Other changes to the DSA were updates to support programs; a "Margin of Safety" section was added to Chapter 3 to support Unreviewed Safety Question (USQ) determinations; the Fire Protection Program discussion in Chapter 5 was updated to take exception to key attribute 11-5 as the facility does not have any fire protection systems; and references to the safety management programs (SMPs) in Chapter 3 and Appendix A were updated reflect the current SMP titles. Minor clarifications and edits were made throughout the document.

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Terms

AC	administrative control
ACT	air cleanup train
ALARA	as low as reasonably achievable
ARF	airborne release fraction
CFR	Code of Federal Regulations
CHPRC	CH2M HILL Plateau Remediation Company
CP	Central Plateau
CW	collocated worker
D&D	decommissioning and demolition
DC	direct current
DID	defense-in-depth
DOE	U.S. Department of Energy
DSA	documented safety analysis
HA	hazard analysis
HDPE	high-density polyethylene
HEPA	high-efficiency particulate air
ICRP	International Commission on Radiological Protection
ISMS	Integrated Environment, Safety, and Health Management System
ISO	International Organization of Standardization
ITS	important to safety
LLM	low level mixed
LLW	low level waste
MAR	material at risk
MOI	maximally-exposed offsite individual
N/A	not applicable
NANU	Nitric acid neutralization unit
NU	Neutralization unit
NPH	natural phenomena hazard
PHA	preliminary hazards analysis
PCB	polychlorinated biphenyl
PUREX	Plutonium-Uranium Extraction
QA	quality assurance
RCRA	Resource Conservation and Recovery Act
REDOX	Reduction-Oxidation
RF	respirable fraction
RL	Richland Operations Office
S&M	surveillance and maintenance
SDT	Settle and decant tank
SMP	Safety Management Program

SSC	structure, system, and component
SWDB	steel waste disposal box
TED	total effective dose
TL	Tank
TSCA	Toxic Substances Control Act
TRM	transuranics mixed
TRU	transuranic
TSR	technical safety requirement
USQ	unreviewed safety question
V	volts
WESF	Waste Encapsulation and Storage Facility

Chapter 1.0

Introduction

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1.0 Introduction

1.1 Summary

This document provides the documented safety analysis (DSA) and CH2M HILL Plateau Remediation Company (CHPRC) requirements that apply to surveillance and maintenance (S&M) activities at the 221-B Canyon Building and ancillary support structures (aka B Plant). B Plant is nonoperational, deactivated, and undergoing long-term S&M prior to decommissioning and demolition (D&D). This DSA is compliant with 10 Code of Federal Regulations (CFR) 830, "Nuclear Safety Management," Subpart B, "Safety Basis Requirements." This DSA was developed in accordance with DOE-STD-1120-2005, *Integration of Environment, Safety, and Health into Facility Disposition Activities*; 10 CFR 830, Appendix A, Table 2; letter 02-ABD-0053, "Contract Number DE-AC06-96RL13200 – Fluor Hanford Nuclear Safety Basis Strategy and Criteria," for facilities in long term S&M; letter 02-ABD-0091, "Contract No. DE-AC06-96RL13200 – FHI Nuclear Safety Expectations for Nuclear Facilities in Surveillance and Maintenance"; and HNF-8739, *Hanford Safety Analysis and Risk Assessment Handbook (SARAH)*.

1.2 Facility Overview

The 221-B Canyon Building is located adjacent to the Waste Encapsulation and Storage Facility (WESF [aka 225-B Building]) in the Hanford Site's 200 East (200E) Area (Figure 1-1 and Figure 1-2). B Plant includes deactivated buildings and associated process equipment used for the dissolution of irradiated reactor fuels and subsequent separation of uranium, plutonium, cesium, and strontium, as well as deactivated equipment formerly used for waste concentration, waste neutralization, and solvent recovery.

Unauthorized access to the facility is prohibited and the facility structures are locked. A 1.8 m (6 ft) cyclone fence encloses the immediate deactivated area (except for the 207-BA B Plant cooling water sampling building). Unauthorized access to the Hanford Site is prohibited and the CHPRC infrastructure provides general site security, fire protection, emergency preparedness, waste disposal, and utility (e.g., water and electrical power) services and supports integrated health, quality, and safety programs.

The 221-B Canyon Building is physically adjacent to WESF, but the physically interfaced systems between the two facilities have been isolated. All systems that extend from B Plant to other sites/systems (e.g., Tank Farms, liquid effluents) have been isolated. Electrical power to B Plant was isolated during deactivation. New utility services, independent of the B Plant electrical system, were added as separate systems for 221-B, 271-B, and 212-B Buildings, which includes the surveillance lighting systems, the canyon exhaust system, and the retired filter liquid level system. Water is provided for the fire hydrant loop around B Plant.

The U.S. Department of Energy (DOE) owns and has overall responsibility for the Hanford Site. CHPRC is the plateau remediation prime contractor responsible for the safe, environmental cleanup of the Hanford Central Plateau (CP). The CHPRC CP S&M Organization has responsibility for the overall coordination and operation of the facilities within its jurisdiction. The S&M Organization is responsible for S&M at B Plant.

1.3 Summary of Facility Hazard Categorization

B Plant has been categorized as a Hazard Category 2 nuclear facility based on the sum-of-ratios approach described in DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*. The hazard categorization calculation is given in Section 3.2.

1.4 Summary of Safety Analysis Results

There are no safety-class or safety-significant structures, systems, and components (SSCs) required to support S&M activities at B Plant. This determination was based on the current criteria for selecting safety-class systems as identified in PRC-PRO-NS-700, *Safety Basis Development*, and the guidance in HNF-8739. Specifically, any scenario with a risk bin value greater than III requires safety-class or safety-significant SSCs to reduce the risk bin to III or less. Safety class systems are identified for the maximally exposed offsite individual (MOI) and safety significant systems are identified to reduce the risk to the collocated worker (CW). Systems are evaluated for defense in depth (DID) if they are below the criteria for safety-class and safety-significant SSCs discussed above.

The 221-B Canyon Building structures, which include the canyon walls and roof, air cleanup train (ACT) filter structure, and the retired filters structure (including the deactivated exhaust system downstream of the concrete plugs in the air tunnel and the retired filter vaults), are designated as providing DID. These B Plant structures provide safety functions, as passive SSCs, that are effective for multiple hazards, which is one of the characteristics listed in PRC-PRO-NS-700 for identifying important to safety (ITS) equipment. The 221-B Canyon Building structures and the retired filters structure are not credited in the accident analyses for providing a preventive or mitigative function; however, the 221-B Canyon Building structures provide confinement of hazardous materials and shielding for worker protection during normal operations and accidents. The retired filter structure provides confinement of hazardous materials and protection of filter material from impact.

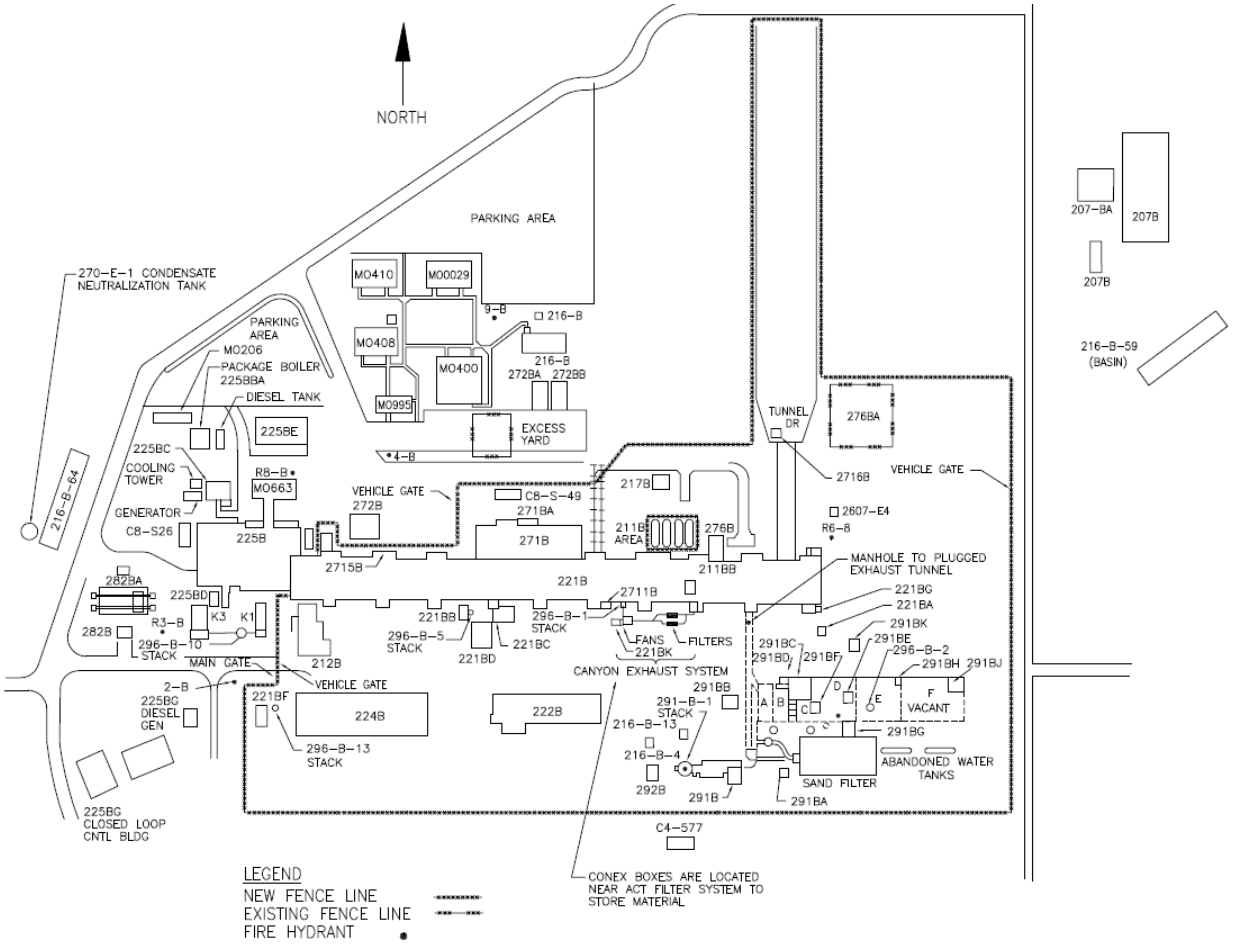

Figure 1-1. B Plant

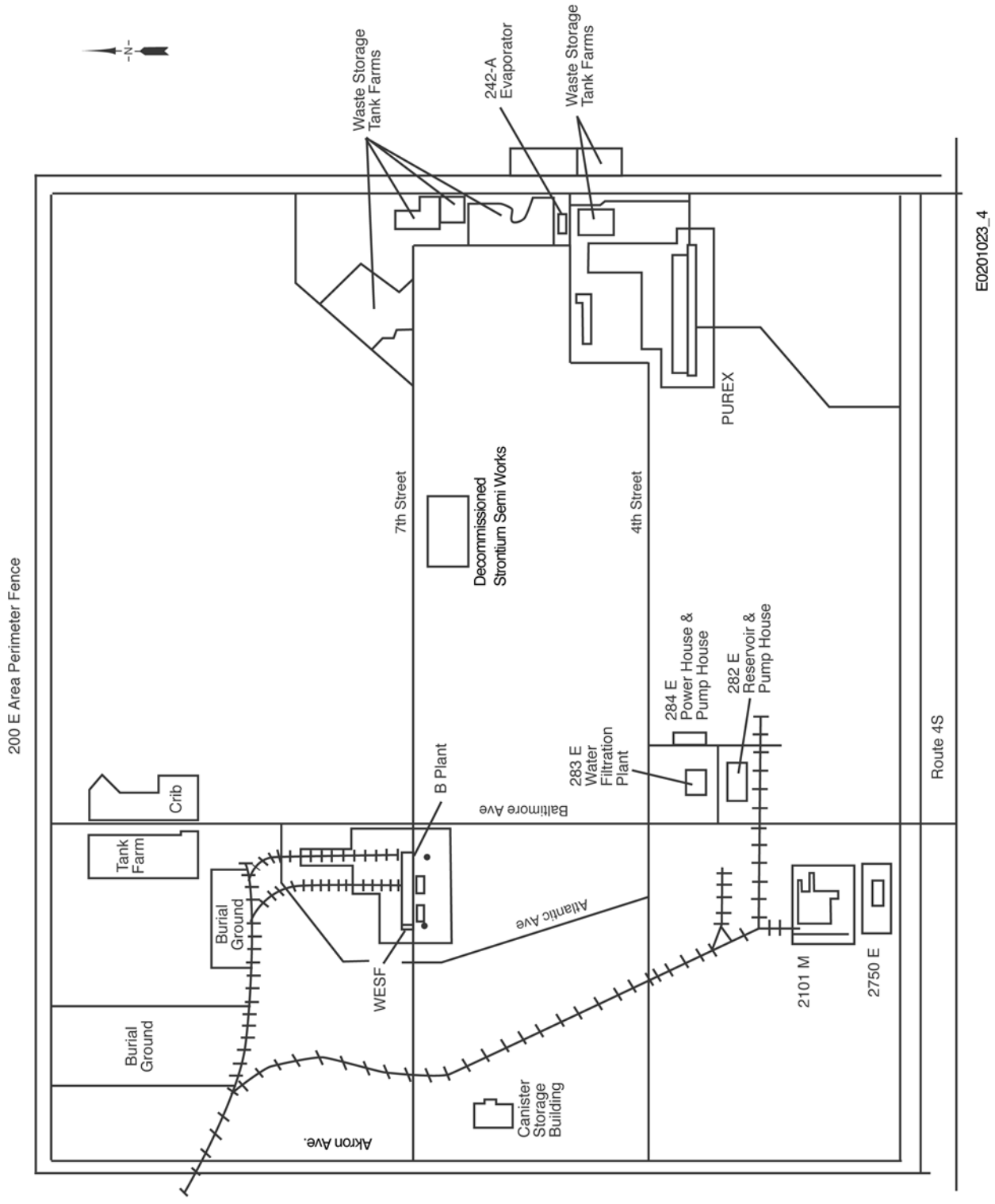

Figure 1-2. 200 East Area

Chapter 2.0

Facility Description

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2.0 Facility Description

This chapter provides a description of B Plant, with emphasis on the major features of the facility and the processes. The facility description provides the basis for the assumptions made in the hazards and accident analyses (Chapter 3.0).

2.1 Facility Operational History

The B Plant Facility was constructed in 1945 in the 200E Area of the Hanford Site. The facility was designed to chemically process spent nuclear fuel using the bismuth-phosphate process. B Plant began separations processing using actual irradiated uranium feed from Hanford's B and D Reactors on April 13, 1945. The original separations process used at B Plant produced a plutonium nitrate product that was shipped to Los Alamos, New Mexico, for fabrication into atomic weapons. In 1952, due to the greater efficiency of a new radiochemical separations process at Hanford known as reduction-oxidation (REDOX), B Plant closed as a plutonium separations facility.

In the early 1960s, the decision was made to retrofit B Plant for a large waste-partitioning mission to separate ^{90}Sr and ^{137}Cs from high-level wastes already stored in Tank Farms associated with the Plutonium-Uranium Extraction (PUREX) and REDOX Plants, as well as PUREX acid wastes and sludge. The canyon and process cells were extensively decontaminated of residual plutonium when B Plant was prepared for the cesium separations mission. Some plutonium may remain in the air tunnel, the underground ducts, and other portions of the canyon and old ventilation system; however, the only known or estimated remaining plutonium is in the old ventilation system filters. During the separations mission, individual strontium and cesium solutions were transferred to WESF for processing, encapsulation, and storage in pool cells. B Plant supported WESF by providing utility support (e.g., water, chemical supplies) and effluent discharge storage and transfer to the Hanford Tank Farms.

B Plant entered a cleanout and stabilization program in 1992, was declared an inactive surplus facility, and entered a deactivation program in 1995 prior to being declared deactivated in 1998. In 1995, DOE formally declared B Plant an excess facility. From 1995 through 1998, the primary activity in B Plant was deactivation of the structures and equipment. Deactivating B Plant involved eliminating the WESF operations' reliance on B Plant, minimizing the hazards at B Plant by removing the majority of residual process products, isolating the remaining hazards, and shutting down all B Plant processes.

2.2 Facility Life-Cycle Planned Operations

There are currently no operating processes at B Plant since it is deactivated. During the current facility life-cycle stage, planned facility activities will consist primarily of S&M and storage of incidental goods and supplies required for S&M activities of B Plant. B Plant is nonoperational, deactivated, and undergoing long-term S&M.

DOE/RL-96-105, *Richland Environmental Restoration Project Baseline, Multi-Year Work Plan*, predicts completion of D&D at B Plant by the end of fiscal year 2023. While this date could change, it is understood that B Plant is expected to remain in its current mode of S&M for an

extended period of time. No specific plans have been developed for the D&D stage to be completed at B Plant.

This section provides additional detailed information; however, the scope of work generally involves planned/routine and unplanned/non-routine S&M activities. The anticipated non-routine activities involve cleanup and/or stabilization activities for hazardous materials or contamination that are found to be unstable, replacement or upgrades of postings or barriers, container management, repairs to SSCs, spill response, characterization, and response or investigation of non-typical surveillance reports.

Process activities are not anticipated during the S&M phase. Routine surveillance activities will be performed to monitor facility conditions for potential changes that could impact the safety basis. Routine maintenance activities will be performed to maintain the operating and passive systems, including the following:

- Canyon exhaust system
- Retired filters passive vent system
- Liquid-level detection in Cell 10
- Surveillance lighting in 221-B, 271-B, and 212-B

Facility or activity-specific procedures are prepared to implement the S&M requirements and the technical safety requirements (TSRs) defined in Appendix C. Facility- or activity-specific procedures are prepared consistent with the work control processes and commitments for Integrated Environment, Safety, and Health Management System (ISMS) that are more fully described in programmatic detail in Chapter 5.0.

The Unreviewed Safety Question (USQ) Process is a programmatic control used in configuration control of the safety basis. Routine procedures are screened and evaluated as required in accordance with USQ requirements, and work packages will be screened and evaluated as required under the USQ Process. Non-typical surveillance reports, audits, and similar documents will be reviewed to determine if they meet the entry criteria for USQ screenings and evaluations in accordance with discovery requirements of the USQ Process.

B Plant is unoccupied, except for periodic S&M activities. The S&M activities (e.g., routine surveillances) will occur at or in the 221-B Canyon Building's electrical and pipe galleries; the 271-B Support Building; the canyon exhaust system; ancillary buildings, including the 212-B Cask Station and the 222-B Office Building; and in the 291-B Area, which includes the retired filters. Routine surveillances are implemented by approved procedures.

With the exception of the ACT ventilation system, all of the old operating systems in B Plant have been deactivated (e.g., shut down, de-energized of electrical power, abandoned in place). Equipment that could contain solutions has been drained or pumped empty as much as possible using the existing equipment configuration. The majority of hazardous material consists of fairly adherent radioactive films and residues in deactivated equipment and structures.

The following activities are not authorized:

- Destructive assay techniques
- Pumping of contaminated or hazardous liquids

- General deactivation such as removal of facility equipment unless it is in response to indications of degradation of equipment or spread of contamination to ensure continued safe operation

The intent of the above restrictions is to ensure that operations (1) remain within the bounds of authorized S&M activities and (2) that they do not result in potential hazards that have not been analyzed. Proper maintenance of the facility includes housekeeping. As such, the clean-up of liquids that may accumulate (e.g. rainwater intrusion resulting from a roof leak) is authorized as long as the inventory content of the liquid is less than a Hazard Category 3 quantity of material. (see Section 2.2.2).

2.2.1 Operations, Surveillance, and Maintenance of the Canyon Exhaust System

The canyon exhaust system (Figure 2-1 and Figure 2-2) is designed to operate with one exhaust fan and both ACTs in service at one time, at an average air flow of 6.4 to 8.5 m^3/sec (13,500 to 18,000 cfm). This flow should maintain the canyon air space at a negative pressure with respect to the outside atmosphere. The exhaust fans have the capacity to draw up to approximately 4,200 Pa (16.9 in water column) (0200E-US-N0025-02, *B Plant Exhaust Changes*). The high-efficiency particulate air (HEPA) filter unit for each ACT is rated at a maximum of 4.25 m^3/sec (9,000 cfm). Interlocks prevent the operation of both fans at one time and will shut the operating fans off if the filter differential pressure exceeds 2.3 kPa (9.23 in water column).

Filter change-out is determined based on the dose, as low as reasonably achievable (ALARA) considerations and other factors and is normally performed with the exhaust fan shut down. Conditions requiring change-out include exhaust filter high differential pressure, high radiation level, and age or failed filter test. Individual ACT units may be isolated by closing inlet and outlet valves when filter change-out is required. Bag-in/bag-out filter change is provided by design and operating procedures.

The operator interface unit displays local indication of the following exhaust system operating parameters:

- 221-BK room temperature
- Canyon to atmosphere differential pressure
- Stack flow rate and temperature
- Canyon temperature
- ACT filter total differential pressure
- Exhaust fan bearing temperature and bearing vibration
- Cell 10, TK-10-1 liquid-level status

Instrument panel IP-200, located near the ACT units, provides indication of individual filter bank differential pressures. If the canyon exhaust system fails, the operations organization will receive a signal by telephone or pager. The operating contractor will investigate the situation and regain operation of the system.

The canyon exhaust system is not relied upon for keeping any accident consequence below any risk evaluation guidelines.

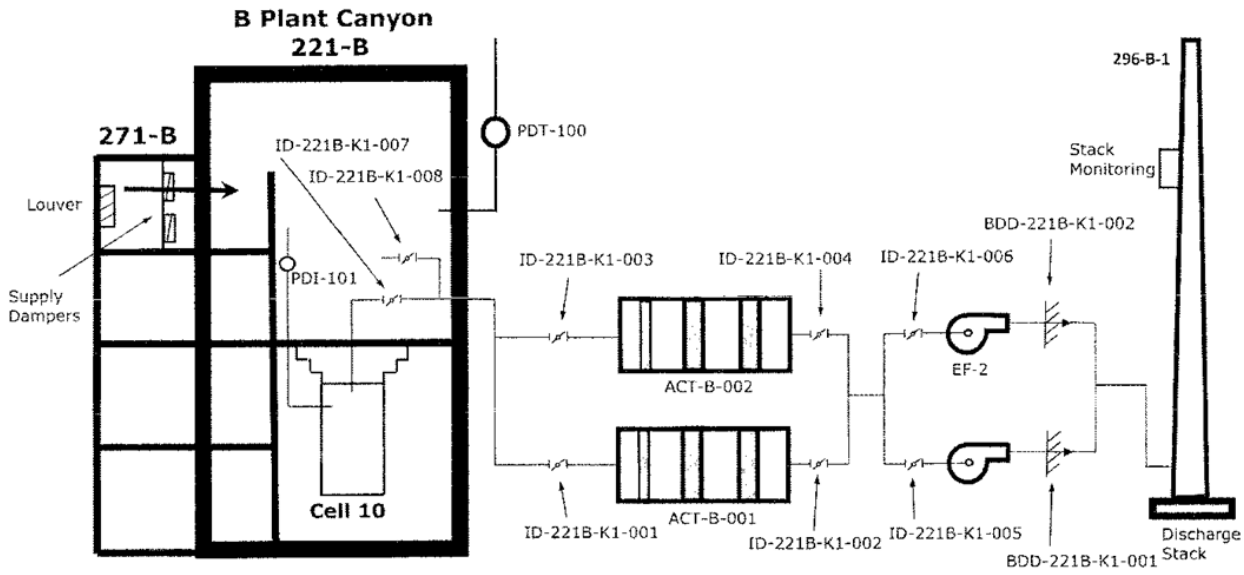

Figure 2-1. Canyon Exhaust System

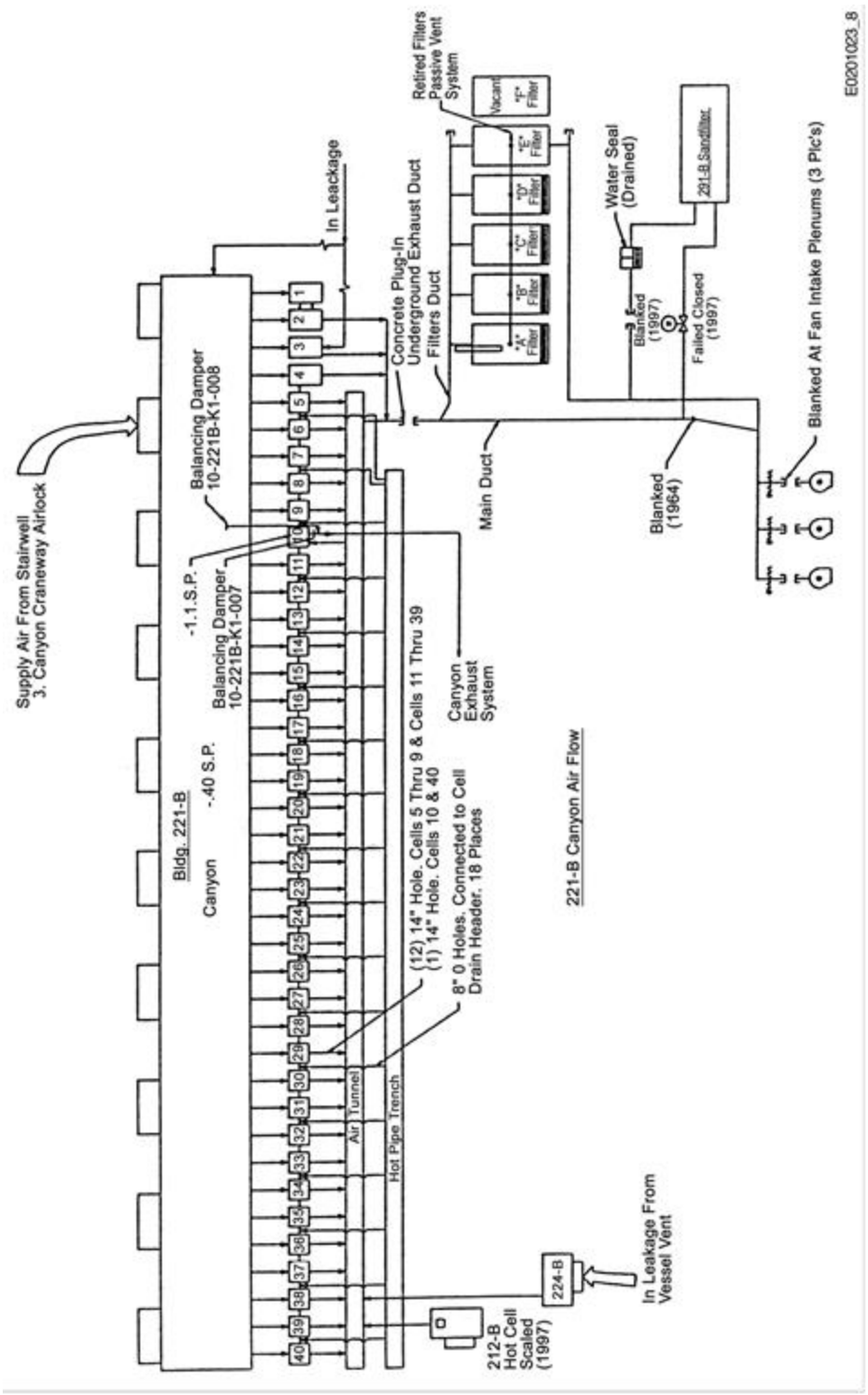

Figure 2-2. B Plant Airflow Diagram

2.2.2 Surveillance and Maintenance of the Cell 10 Liquid-Level Monitoring System

Tank TK-10-1 (located in Cell 10) served as a collection tank for liquids that leaked into the cells and air tunnel during past missions. The tank will be used to collect any liquids that may exist in the cells and air tunnel during the S&M phase. Drains from all the cells are connected to a common drain header that is routed to Cell 10. Tank TK-10-1 is the lowest tank in the canyon building. TK-10-1 has a 38-kL (10,000 gal) capacity. The liquid-level monitoring system monitors the liquid level in TK-10-1. A concrete plug provides a small access port into the Cell 10 cover block. The port is provided to allow for future installation of a submersible sump pump in the event liquids accumulate and need to be pumped out of TK-10-1.

Four resistance-type probes are found in the tank to provide alarm contacts corresponding to liquid levels of 0.5 m (20 in.), 1.0 m (40 in.), 1.5 m (60 in.), and 2.0 m (80 in.). The tank is a completely open, rectangular stainless-steel lined vault, 5.5 m (18 ft) long, 3.4 m (11 ft) wide, and 2.1 m (7 ft) high in the bottom of Cell 10. The alarm contacts correspond to 25 percent, 50 percent, 75 percent, and 100 percent tank volumes. The S&M plan requires that the TK-10-1 liquid level be monitored. The liquid level in TK-10-1 is continually monitored by instrumentation in the 221-BK Building.

The tank was emptied to minimum heel. It is anticipated that there may be small discharges to TK-10-1 from pipes due to residual liquids left in pipes. There may be discharges to the tank if water leaks into the canyon from rain or snowmelt. Infiltration from extreme snowmelt was observed in 1998 to significantly impact the tank's liquid levels; however, the roof installed in 2002 is designed to reduce or preclude this infiltration path. No detectable liquid accumulation in TK-10-1 has occurred since the facility was deactivated in September 1998.

As a condition of approval for this DSA, the pumping of contaminated or hazardous liquids is not authorized. If it is determined that the liquid needs to be pumped from the tank, a specific plan will be developed to analyze the potential hazards and to identify the requirements applicable to sampling. Sampling will be performed and pumping of the tank will be authorized if it is determined that the inventory content of the tank is less than a Hazard Category 3 quantity of material.

In the event that inventory of the tank is greater than or equal to Hazard Category 3, controls and procedures for removal of the liquid will be written, including method for appropriate disposal of the contaminated materials and liquids and a hazard evaluation of the planned activity. An authorization request will be submitted to DOE Richland Operations Office (RL) to perform the activity in accordance with the appropriate safety and environmental programs.

2.2.3 Surveillance and Maintenance of Barriers and Postings

Barriers and postings are used to prevent unwarranted access to hazardous areas and to inform personnel of conditions that exist at B Plant. Examples include locks and tags, door locks, fencing, confined space postings, and radiological area postings. Inspection of barriers and postings are conducted as part of the S&M activities. Discrepant conditions regarding barriers or postings are identified on associated data/inspection sheets. Maintenance activities will address discrepant conditions, as applicable.

2.2.4 Surveillance and Maintenance of Confinement Systems

The B Plant confinement systems are defined in Section 2.4.1.4. The S&M of confinement systems is performed to ensure that hazardous materials remain confined within the systems. Confinement, as used in this document, means that a barrier prevents uncontrolled release of contamination to the environment or to facility workers. Upgrades or modifications to these SSCs may be performed if the changes are necessary to provide equivalent or improved confinement. Changes will be evaluated using the USQ Process on a case-by-case basis to ensure that the changes are implemented with appropriate authorization prior to implementation.

2.2.5 Surveillance and Maintenance of Structures

The integrity of structures will be monitored in order to identify and correct anomalies. Maintaining confinement is of the utmost concern, but there are other reasons to maintain the integrity for all B Plant structures. Maintaining confinement for radioactive materials inherently enhances maintaining confinement of other remaining hazardous materials (e.g., lead, asbestos). In addition, S&M of the SSCs is important to enhance the protection of facility workers and SSCs from hazards associated with parts of structures falling or being windblown.

During the S&M phase, facility workers will perform surveillances of the SSCs. The workers will look for the following:

- Changing conditions with respect to known remaining hazardous materials
- Accumulation of water or other solutions
- Indications of leaking roofs, pipes, vessels, or other SSCs
- Indications of degradation of the SSCs

If anomalies are identified from surveillances, the condition will be assessed to determine the appropriate level of corrective action to be implemented to correct and/or prevent increase in SSC integrity degradation and risk of maintaining the facility, as authorized by the DSA. Proposed changes will be evaluated individually to determine if these are within the bounds of the safety analysis as required by the work control and USQ programs.

2.2.6 Container Management

Normally, relatively small volumes of waste are accumulated during S&M activities. Risk reduction actions or other non-routine activities provide the need for conservative contingency plans. Designated areas may be used to accumulate waste before shipping. The addition of fissile or radiological material from other facilities to the current B Plant Facility inventory is not authorized. This does not apply to instrument check sources and calibration check sources. Waste staged for transport is placed in waste containers that comply with applicable shipping and disposal requirements.

Surveillance activities include inspecting existing containers, sampling, identifying, and labeling unlabeled containers. Containers are removed and transported to a permitted storage facility for treatment, storage, and/or disposal. Periodic container inspections are performed to identify container deterioration or signs of leakage. If a deteriorating or leaking container is found, the situation is evaluated and actions are taken based on the severity of the situation, e.g., the container may be monitored, repackaged, or moved to an appropriate treatment/disposal facility.

Corrective action, when applicable, is taken to prevent recurrence. The activities are managed consistent with applicable requirements of the Hazardous Material Protection, Fire Protection, and Radiation Protection Programs.

2.2.7 Equipment Calibration, Testing, Maintenance, and Repair

Calibration and testing are conducted as appropriate on equipment such as electrical components.

Maintenance and repairs are performed as necessary to maintain equipment. Proposed changes are evaluated individually to determine if they are within the bounds of the safety analysis as required by the work control and USQ programs.

2.2.8 Inspection for and Response to Spills

Periodic surveillances of B Plant are performed. During these activities, the surveillance team looks for indications of a spill of a hazardous material. If a spill is discovered, the affected area will be isolated to prevent personnel exposure; corrective measures will be determined and the spilled material will be packaged and shipped to an appropriate disposal facility in accordance with appropriate programs and procedures.

2.2.9 Stabilization or Removal of Unstable Hazardous Materials

Process chemicals were removed and process systems were flushed in the 1998 cleanout campaign. Only residual films or small heels remain after deactivation. During surveillance, the spread of unstable hazardous material contamination (e.g., leaking pipes) is possible. Upon discovery of the material and its condition, a decision will be made whether to stabilize or remove the material based on cost, benefit, and magnitude of the hazard.

2.2.10 Identification and Removal of Unstable or Friable Asbestos

Asbestos-containing materials or presumed asbestos-containing materials are inspected before renovation or demolition activities. If damaged friable asbestos is encountered, the actions to be taken will depend upon the scope and severity of the damage. Repair, encapsulation, or removal will be managed through the hazardous material control program requirements of the Safety Management Program (SMP).

2.2.11 Hazardous Material Disposal

Any hazardous material removed from B Plant may, after proper waste designation, be disposed of at the Environmental Restoration Disposal Facility or at another approved disposal facility, as appropriate. Wastes will be packaged and shipped to an appropriate disposal facility in compliance with requirements of the Hazardous Materials Control Program.

2.2.12 Nondestructive Assay Waste Characterization and Sampling

Nondestructive assay, waste characterization, and sampling may be performed in B Plant. The activities will be performed in accordance with established programs and procedures, and will comply with the safety basis. These activities may be performed to better identify and characterize radioactive material inventory and location, determine quantity and makeup of

newly discovered material, or support planning for eventual disposition. The use of destructive assay techniques is not authorized.

Characterization, sampling, and geophysical logging activities may include the insertion, setup, sampling, and (if needed) decommissioning of boreholes (wells). The boreholes (wells) are to be located and operated such that they do not compromise the function or integrity of any facility SSC or program credited with a safety function.

2.2.13 Radiological Surveys

Radiological surveys are performed in support of S&M activities. These surveys are performed in accordance with established programs and procedures.

2.2.14 General Inspections and Tours

General inspections and tours may be performed that are separate from S&M activities. Inspections and tours will be conducted in accordance with appropriate programs and procedures.

The CP S&M Organization recognizes the potential for impacts due to adverse environmental conditions. Extreme wind, snow loads, or potential ash loads are anticipated occurrences. Should unusual or extreme conditions occur, additional inspections will be initiated to determine if corrective or protective actions are appropriate or necessary. Of particular concern are the unreinforced end walls of the 221-B Canyon Building. The potential for structural damage from seismic activity also exists.

2.2.15 Intrusive Work

There are no intrusive activities planned for B Plant with the exception of the ACT HEPA filter change out. Contingency activities could include removal of liquid waste from Cell 10 (from collection tank TK-10-1, see Section 2.2.2) and stabilization and equipment removal if a leak or contamination spread occurs.

2.2.16 Removal of Equipment

General deactivation, such as removal of facility equipment, is not authorized unless it is in response to indications of degradation of equipment or spread of contamination to ensure continued safe operation.

2.3 Facility Description

This section presents information on the major B Plant structures and systems, including the 221-B Canyon Building, 271-B Support Building, 212-B Cask Station Building, retired canyon ventilation system, new canyon exhaust system, and new roof system.

B Plant was constructed and modified in accordance with the design codes, standards, and regulations in place at the time of construction and modification. The canyon exhaust system and passive vent system on the retired filter vaults were designed and constructed in accordance with the appropriate codes and standards specified in HNF-SD-W059-FDC-002, *Functional Design Criteria, Project W-059, B Plant Canyon Ventilation Upgrade*.

The B Plant Facility's physical boundary includes the building structures as described in Table 2-1 and the yard area within the fence surrounding the facility and underground piping. Table 2-2 lists unplanned release sites and waste sites specifically outside the scope of the B Plant DSA.

> Note: The 224-B Facility's physical boundary is limited to the 224-B Building structure and any active containments or structures supporting 224-B Building entries that are within the B Plant fence. This area within the B Plant fence is covered under CP-18179, *224-B Facility Documented Safety Analysis*, not this DSA. The 224-B Building hot cell vent is connected to the B Plant canyon exhaust air tunnel and the piping associated with this vent line is within the B Plant boundary.

The table also lists inactive waste sites, external to the buildings. Management and operation of these waste sites are outside the scope of this DSA, since they are less than Hazard Category 3 nuclear facilities.

Table 2-1. B Plant Structures and Components

Building ID	Building Description/Components	Location
207-BA	B Plant cooling water sampling building	Northeast of facility, east of Baltimore Street (outside of the facility fence enclosure)
211-B	Chemical tank farm area	North of 221-B
211-BB	MCC Building for 211-B area	Between 211-B and 221-B
212-B	Cask transfer building	South of west end of 221-B
217-B	Demineralized water building	North of 221-B and 211-B area
221-B	B Plant canyon building: • Canyon and process cells • Electrical gallery • Pipe gallery • Operating gallery • SWP change room • Railroad tunnel	Inside 221-B
221-BA	15-in. cooling water monitor building	South of east end of 221-B
221-BB	Condensate building for LLW concentrator	South of 221-B
221-BC	SWP change building	South of 221-B
221-BD	Laundry storage building	South of 221-B
221-BF	BCP diversion pit building	South of west end of 221-B
221-BG	24-in. cooling water monitor building	Southeast corner of 221-B
221-BK	Canyon exhaust system instrumentation building and canyon exhaust system: • Duct • Filters • Fans	South side of 221-B
222-B	Office building	South of 221-B

Table 2-1. B Plant Structures and Components

Building ID	Building Description/Components	Location
271-B	B Plant support building: • Basement • First floor • Second floor • Third floor	North side of 221-B
271-BA	Laundry storage building	North side of 221-B
2711-B	Breathing air compressor building	South side of 221-B
2715-B	Paint and oil storage building	North side of 221-B
2716-B	Storage building - railroad cut	North of railroad tunnel door
276-B	Paint shop	North of 221-B
276-BA	ISO tank area	Northeast of 221-B
291-B	Exhaust fans control/turbine building	South of 221-B
291-BA	Exhaust air sample house	South of 221-B
291-BB	A and B filter instrument building	South of 221-B
291-BC	A and B filters	South of 221-B
291-BD	C filter and instrument building	South of 221-B
291 BE	Stack exhaust encapsulation structure	South of 221-B
291-BF	D filter	South of 221-B
291-BG	D filter instrument building	South of 221-B
291-BH	E filter instrument building	South of 221-B
291-BJ	F filter instrument building	South of 221-B
291-BK	E and F filter instrument building	South of 221-B
292-B	Stack monitoring building	South of 221-B
291-B-1	Retired canyon ventilation stack	South of 221-B
296-B-1	Canyon ventilation stack	South side of 221-B
296-B-2	Filter vault passive vent stack	Above vault E
296-B-5	Retired 221-BB stack	Adjacent to 221-BB
296-B-13	Retired 221-BF stack	Adjacent to 221-BF
296-B-21	Retired pipe gallery exhauster	North side of 221-B
296-B-22	Retired pipe gallery exhauster	North side of 221-B
296-B-23	Retired pipe gallery exhauster	North side of 221-B
296-B-24	Retired pipe gallery exhauster	North side of 221-B
296-B-25	Retired pipe gallery exhauster	North side of 221-B
296-B-26	Retired pipe gallery exhauster	North side of 221-B
296-B-27	Retired pipe gallery exhauster	North side of 221-B
C8-S49	Main B Plant substation (271-B/221-B)	North of 221-B

Table 2-1. B Plant Structures and Components

Building ID	Building Description/Components	Location
C8-S77	B Plant 291-B area substation	South of 221-B and 291-B area
A-F filters	A-F filter vaults	South of 221-B
Yard	Total area inside the fence	Fence surrounding B Plant
Waste sites internal to 221-B Canyon Building	B Plant waste sites: • 200-E-16, LLW concentrator (in canyon) • 221-B-26-1, radioactive organic waste solvent tank 1 • 221-B-27-2, tank TK-27-2 • 221-B-27-3, radioactive organic solvent TK 2 • 221-B-27-4, radioactive organic waste solvent tank 3 • 221-B-28-3, radioactive organic solvent TK 4 • 221-B-28-4, radioactive organic solvent TK 5 • 221-B-29-4, radioactive organic solvent TK 7 • 221-B-30-3, radioactive organic solvent TK 6 • 221-B NANU, 221-B nitric acid neutralization unit • 221-B SDT, 221-B Plant settle and secant tank • 221-B SHNU, 221-B sodium hydroxide elementary neutralization unit • 221-B-WS-1, B Plant storage • 221-B-WS-2, B Plant waste pile • B Plant filter, F-34-4 filter	
Waste site internal to 291-B sand filter	B Plant waste site: • 200-E-30, 291-B sand filter	
Waste site internal to 217-B	B Plant waste site: • 217-B NU, 217-B Building emergency neutralization unit	

Table 2-1. B Plant Structures and Components

Building ID	Building Description/Components	Location
Waste sites—nonradiological	B Plant waste sites: • 200-E-6, septic tank • 200-E-25, miscellaneous stream 659 • 200-E-28, 221-B steam condensate release • 200-E-55, miscellaneous stream 322 • 200-E-88, miscellaneous stream 3 • 200-E-89, miscellaneous stream 4 • 200-E-90, miscellaneous stream 5 • 200-E-91, miscellaneous stream 6 • 200-E-92, miscellaneous stream 7 • 200-E-93, miscellaneous stream 8 • 200-E-94, miscellaneous stream 9 • 200-E-95, miscellaneous stream 308 • 200-E-97, miscellaneous stream 470 • 200-E-98, miscellaneous stream 490 • 200-E-99, miscellaneous stream 570/1 (duplicate) • 200-E-100, miscellaneous stream 571/2 (duplicate) • 270-E-1, condensate collection tank • 2607-E3, septic tank • 2607-E4, septic tank	Inside and outside the B Plant fence (see WIDS for inventory information and BHI-01119 on the Hanford intranet for location information)

Notes:
BHI-01119, *Hanford Site Atlas*
BCP B Plant process condensate
LLW low-level waste
MCC Motor Control Center
SWP special work permit (protective clothing)
WIDS Waste Information Data System

Table 2-2. B Plant Structures and Components Outside Scope of DSA

Unplanned release sites outside the scope of this DSA	B Plant unplanned release sites: • UPR-200-E-1 • UPR-200-E-2 • UPR-200-E-3 • UPR-200-E-7 • UPR-200-E-32 • UPR-200-E-41 • UPR-200-E-44 • UPR-200-E-52 • UPR-200-E-64 • UPR-200-E-69 • UPR-200-E-80 • UPR-200-E-85 • UPR-200-E-90 • UPR-200-E-95 • UPR-200-E-103 • UPR-200-E-112 • UPR-200-E-140	Inside and outside the B Plant fence (see WIDS for inventory information and BHI-01119 on the Hanford intranet for location information)
Waste sites outside the scope of this DSA	B Plant waste sites: • 207-B cooling water retention basin • 216-B-4 dry well • 216-B-13 Crib • 216-B-59 Trench • 216-B-59B retention basin • 216-B-64 retention basin	Inside and outside the B Plant fence (see WIDS for inventory information and BHI-01119 on the Hanford intranet for location information)

Notes:
BHI-01119, *Hanford Site Atlas*
WIDS Waste Information Data System

2.3.1 221-B Canyon Building

The 221-B Canyon Building, shown in Figure 2-3, Figure 2-4, and Figure 2-5, is a reinforced-concrete and steel structure, 247.4 m (811.7 ft) long and 24 m (78.7 ft) high overall, with partial embedments of 7 m (23 ft) and 5 m (16.4 ft) on the south and north sides. The cross-sectional width of 20 m (66.2 ft) is constant to a height of 18 m (59.8 ft), and then increases to a maximum of 21 m (68.9 ft) at the roof top. The roof slab varies in thickness from 0.9 m (3 ft) at midspan to 1.2 m (4 ft) at the edges where it is supported by the exterior walls. A new roof for the building was recently placed over the existing roof. The new roof is a steel structure that is enclosed with metal panels, shown in Figure 2-6. The roof shape is a sloped shed, built over and enclosing the existing roof, and supported by the facility structure. The roof is designed to provide minimal maintenance and a slope that will drain run-off from the canyon structure. An analysis was prepared for the one-time roof installation activity (HNF-11699, *B Plant Roof Collapse Accident Analysis*). Although controls were required during the installation activity, no controls were

required to remain in place following completion of the activity. The building is supported on a 2 m (6.6 ft) thick concrete slab.

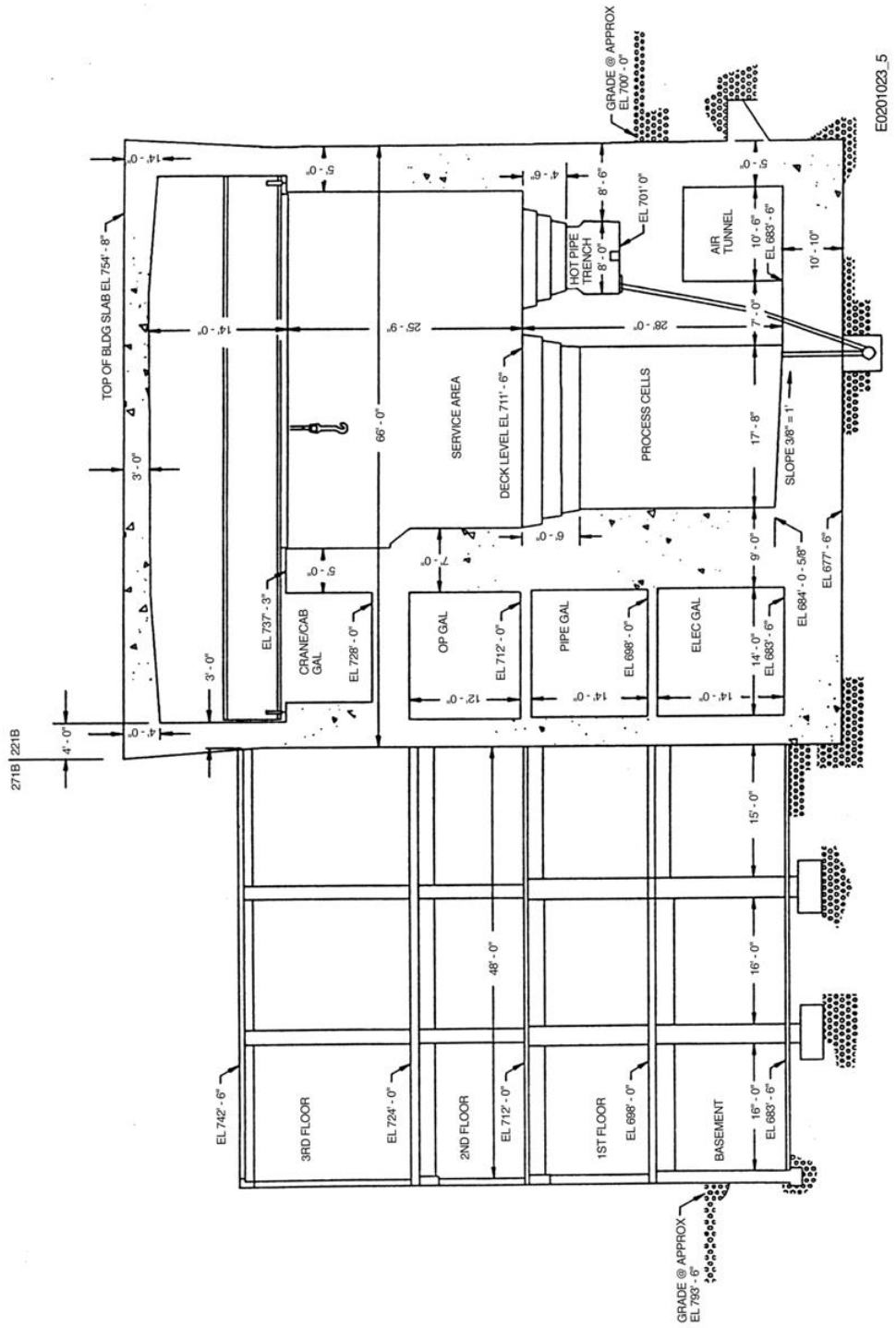

Figure 2-3. B Canyon Building and 271-B Support Building Cross-Section View

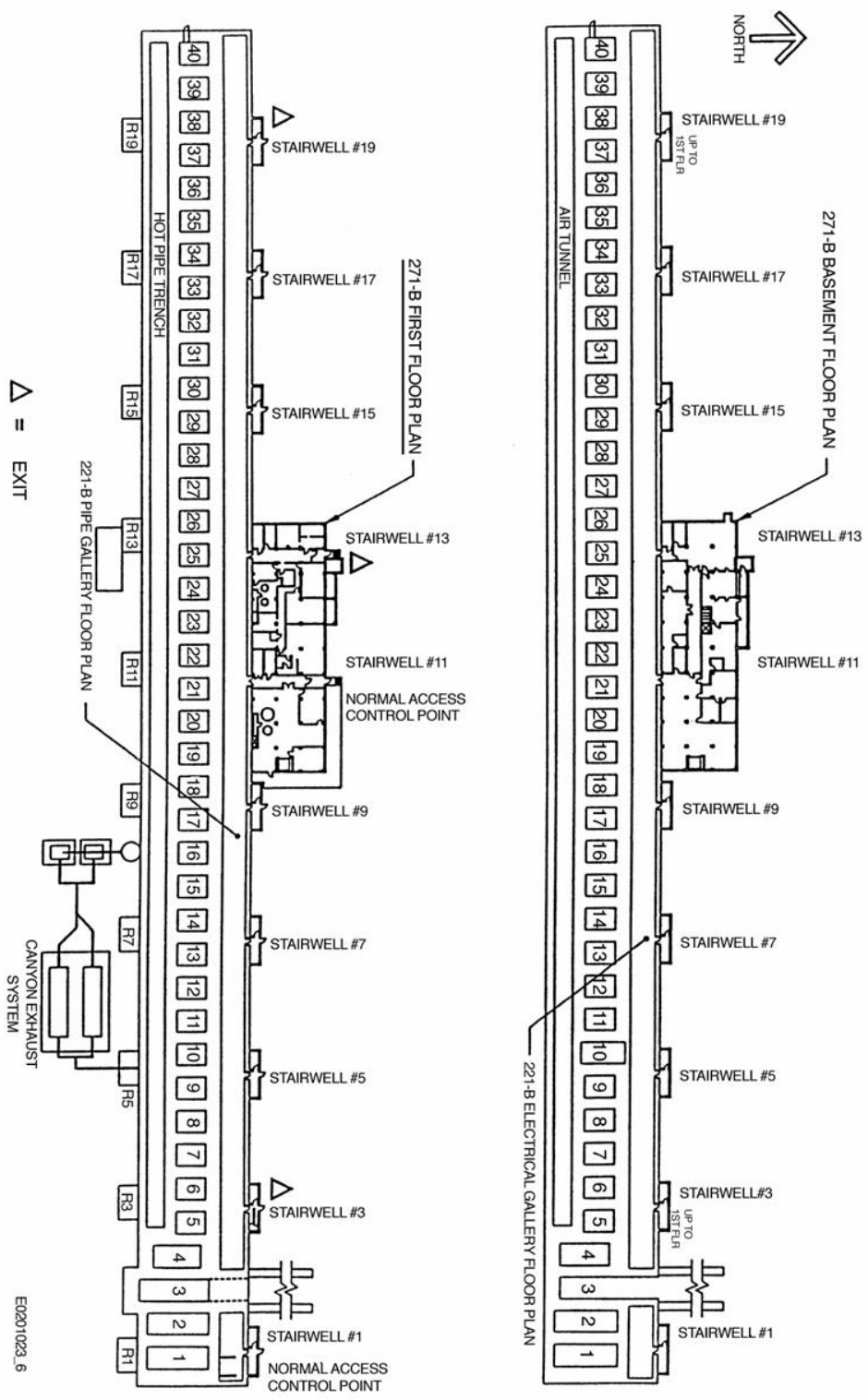

Figure 2-4. 221-B and 271-B Basement and First Floor Plans

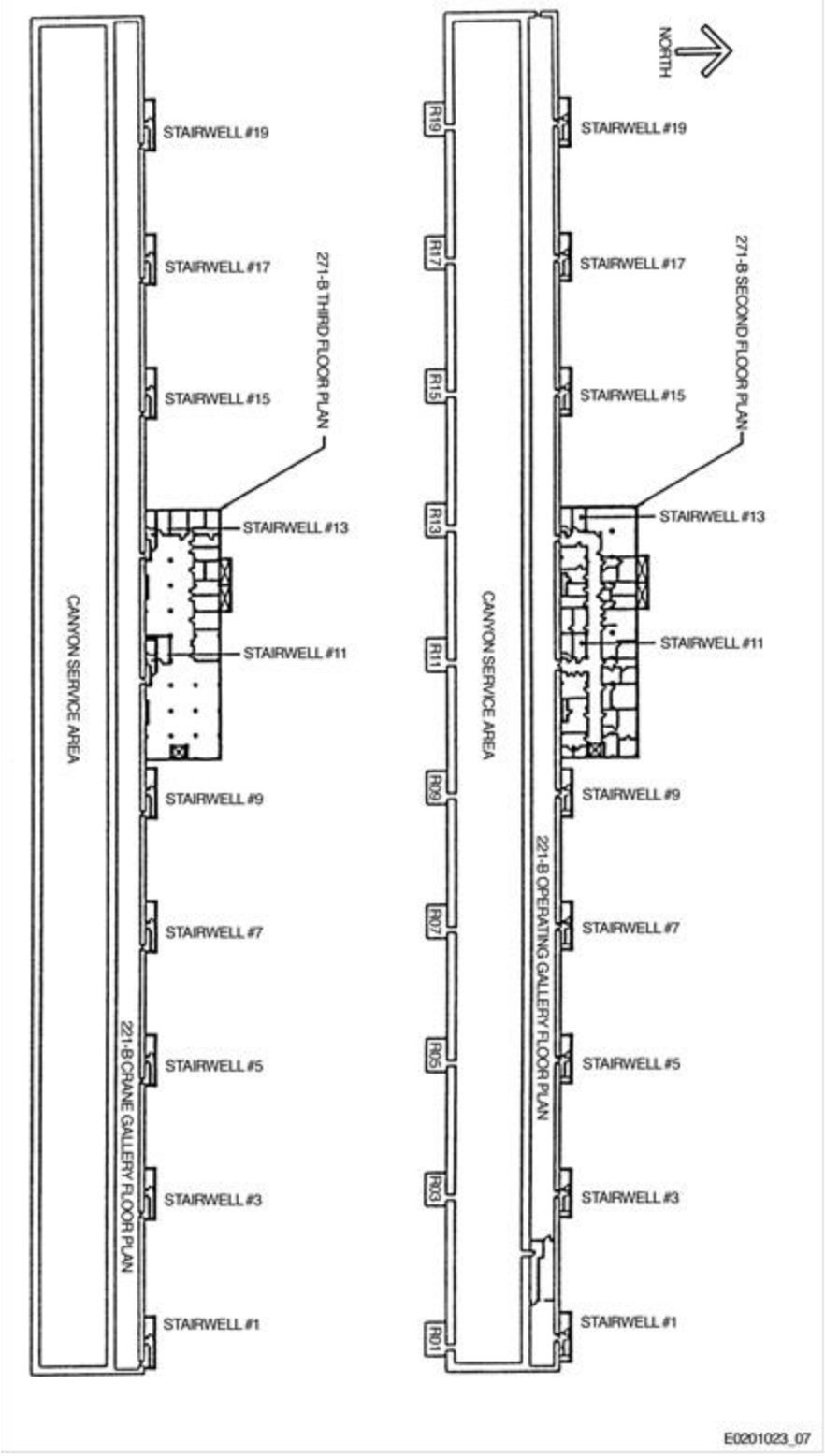

Figure 2-5. 221-B and 271-B Second and Third Floor Plans

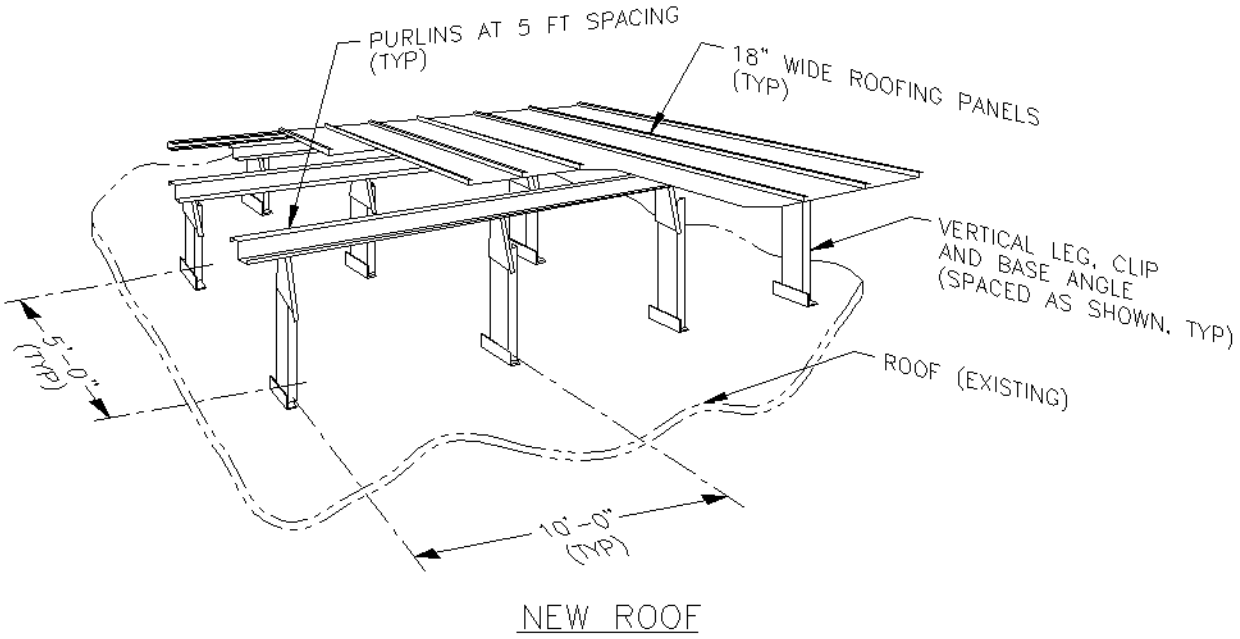

Figure 2-6. 221-B and 271-B Buildings Replacement Roof

The 221-B Canyon Building is divided into 20 sections, with transverse section joints provided at approximate 12 m (40 ft) intervals (with the exception of sections 1, 2, and 20). The transverse expansion joints for sections 1, 2, and 20 are spaced at 13 m (44 ft), 13 m (43 ft), and 14 m (44.5 ft). All expansion joints are keyed and offset to ensure necessary shielding requirements.

The canyon is composed of 40 cells, a hot pipe trench, an air tunnel, a crane cab gallery, service area, and the operating, pipe, and electrical galleries. The cells and the hot pipe trench are covered with removable concrete blocks. A 41 metric ton (45 ton) capacity overhead bridge crane spans the total internal width of the building. In 1998, a surveillance lighting system was installed in the electrical and pipe galleries and in stairwells 1, 3, 11, 13, and 19, and a liquid-level detection system was installed in TK-10-1 in Cell 10.

The third floor contained offices, the chemical makeup head tanks, space for dry and wet chemical storage, the continuous deionization unit, the canyon backup-lighting, and uninterruptible power supply system. The batteries for the power supply system have been removed. No chemicals are stored in the facility. Some of the tanks contain minimum heels.

2.3.2 212-B Cask Station Building

The 212-B Cask Station Building (shown in Figure 2-7) is a sheet metal-covered, steel-frame structure, 23 m (76 ft) long by 15 m (49.2 ft) wide. The inside height of the building varies from 7 m (22 ft) in the cask-handling and surveillance room to 11 m (36 ft) in the cell area. The 212-B cask station is sited at the southwest corner of B Plant so process and utility piping, and other supporting services in B Plant could be conveniently used.

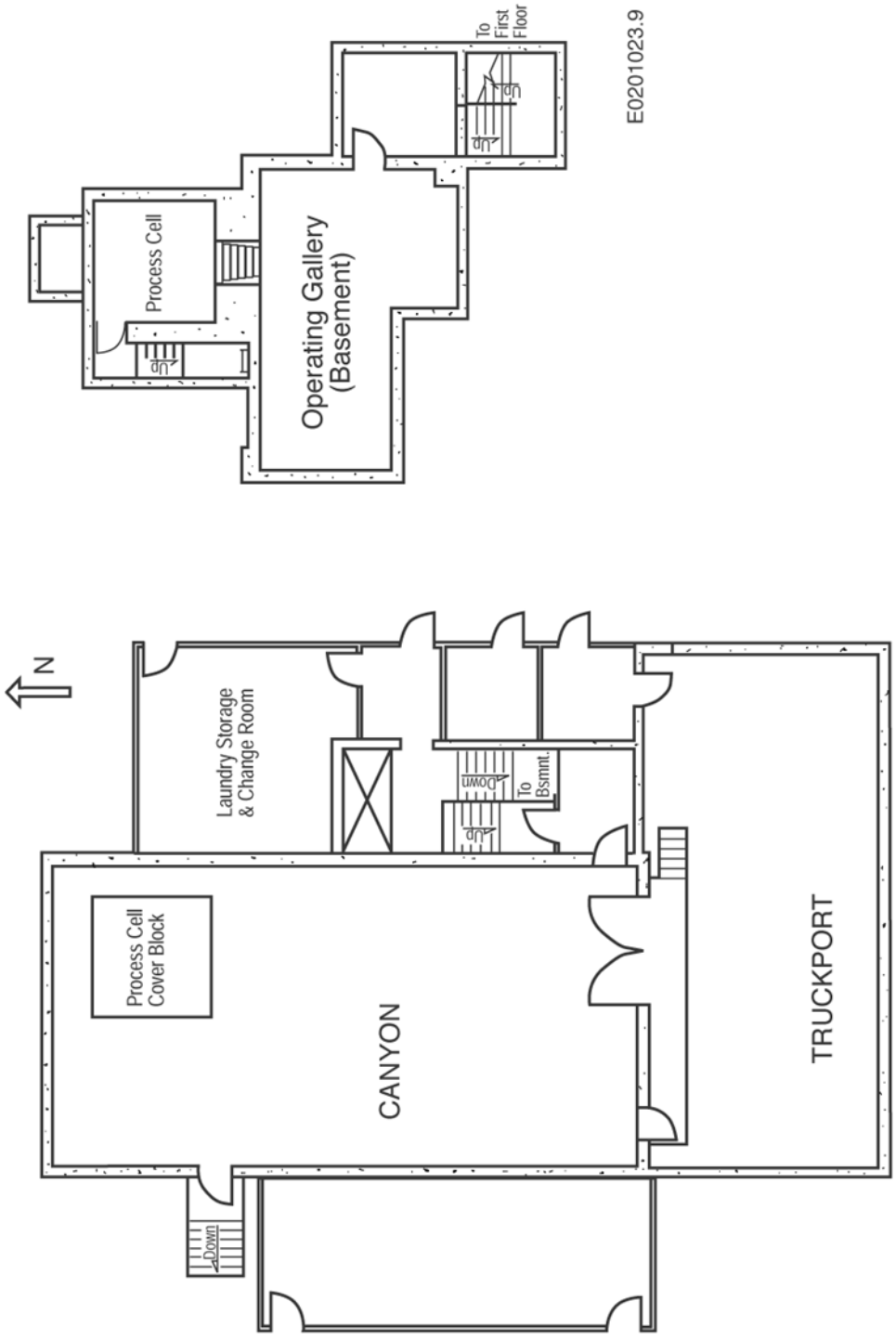

Figure 2-7. 212-B Cask Station Layout

The 212-B Cask Station facility includes a truck port, a cask-handling and surveillance room (canyon), an underground operating gallery and process cell, and laundry storage and change rooms (Figure 2-7). Two personnel access doors are located on the east side of the building. The 221-B Canyon exhaust system draws a vacuum on the 212-B process cell to maintain confinement through a duct connecting the process cell to the 221-B air tunnel (Figure 2-8). The ventilation duct from the 212-B process cell is routed underground and enters the west end of the 221-B air tunnel (Figure 2-1 shows the air flow, but not the exact duct route). Figure 2-8 shows an elevation view of the duct from 212-B to the 221-B air tunnel.

Facilities for loading and unloading fission products from the shielded transfer casks were in the 212-B cask station and Cell 35 in the 221-B Canyon Building. These fission product transfers are no longer performed at B Plant, and all systems in the 212-B Building were deactivated in 1997. The 27 metric ton (30 ton) crane in the canyon was deactivated in place. A new surveillance lighting system was installed in 1998 in portions of 212-B to support S&M activities.

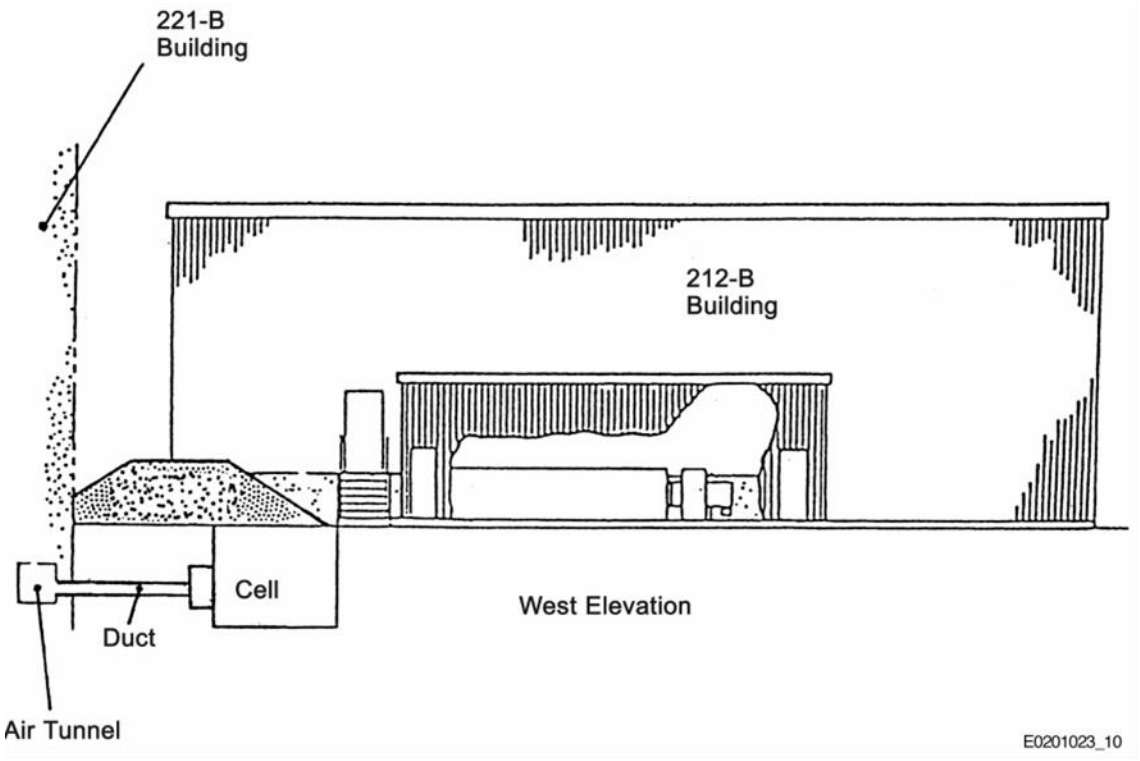

Figure 2-8. Elevation of 212-B Building

2.3.3 271-B Support Building

The 271-B Support Building (shown in Figure 2-3, Figure 2-4, and Figure 2-5) is a reinforced-concrete and cement block structure, 49 m (161 ft) long, 15 m (49.2 ft) wide, and 18 m (60 ft) high, consisting of a basement and three floors. This building is attached to the north-center gallery side of the 221-B Canyon Building. Like the 221-B Canyon Building, a new roof was installed on the 271-B Support Building (see discussion in Section 2.4.1 and Figure 2-6). The 271-B Support Building is no longer occupied, with the exception of current S&M activities. All of the systems are deactivated, de-energized, and abandoned in place, except for a new lighting system installed in 1998 to support S&M activities in portions of the 271-B Support Building. This lighting system will be energized only during S&M activities.

The basement in the 271-B Support Building contained maintenance and instrument shops, process air compressor room, filters for the building ventilation air supply, and electrical distribution panels.

The first floor provided space for offices, locker rooms, and restrooms. The former sodium bicarbonate and sodium bisulfate makeup tanks and receiving dock are located on the east end of the first floor.

The second floor contained administrative and supervisory offices, a lunchroom, and the dispatcher's facilities. Within the dispatcher's office is an abandoned operator interface unit for the facility/process monitor and control system that provided the monitoring and control interface for the operating systems.

2.3.4 Retired Canyon Ventilation System (291-B)

The retired 221-B canyon ventilation system, 291-B, provided confinement and ventilation during the operational phase of B Plant and has been isolated and deactivated. The following subsections describe which structures will still maintain confinement during the S&M phase.

2.3.5 Exhaust Ventilation Duct

The air tunnel is located under the canyon deck, below the hot pipe trench (Figure 2-3). The exhaust duct is a concrete, rectangular duct that extends underground perpendicularly about 59.3 m (194.5 ft) from the air tunnel, south from the canyon building to the 291-B Area. The 291-B Area contains underground concrete exhaust ducts, underground filters concrete vault, filter instrument buildings, sand filter concrete structure, fans, and the stack. The canyon and process cells were extensively decontaminated of residual plutonium when the facility was being prepared for the cesium separations. Negligible plutonium remains in the air tunnel, the underground ducts, and other portions of the canyon and ventilation system. However, relatively small quantities of plutonium remain in the ventilation system filters.

The exhaust duct is blocked with a concrete plug that was poured in place through a manhole access to the exhaust duct. The manhole is located about 15 m (49.2 ft) south of the canyon (Figure 1-1 and Figure 2-1).

The exhaust duct splits into an underground main duct and an underground duct routed to the underground HEPA filter vaults. The main duct, which routed exhaust air to the sand filter, was blocked with two concrete walls in 1964.

2.3.6 291-B Filter Vaults Outlet Duct

An underground concrete exhaust duct from the filter vaults merges with the main exhaust duct downstream from the two concrete walls (which block the main duct). The main duct extends to the exhaust fans. One steam turbine-driven fan and two electric energy driven fans were used. Stainless-steel ducts routed exhaust air from the underground main duct to the sand filter structure above ground and to the above ground fans. Stainless-steel plates have been installed in flanges of the above-ground stainless-steel ducts to isolate the fans and sand filter from the retired HEPA filter vaults.

Stainless-steel ducts routed the exhaust from the fans to the underground duct between the fans and the 291-B-1 stack. The fans and stack are also retired. The isolations and configuration are shown in Figure 2-2.

2.3.7 291-B High-Efficiency Particulate Air Filters and Filter Vaults

The retired 291-B HEPA filters are located in underground vaults in the 291-B Area, which is located approximately 46 to 61 m (150 to 200 ft) south of the east end of the 221-B Canyon Building. The vaults are reinforced concrete, with steel filter frames inside. The vaults are covered by approximately 1 m (3.1 ft) of soil and gravel and are bermed with soil and gravel on three sides. The east end has a vacant vault (F vault) east of and adjacent to the last in-service filter (E filter). The A, B, C, D, and E filters were equipped with multiple banks of HEPA filters, and some filters were also equipped with one or more banks of pre-filters. The filters and vaults have been isolated and abandoned in place.

2.3.8 291-B Sand Filter

The sand filter is located 52 m (171 ft) south and 19 m (62 ft) west of the east end of the 221-B Canyon Building. The filter is connected to the canyon with above-grade, 1.5 m (5 ft) wide by 1.8 m (6 ft) deep stainless-steel ducts, 5.5 m (18 ft) long. The filter is 34 m (110 ft) long, 17 m (55 ft) wide, and 6.4 m (21 ft) high, except at the west end where it is 8 m (26.5 ft) high. The filter is a reinforced-concrete structure with a floor slab that is 30 cm (12 in.) thick, at an elevation of 1.2 (4 ft) below grade.

The sand filter roof consists of 60 pre-cast concrete slabs, 18 cm (7 in.) thick, 5.1 m (16.7 ft) long, and 1.5 m (4.9 ft) wide, covered by a waterproofing membrane composed of layers of asphalt and fabric. The roof is supported by 30 cm (12 in.) thick concrete walls and by 30 cm by 46 cm (12 in. by 18 in.) pre-cast concrete beams, upheld by two rows of 31 cm by 31 cm (12.25 in. by 12.25 in.) reinforced-concrete columns, spaced 3 m (10 ft) apart. The floor has 20 cm by 30 cm by 41 cm (7.8 in. by 11.8 in. by 16 in.) hollow concrete blocks laid longitudinally and separated by 1 mm (0.04 in.) wood dowels for distributing the incoming air.

The sand filter is a deep bed of rock, gravel, and sand, constructed in layers, graded with about 2 to 1 variation in granule size from layer to layer. Air flow direction is upward, and granules decrease in size in the direction of the air flow. The collection mechanism of a sand filter is largely gravity settling and Brownian diffusion. A top layer of moderately coarse sand prevents fluidization of the finer sand.

The sand filter has been isolated and deactivated by disabling a 122 cm (48 in.) sand filter inlet duct motor-operated valve in the closed position, and by installing a pancake flange in the sand filter outlet duct directly downstream from the deactivated outlet water seal tank, which is now empty (Figure 1-1 and Figure 2-2). Utility water is isolated from the 291-B Area and all water seal vessels and pipes.

2.3.9 Steam Supply System

Steam used in B Plant was produced in the 284-E powerhouse, but B Plant no longer uses steam. The 284-E powerhouse was shut down in late 1997. The B Plant steam system and the steam turbine exhaust fan are deactivated.

2.3.10 B Plant Gallery Air Exhausters

Seven gallery exhausters were located on the north side of the 221-B Canyon Building at ground level. All of these exhausters were deactivated and the electrical power was removed by isolating the electrical power to the canyon building. A physical gap was made between the ducts and the exhauster, and the outlets to the ducts were sealed with a sealant and metal plates bolted in place. Both the inlet and outlet of the isolated exhausters were sealed in the same manner as the ducts. The exhauster's HEPA filters, which were located in the galleries, were removed and disposed of as waste. No contamination was found on any of the exhausters; thus, contamination is not expected in the ducts.

2.3.11 Plant Penetrations

All door and plant penetrations were sealed with aluminum flash tape and/or insulator foam. Roof vents to the facility were plugged with a rubber stopper and sealed with two-part epoxy to prevent vermin and water intrusion into the building. The expansion joints of the building were repaired in 1990 by injecting epoxy into the joints. The joints were examined in 1998 and no evidence of deterioration was found. No discernible deterioration has been observed during the S&M period following deactivation.

2.3.12 Effluents

Four effluent systems were associated with B Plant: sanitary water, chemical sewer, steam condensate, and process cooling water. These systems were deactivated by isolating the effluent sources from the effluent discharge pipes.

2.3.13 Sanitary Sewer

The sanitary sewer received water from sinks, toilets, and showers. The sinks and toilets were removed from all the deactivated buildings. Drains to the sinks, toilets, and showers were plugged with a rubber stopper and sealed with a two-part mixed epoxy. All pipes exiting the 221-B and 271-B basement-level outer accessible walls were also plugged and sealed from inside the buildings. The sanitary sewer is not expected to be contaminated with chemicals or radionuclides.

2.3.14 Chemical Sewer

The B Plant chemical sewer effluent line received miscellaneous liquid wastes, including nonradiological chemical makeup tank overflow, tank flushes, various floor drains, and similar sources with low probability for radiological contamination. This effluent line was shared by B Plant and WESF; however, B Plant has since been isolated from the system. All floor drains were plugged with a rubber stopper and sealed with two-part epoxy. Chemical sewer pipes that penetrate the outer walls were also plugged and sealed from inside the buildings. There is no known radiological contamination of the chemical sewer. Some residual chemical and/or radionuclide contamination may be present in the abandoned pipes.

The WESF Organization still uses and maintains a monitoring system for this effluent line, routed to the Treated Effluent Disposal Facility.

2.3.15 Steam Condensate

Steam has been isolated from B Plant. The steam condensate effluent line went from 221-B to 221-BB and/or 221-BF. Condensate that was contaminated with radionuclides was routed to 221-BF, where it was filtered. From 221-BF, condensate water was pumped to Basin 216-B-64. During deactivation, air was blown into the condensate pipe from 221-BB back into 221-B to empty the pipe as much as possible of any remaining liquids. The line was opened at the low points to drain liquids remaining in the pipe. The pipe was then capped and sealed in 221-BB. Residual radiological contamination could potentially exist in the underground pipes to 221-BB and/or 221-BF and the 216-B-64 basin. The level of contamination in these pipes and the basin has not been quantified.

2.3.16 Process Cooling Water

Raw water was used to feed the process vessels cooling coils. Two headers were used for cooling water effluents: the 38 cm (15 in.) header and the 61 cm (24 in.) header. The 38 cm (15 in.) header was used to discharge cooling water for vessels that had potential (i.e., high-risk) to be contaminated if a coil break were to occur. The high-risk effluent was monitored in the 221-BA Building. The 61 cm (24 in.) header was used as a cooling water discharge line for vessels with low potential (i.e., low risk) for radiological contaminants. The low-risk effluent was monitored in the 221-BG Building. The high-risk header intersects the low-risk header downstream of the monitoring station through a diversion control station. Uncontaminated cooling water was automatically routed to the 271-B pond. Contaminated cooling water was automatically routed to the 216-B-59 retention basin and resample. If the effluent was contaminated, it was returned to the canyon building and dispositioned from there.

To isolate the underground effluent pipes, jumpers were removed from the nozzles that routed cooling water to the cooling water headers. In addition, the cooling water was isolated from the buildings that discharged water to the cooling water systems. The effluent discharge lines to basins were plugged by pouring concrete in the valve pits. Sampling has not been performed to determine the contamination levels in the deactivated pipes and/or basins. Some residual contamination may exist in the cooling water sewers, but it is expected that the contamination levels are small. Any remaining contamination is likely to be fixed residual contamination.

2.4 Structures, Systems, and Components

2.4.1 Support Systems

Three active electrical distribution systems are in use at B Plant. Electrical power is provided for surveillance route lighting in the 221-B Canyon Building, 271-B Support Building, and the 212-B cask station; for the canyon exhaust system; and TK-10-1 liquid-level detection instrumentation. Utility water is provided to the fire hydrants as described in Section 2.4.1.1. All other utility distribution systems (i.e., water, steam, electricity, and compressed air) have been deactivated and isolated outside all of the buildings and in the 291-B Area.

2.4.1.1 Fire Detection and Suppression System

The fire protection systems of B Plant have been isolated, drained, and deactivated, except for the following fire hydrants, which are located outside of the 221-B Canyon Building:

- Raw water hydrant R6-B, located at the northeast corner of 221-B
- Raw water hydrant R3-B, located at the west-southwest corner of 221-B
- Raw water hydrant R8-B, located at the northwest corner of 221-B
- Sanitary water hydrant 2-B, located southwest of 221-B and northwest of 221-BF
- Sanitary water hydrant 4-B, located north of 221-B and south of the office trailers

The deactivated fire protection systems encompassed fire prevention, detection, annunciation, control, confinement, suppression, and extinguishment. The hazard and accident analyses (Chapter 3.0) do not rely upon the fire detection/suppression systems to prevent or mitigate postulated accident consequences.

CP-41843, *B-Plant Fire Hazard Analysis*, confirmed that there are no significant fire hazards for the deactivated facility during the S&M phase.

2.4.1.2 Electrical Power

All of the electrical power (normal and backup) that served B Plant SSCs prior to deactivation was physically isolated from the SSCs during the deactivation mission by removal of the service conductors from the electrical utility power lines. New electrical power services and lighting systems were installed to enhance the longevity of operable electrical systems during the S&M phase, minimize maintenance on the old systems, and minimize the probability of hazards associated with the old electrical systems (e.g., electrical short circuits and fires). Electrical power is provided for surveillance route lighting in the 221-B Canyon Building, 271-B Support Building, and the 212-B Cask Station Building; for the canyon exhaust system; and TK-10-1 liquid-level detection instrumentation.

2.4.1.2.1 Electrical Utility Power to 200 East Area

The Bonneville Power Administration, through substations at Vernita and White Bluffs, supplies electrical utility power to the Hanford Site loop at 251-W substation A8 by 230-kV overhead lines equipped with static wire protection. Two independent sources are available in the loop to allow multiple component failure without irredeemable power loss. From the 251-W substation A8, with two 230-/13.8-kV transformers, power lines are routed to 200E Area facilities through independent overhead lines C8-L5 through C8-L8.

2.4.1.2.2 Main Distribution Feeders to B Plant

Electric utility power from 251-W Substation A-8 is transmitted by two independent, 13.8 kV overhead lines (C8-L6 and C8-L7) to B Plant. On the north side of B Plant, lines C8-L6 and C8-L7 supplied power to B Plant substation C8-S49. The two lines have been removed from C8-S49 to deactivate electrical power to B Plant. A transformer has been installed on the pole of C8-L7 to provide power to B Plant's north side for the surveillance route lighting system inside the 271-B Support Building and the 221-B Canyon Building (Figure 2-9). Line C8-L6 now provides power to the south side of B Plant for the new canyon exhaust system, the 291-B filter vaults, and the Cell 10 liquid-level detection system in tank TK-10-1 (Figure 2-10). Line C8-L7 provides power for surveillance lighting in the 212-B Building (Figure 2-11) (0200E-US-N0048-02, *B Plant SAR Clarification*).

2.4.1.2.3 Reliability of Main Distributor Feeders

The potential for B Plant electrical systems to experience multiple failures which result in a complete loss of power is considered improbable. Electrical utility personnel can be called upon if switching loads or other work is required. No requirement exists for backup electrical power at B Plant because no accident scenarios rely on electrical power to support mitigation or prevention of accident consequences. Loss of electrical power will result in the loss of power to the surveillance lighting systems in the 271-B, 221-B and 212-B Buildings, the canyon exhaust system, and the liquid-level monitoring systems in TK-10-1. A hydrogen explosion in the canyon building or retired filters is not a credible scenario, and loss of electrical power does not present a risk of a hydrogen hazard. Based on the discussion of Section 2.2.1, backup electrical power is not required to maintain confinement.

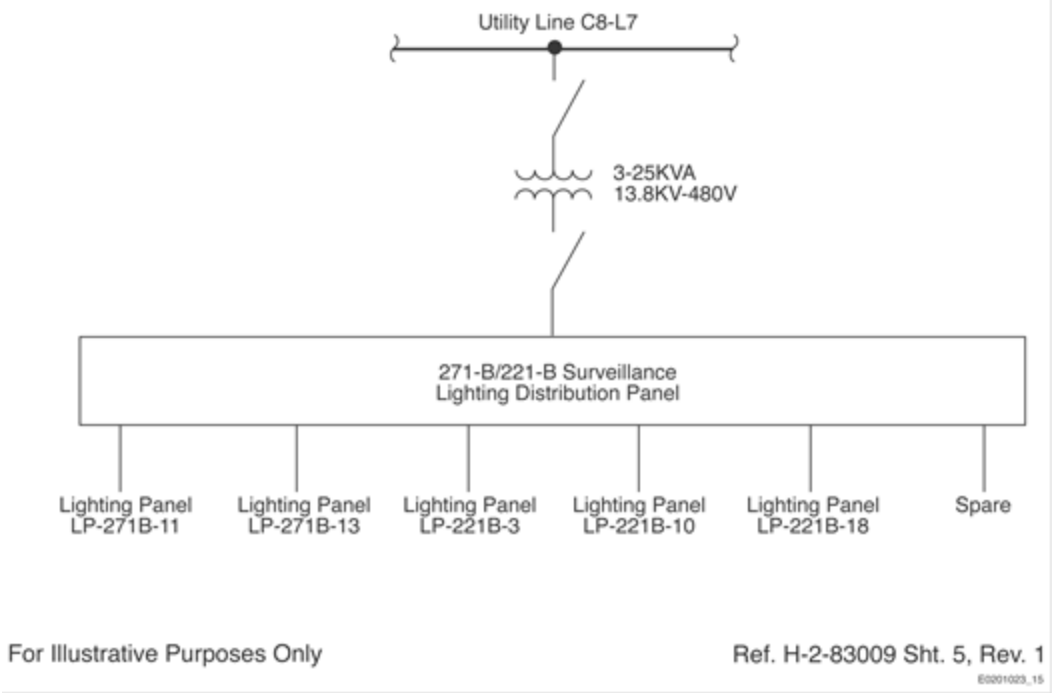

Figure 2-9. 271-B/221-B Surveillance Lighting One-Line Diagram

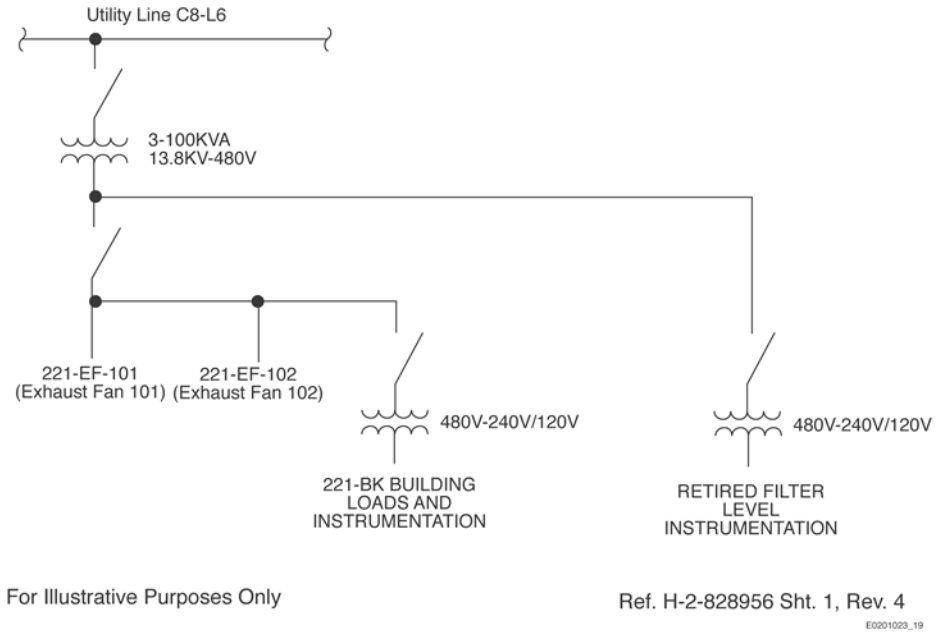

Figure 2-10. 221-BK Electrical One-Line Diagram

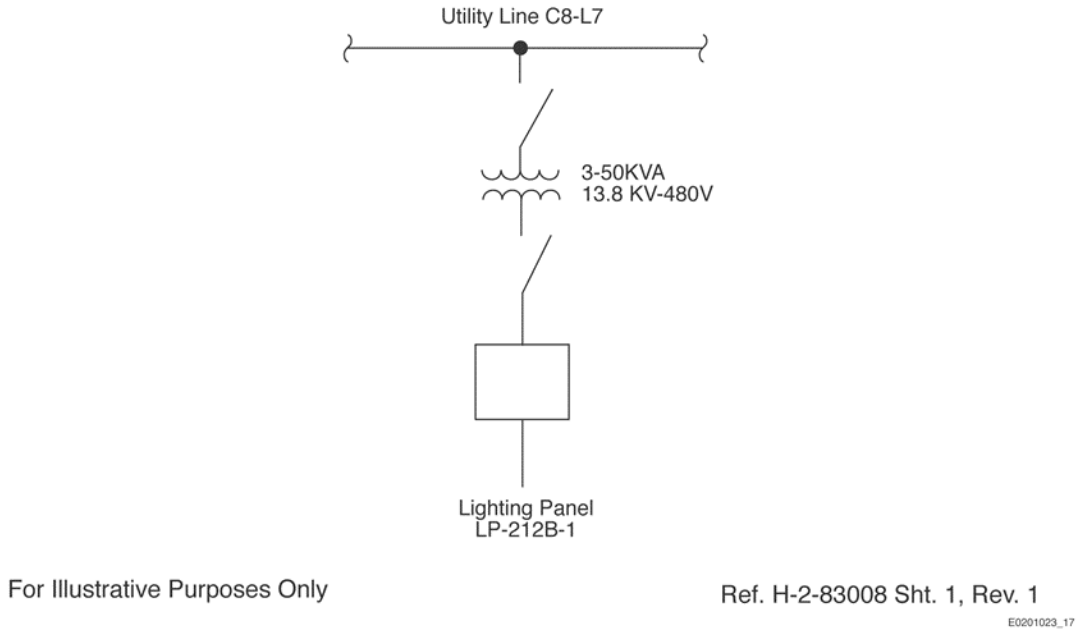

Figure 2-11. 212-B Surveillance Lighting One-Line Diagram

2.4.1.3 Water Supply System

The Columbia River is used to provide the water to the Hanford Site. Water is pumped from the river at the 100B Area to a reservoir at the 100B Area, then through underground export water piping to the 200 Areas (0200E-US-N0048-02). Two alternate pumping sources (at B and D Reactors) feed the export water pipelines and provide a redundant system as long as the export water pipeline remains intact.

2.4.1.3.1 Sanitary Water System

Sanitary water was used in B Plant for safety showers, operating area washdown, drinking, toilet facilities, making deionized water for process use, and as an emergency backup for firefighting. The sanitary water utility has been physically isolated from B Plant by installing blank flanges in the utility water lines external to the B Plant buildings and outside of the 291-B Area. The 291-B Area encompasses the retired ventilation filters, fans, underground duct, and stack.

The isolations were performed underground by removing a piece of pipe and installing blind flanges on both sides as near as possible to the system main header. No radiological or chemical contamination is expected to reside in the deactivated portions of these pipes.

The water sources closest to the 291-B Area are the underground sanitary and raw water utility pipes, located about 43 m (141 ft) south of the 291-B Area. The utility pipes extend from east to west. All water vessels and pipes inside and near the 291-B area have been drained and isolated from the vaults and the utility water header.

The following hydrants supply sanitary water:

- Sanitary water hydrant 2-B, located southwest of 221-B and northwest of 221-BF

- Sanitary water hydrant 4-B, located north of 221-B and south of the office trailers

2.4.1.3.2 Raw Water System

Raw water was used at B Plant as a heat transfer fluid in cooling coils for process and storage tanks; condensers for the concentrator, air compressors, and diesel engines; sprays; filter seals; and fire protection. Utility raw water has been isolated from the 221-B Canyon Building, the 212-B Cask Station Building, 222-B Office Building, the 271-B Support Building, and the 291-B Area by installing blank flanges in the utility water lines external to the B Plant buildings and outside of the 291-B Area.

The isolations were performed underground by removing a piece of pipe and installing blind flanges on both sides as near as possible to the system's main header. No radiological or chemical contamination is expected to reside in the deactivated portions of these pipes.

The water sources closest to the 291-B area are the underground sanitary and raw water utility pipes, located about 43 m (141 ft) south of the 291-B area. The utility pipes extend from east to west. All water vessels and pipes inside and near the 291-B area have been drained and isolated from the vaults and the utility water header.

The following fire hydrants, which are located outside of the 221-B Canyon Building, supply raw water:

- Raw water hydrant R6-B, located at the northeast corner of 221-B
- Raw water hydrant R3-B, located at the west-southwest corner of 221-B
- Raw water hydrant R8-B, located at the northwest corner of 221-B

2.4.1.3.3 Deionized Water

Deionized water was provided from B Plant for the WESF pool cell makeup water and at both B Plant and WESF for dry chemical makeup, tank flushes, and general miscellaneous use. Deionized water was produced by a continuous deionizer unit located on the third floor of the 271-B Support Building. The deionized water system was isolated, deactivated, and abandoned in place. Resins were removed and the tanks are now empty.

2.4.1.4 Confinement Systems

This section discusses the three confinement systems at B Plant: the canyon building (which has a canyon exhaust system), the retired filter vaults (which have a passive vent system), and the 212-B Building (which has a sealed process cell).

2.4.1.4.1 Canyon Exhaust System.

The canyon exhaust system is shown in Figure 2-1. A plan view is shown in Figure 1-1 and Figure 2-12. The new canyon exhaust system consists of ducts, two parallel ACTs (each consisting of a bank of maintainable pre-filters and two banks of maintainable HEPA filters), two parallel exhaust fans, exhaust stack 296-B-1, and control and monitoring equipment.

A new cover block was constructed for Cell 10 to provide three penetrations into the cell. A 76 cm (30 in.) penetration is provided for a duct to route an exhaust air stream from Cell 10 to the ACT inlets, and another penetration is provided for access to the tank to allow pumping liquids out of TK-10-1, if necessary. This penetration is blocked with a removable concrete

plug. The third penetration is provided for the TK-10-1 liquid-level monitoring system cable. The new cover block, which replaced the two south cover blocks, is now the key cover block. As the key cover block, it would have to be removed first to gain access to the cell. Access into the cell is not anticipated during the S&M phase.

A 76 cm (30 in.) carbon-steel pipe is used for the duct from the cover block penetration to the ACT inlets. Another inlet to the steel pipe exists above the pipe trench cover block near Cell 10 to provide an air stream to be drawn from the canyon service area. The service area is the large airspace above the cells and pipe trench cover blocks. There are two inlets for air from the canyon to the ACTs, and each inlet's air flow is controlled by a manually adjusted volume damper. The dampers are located above the cover blocks (often referred to as the canyon deck).

The two dampers were manually set to a fixed position during system startup testing and air balance to maintain the cells at a negative pressure relative to the canyon. Approximately 40 percent of the air flow is from the canyon service area air space through the duct inlet on the canyon deck. The remaining air flow is from Cell 10 through the duct inlet penetration in the Cell 10 cover block. Because the cells are at a negative pressure relative to the canyon service area, air is drawn from the service area into the cells through gaps between the cells' cover blocks.

Air is then drawn from the cells through the cells' common drain header and the air tunnel, to Cell 10, and then to the ACTs. The steel duct extends through a hole drilled through the 1.5 m (5 ft) thick concrete outer wall of stairwell R5. This hole does not weaken the canyon structure because the outer stairwell wall is not a main canyon structural component. The low-flow range of the inlet vane dampers is limited to approximately 13,500 cfm to minimize vibration and turbulence (0200E-US-N0025-02).

The two parallel ACTs are arranged adjacent to, and parallel with, the canyon wall between stairwells R5 and R7 (Figure 1-1 and Figure 2-12). The exhaust fans are located downstream (west) of the ACTs and discharge into exhaust stack 296-B-1. Each exhaust fan is a 45 kW (60 hp), belt-driven centrifugal fan with manual inlet vane dampers to control normal fan flow. Backdraft dampers on each fan preclude backflow through the standby fan, and isolation valves are provided for maintenance.

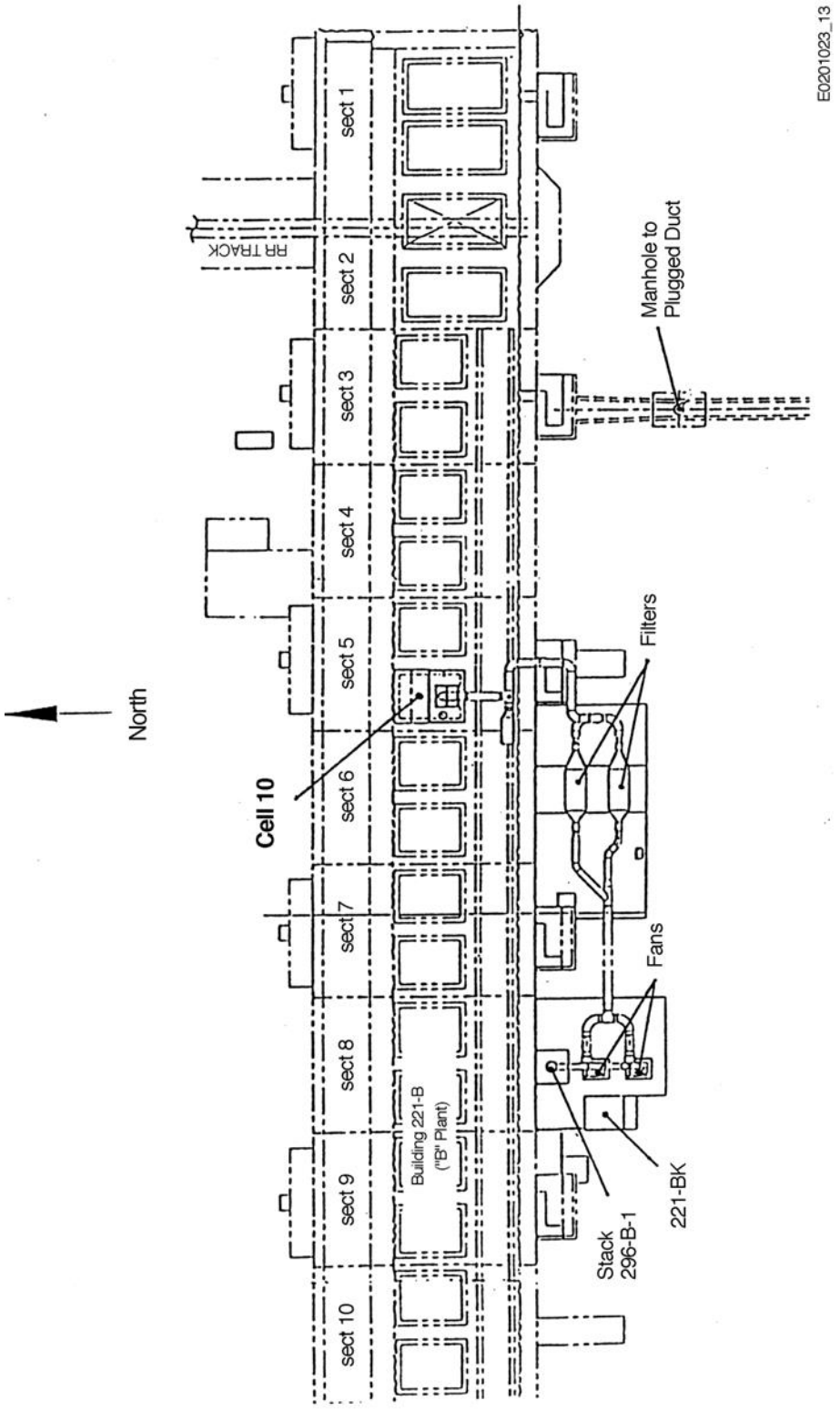

Figure 2-12. Canyon Exhaust System Plan View

Exhaust stack 296-B-1 is constructed of 81 cm (32 in.) painted carbon-steel pipe. The stack is 29 m (95 ft) high and is immediately adjacent and anchored to the 221-B Canyon Building. A stack emissions sampling system has been installed to collect particulate samples from the exhaust air stream.

All canyon exhaust system equipment is located immediately outside a 57.3 m (188 ft) radius from the retired 291-B-1 ventilation exhaust stack, which was isolated and abandoned in place. The 291-B-1 stack is approximately 57.3 m (188 ft) high.

Air enters the canyon by infiltration and through a designed plenum at Cell 3 on the north side of the canyon. This plenum directs outside air through the Cell 3 stairwell (upper floor) and the airlock to the canyon craneway. The points of potential infiltration are associated with the canyon structure, the railroad tunnel, and the hot cells in the 212-B and 224-B Buildings because the cells are connected to the canyon exhaust air tunnel. There is limited potential of infiltration from the galleries and canyon access stairwells. Previously, air entered the canyon from the canyon air supply system; however, the canyon air supply system has been deactivated. There is not a forced-air supply system. The supply dampers are static pressure-controlled backdraft dampers that will close when no vacuum is drawn on the canyon airspace.

Control valves and a branch duct with an inlet plenum allow flow control and a balance of the mix of air from Cell 10 and the canyon air space above the cells cover blocks. Air enters the cells from the canyon through gaps between the cell cover blocks, except the Cell 10 cover block gaps are sealed to prevent short-circuiting air flow between the cell and the canyon air space above the cells.

Air is drawn from Cell 10 and the canyon air space through the ACTs and is exhausted out the stack. Air entering each of the ACTs passes through one pre-filter stage and two HEPA filter stages. New HEPA filters are designed and tested for 99.97 percent efficiency for the removal of particulate with a median diameter of 0.3 μm. The prefilter associated with each HEPA assembly is listed with a 30 percent nominal particulate efficiency. The prefilters are designed to catch larger particles and, thus, prolong the life of the HEPA filters. Each stage is a three-filter-wide by three-filter-high arrangement. Differential pressure gauges provide a signal that is used to monitor the condition of and the loading on each filter.

The exhaust system design reduces the probability of failure of the HEPA filters. The fans cannot produce sufficient differential pressure across the filters to breach them by separation of the filter materials or seals, even if they are plugged with particulate. The fans can produce a maximum static differential pressure of 4 kPa (16 in water column). The exhaust fans cannot draw a vacuum large enough to fail the canyon structure. An interlock will shut down the fans if the HEPA filter differential pressure exceeds 2.3 kPa (9.23 in water column).

2.4.1.4.2 291-B Filter Vaults Passive Vent and Liquid-Level Monitoring System

During deactivation of B Plant, a passive vent system and liquid-level detection were installed in the retired filter vault. This was a precautionary measure to preclude explosive hydrogen concentrations if, however unlikely, the contaminated filters were to become flooded. Detailed analysis after deactivation determined that an explosive hydrogen hazard was not applicable. Both the hydrogen mitigation system and the filter liquid level detection system have been deactivated.

2.4.1.4.3 212-B Process Cell

The structure of the 212-B process cell provides confinement for the radioactive materials contained within the cell (see Table 3-1). The process cell is maintained at a vacuum relative to atmospheric pressure through a connection to the 221-B Canyon Building air tunnel and the canyon exhaust system (see Figure 2-1 and Figure 2-8).

2.4.1.5 Compressed Air Systems

The B Plant process and instrument air compressors are isolated and deactivated. The compressed air intertie between B Plant and WESF is isolated and blanked in WESF. There is no requirement or use for compressed air at B Plant.

2.4.1.6 Radiological Control Systems

The ACT exhaust system minimizes potential releases to the environment and reduces the chances of contamination spread from the canyon to the gallery areas. The canyon exhaust system discharge out stack 296-B-1 is monitored and sampled, as described in Section 2.4.1.4.1.

The buildings' structures (including the roofs) also provide radiological control.

Chapter 3.0

Hazard and Accident Analysis

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3.0 Hazard and Accident Analysis

This chapter presents the results of the hazards analysis (HA) and the accident analysis performed for the B Plant Facility.

The HA was performed to evaluate the current S&M activities, as well as potential deactivation activities as discussed in Chapter 2.0. The purpose of the HA was to systematically identify and evaluate the hazards associated with the current activities and anticipated preparatory activities for final demolition of the B Plant Facility. The HA is intended to meet the guidance and/or requirements of the following documents:

- DOE-STD-1027-92
- DOE-STD-1120-2005

Completing the HA, analyzing the accidents, and developing this document consistent with the guidance and/or requirements of DOE-STD-1120-2005 provides for compliance with the expectations of 10 CFR 830.

3.1 Summary of Remaining Hazards

3.1.1 Radiological Material Inventory

The estimated radiological inventory at B Plant is shown in Table 3-1. Table 3-1 shows only the structures that contain the major contamination inventory (i.e., only the contamination inventory in the deactivated filter vaults, the 221-B canyon, and the 212-B process cells). Several ancillary structures, such as the 271-B, 222-B, 221-BC, and 291-BC Buildings, have much lower levels of contamination. The contamination levels of the ancillary buildings in the B Plant yard are recorded in radiological dose maps that are in the deactivation files. Underground pipes are contaminated, including the pipes between the 221-B Canyon Building and the 212-B and 224-B Buildings. The levels of contamination in these pipes are unknown. It is expected that most contamination in the underground pipes is relatively fixed to the interior of the pipes, because it was normally required that all transfers to other buildings and/or facilities such as these buildings and Tank Farms were followed by wash and rinse solutions. Some contaminated soils are found around B Plant, which have been covered with dose and contamination spread barrier materials to protect facility workers and prevent further spread of the contamination. Known areas with contaminated soils are posted and identified as unplanned release sites or waste sites (see Table 2-1). Deactivated effluents, underground pipes, and associated basins may also contain some degree of contamination. The buildings/structures given in Table 3-1 contain the bounding activities. The hazard and accident analyses will, therefore, concentrate on these buildings.

Table 3-1. B Plant Radioactive Material Inventories

Location	Type	Inventory
A filter	^{137}Cs	18,000 Ci
	^{90}Sr	12,000 Ci
	Plutonium mixture[a, b]	1 g

Table 3-1. B Plant Radioactive Material Inventories

Location	Type	Inventory
B filter	^{137}Cs	43,000 Ci
	^{90}Sr	29,000 Ci
	Plutonium mixture[a, b]	1 g
C filter	^{137}Cs	25,000 Ci
	^{90}Sr	16,000 Ci
	Plutonium mixture[a, b]	1 g
D filter	^{137}Cs	70,000 Ci
	^{90}Sr	14,000 Ci
	Plutonium mixture[a, b]	1 g
E filter	^{137}Cs	3 Ci
	^{90}Sr	2 Ci
Sand filter	^{137}Cs	2,000 Ci
	^{90}Sr	3,000 Ci
	Plutonium mixture[a, b]	11 g
221-B Canyon contamination	^{137}Cs	81,000 Ci
	^{90}Sr,	44,000 Ci
	Plutonium mixture[c]	8.1 g
212-B cask loading station	^{137}Cs	100 Ci
	^{90}Sr	1,000 Ci
ACT filters	^{137}Cs[d]	9.4 Ci
	^{90}Sr[d]	9.4 Ci
	Plutonium mixture[c]	9.40E-04 g
Total	^{137}Cs	239,000 Ci
	^{90}Sr	119,000 Ci
	Plutonium mixture	23 g

Notes:

[a] For purposes of this document, the plutonium in the filters is assumed to be a mixture of ^{238}Pu through ^{242}Pu and ^{241}Am, for 12% ^{240}Pu mix as taken from HNF-SD-W059-CN-001, *Consequence Analysis of Certain Accidents Related to the Retired Filter System at B Plant*.

[b] The 212-B and filter inventory values are maintained from Table 1-9 of the previous safety basis document (HNF-3208, *Documentation of Remaining Hazardous Substances/Dangerous Wastes in B Plant*). The canyon contamination inventory is reported from HNF-3208 with additional plutonium values added as in note 3.

[c] Plutonium assumed present in canyon and ACT filters at a ratio of 10^{-4} g of Pu/Ci of ^{137}Cs

[d] The inventory of radionuclides for B Plant ACT filters was surveyed in February 2009 and documented in survey RC-05282. The inventory values for ^{137}Cs and ^{90}Sr, 1.50 Ci and 0.85 Ci respectively, are less than the 9.4 Ci and therefore are bounded by the analysis.

The canyon radionuclide inventory was estimated using results of an inventory estimation campaign performed in 1998 while the canyon was deactivated, using a GammaCam system as described in HNF-3208, *Documentation of Remaining Hazardous Substances/Dangerous Wastes*

in B Plant. It is conceivable that differences in the reported inventory and the inventory determined through actual sampling could occur (0200E-US-N0049-02, *B Plant SAR Radiological Inventory Inconsistencies*).

The retired filters inventory is discussed in HNF-3358, *B Plant Surveillance and Maintenance Phase Safety Analysis Report*.

The sand filter cesium and strontium inventory was estimated in 1994 using the sand filter operating history and previous samples and estimates of air tunnel air concentrations as the basis. The estimates are rough order-of-magnitude estimates, based on assumption and calculations documented in memorandum 16500-94-075-JWG, "Estimate of Sand Filter Inventory."

The sand filter plutonium inventory was estimated in 1994 using sand filter operating history and radionuclide release data. The estimates are rough order-of-magnitude estimates, based on assumptions and calculations documented in memorandum 16550-94-130-JWG, "Preliminary Estimate of Pu Inventory on B Plant Sand Filter."

The ACT filter inventory is estimated based on an observed ^{137}Cs activity loading on the filter, which accumulated at a rate of 7.8×10^{-3} Ci per month. It will be assumed that buildup on the filters occurs over a 100-year period. If build up occurs over a 100-year period, the ^{137}Cs activity would be 9.4 Ci. For additional conservatism, the ^{90}Sr activity will be assumed to be equal to the ^{137}Cs activity.

There are no data indicating plutonium isotopes present in the canyon area. An estimate of activity is assumed based on the ratio of plutonium content to ^{137}Cs activity of the A through D filters. The ratio of the A through D filter is believed to be more representative than the sand filter since these filters reflect the recent operation of B Plant. The plutonium content of the filter divided by the ^{137}Cs content ranges from 1.4E-5 g Pu/Ci of ^{137}Cs to 5.6E-5 g Pu/Ci of ^{137}Cs. The plutonium content in the canyon is conservatively calculated based on a bounding value of 1.0E-4 g of Pu/Ci of ^{137}Cs. Since there are 81,000 Ci of ^{137}Cs in the canyon, a plutonium canyon inventory of 8.1 g is assumed.

3.1.2 Hazard Chemical and Toxic Material Inventory

Toxic materials that remain in B Plant are listed in DOE/RL-99-24, *Surveillance and Maintenance Plan for the 221-B Facility (B Plant)*, Appendix A. Liquid chemical inventories have been removed and the significant quantity of dry chemical that remains in the canyon is stable, dry tri-sodium phosphate. Small amounts of materials may remain as dried heels in tanks but this material will not be released in accident scenarios. Other toxic chemicals that could be present are:

- Asbestos in floor tiles, siding gaskets, etc.
- Lead in paint, plumbing, etc.
- Mercury in thermostats
- Polychlorinated biphenyls in ballasts or oil
- Silver and lead contacts in the electrical systems

The SMPs described in Chapter 5.0 mitigate the facility worker risks from chemical hazards. There is no significant public health hazard from chemicals due to the relative small quantities

and the fact that the chemicals are not easily dispersible. Therefore, the accident analysis focuses on the radiological hazard.

3.1.3 Industrial Hazards

B Plant is in S&M mode and is not normally occupied. Entries to the building are done for inspections and maintenance activities. Industrial hazards associated with these entries are the hazards associated with entry to any large industrial facility that is not normally occupied. Hazards associated with facility entries are mitigated by the SMPs described in Chapter 5.0.

3.2 Facility Hazard Categorization

B Plant has been categorized as a Hazard Category 2 nuclear facility. The inventory present in the facility is shown in Table 3-1.

A preliminary hazard categorization was performed by adding the activities divided by threshold values as determined from DOE-STD-1027-92. The threshold activities for Category 2 are 22,000 Ci for ^{90}Sr, 89,000 Ci for ^{137}Cs, and 56 Ci for ^{239}Pu. The sum of fractions for the three isotopes are as follows:

$$\text{Sum of fraction} = \frac{^{90}\text{Sr activity}}{^{90}\text{Sr threshold}} + \frac{^{137}\text{Cs activity}}{^{137}\text{Cs threshold}} + \frac{^{239}\text{Pu activity}}{^{239}\text{Pu threshold}}$$

Using the inventories shown in Table 3-1 and the sum of fractions equation, the preliminary hazard categories are determined in Table 3-2.

Table 3-2. Hazard Categorization Data

	Activity in Building (Ci)	Category 2 threshold (Ci)	Fraction
221-B Canyon Building			
^{90}Sr	44000	22000	2.0
^{137}Cs	81000	89000	0.91
^{239}Pu	0.5	56	0.01
Total			2.92
291-B Retired Filters			
^{90}Sr	74000	22000	3.36
^{137}Cs	158000	89000	1.78
^{239}Pu	0.9	56	0.02
Total			5.16
212-B Cask Station			
^{90}Sr	1000	22000	0.0455
^{137}Cs	100	89000	0.0011
Total			0.047

The criterion for Hazard Category 2 is a sum of fractions greater than 1. The 221-B Canyon Building and the 291-B retired filters meet the Hazard Category 2 criterion. The accident analyses include additional transuranic (TRU) isotopes, which are inferred from the ^{239}Pu content. These isotopes are not included in the hazard categorization because the facility is a Hazard Category 2 based on the three isotopes given in Table 3-2. The additional TRU isotopes would not change the hazard category because there is no upper inventory limit for a Hazard Category 2 facility.

The 212-B Cask Station sum of fractions is not greater than 1; however, 212-B is within the Hazard Category 2 boundary of B Plant.

3.3 Hazard Analysis

Protection against expected hazards associated with operation of the Hanford nuclear facility are provided by the SMPs outlined in Chapter 5.0. Analyses have been performed on specific hazards associated with B Plant in an S&M mode to determine if additional specific controls are required. The hazard identification and evaluation report is provided in Appendix A. The following sections summarize the methodology used and the identified hazards.

Hazard identification and evaluation is the process of highlighting natural phenomena, material, system, process, and facility characteristics with the potential to initiate accidents having undesirable consequences. The method for hazard identification and evaluation used for B Plant S&M was a preliminary hazards analysis (PHA), which uses a form-driven approach to identify hazards and candidate controls and to ensure a comprehensive and thorough review. A PHA focuses on the basic elements of a facility or system and identifies the hazards, evaluates potential causes and effects, and proposes potential preventative and mitigative measures. The PHA was performed by personnel with experience in safety analysis methodology and personnel with knowledge of the B Plant design and operations in an S&M mode. The results from the PHA are used for grouping and screening of hazards and for selecting representative and unique accident scenarios.

This hazards identification and evaluation process was conducted in accordance with HNF-8739 and PRC-PRO-NS-700, which specifies classifying accident consequences as low, moderate or high and binning these events into risk bins based on a combination of consequences and frequency. The risk bin methods were used for the evaluation of the consequences of the representative accidents and to determine if controls are required. Facility workers were also addressed in the HA to determine if the hazards associated with B Plant operation exceeded that of a normal industrial facility.

The original hazard identification and HA was documented in 0200E-US-N0048-02. An updated hazard identification and HA was performed and is shown in Appendix A. The proposed work scope and applicable hazards were screened. The hazard assessment was conducted on April 19, 2007, by a team of individuals representing nuclear safety, S&M engineering operations, and radiation control technicians. The assessment was conducted in four steps:

1. A hazard identification checklist from a previous version of the DSA was reviewed.

2. The hazard identification and energy designators checklist provided in HNF-8739 was completed to identify potential hazardous energy sources that might be present in the building.
3. A PHA was conducted to identify potential hazards and accidents. The PHA looked at potential hazards and accidents and estimated the frequency and unmitigated consequences of these events. The SSCs and administrative controls (ACs) that would serve to prevent or mitigate the event were then identified. The identification of controls was based primarily on a review of available facility and operations documentation and by consulting experienced facility personnel.
4. A table was created to provide a bridge between the hazardous identification and energy designators checklist and the PHA table to ensure that all energy sources were either covered by the SMPs or were carried over to the PHA table for further analysis.

The frequency and consequence categories used by the HA team are presented in Table 3-3 and Table 3-4.

Table 3-3. Frequency Categories Used in the Hazard Analysis

Estimated Annual Frequency	Description: Based on the initiating event(s) postulated
Anticipated: 10^{-2}/yr < to < 10^{+0}/yr	The hazardous condition has occurred or is likely to occur during the lifetime of the facility.
Unlikely: 10^{-4}/yr < to < 10^{-2}/yr	The hazardous condition is foreseeable, but unlikely to occur during the lifetime of the facility.
Extremely Unlikely: 10^{-6}/yr < to <10^{-4}/yr	The hazardous condition is perhaps possible, but extremely unlikely to occur during the lifetime of the facility.
Beyond Extremely Unlikely: < 10^{-6}/yr	The hazardous condition is considered too improbable to warrant further consideration.

Table 3-4. Consequence Assessment Codes Used in the Hazards Analysis

Consequence	Maximum Offsite Individual	Worker
High	> 25 rem TED or > ERPG-2/TEEL-2	> 100 rem TED or > ERPG-3 at building boundary[a] or prompt death/serious injury to a building worker.
Moderate	> 1 rem TED or > ERPG-1/TEEL-1	≥ 25 rem TED at building boundary[a] or > ERPG-2/TEEL-2 at building boundary, or significant radiological or chemical exposure to building workers[b]
Low	< Moderate consequence	< Moderate consequence

Notes:

[a] No less than 100 m (328 ft). For elevated releases, use point of highest dose.
[b] "significant exposure" is one that is qualitatively judged to result in immediate, but reversible health effects.
ERPG emergency response planning guideline
TED total effective dose
TEEL temporary emergency exposure limit

Using the scenario frequency and consequence categories assigned by the HA team, the overall scenario risk is determined by Table 3-5.

Table 3-5. Risk Bin Values

	Beyond Extremely Unlikely Below 10^{-6}/yr	**Extremely Unlikely 10^{-4} - 10^{-6}/yr**	**Unlikely 10^{-2} - 10^{-4}/yr**	**Anticipated Above 10^{-2}/yr**
High Consequence	III	II	I	I
Moderate Consequence	IV	III	II	I
Low Consequence	IV	IV	III	III

The results of the updated PHA are documented in Appendix A, Table A-4, "B Plant Preliminary Hazards Analysis." Part of the PHA consisted of a selection process to determine which hazards would be further examined. Thirty-one potential events were identified. The item numbers given in the following listing refer to Table A-4 in Appendix A. This table should also be consulted for details on the identified hazard. The events are grouped as follows:

1. Four natural phenomena events were identified (Items 1, 2, 3, and 13): seismic, high wind, ash and snow loading, and range fire. High wind was identified as bounded by the seismic event and snow and ash loading were identified as bounded by the canyon roof collapse scenario. The range fire was bounded by the fire involving staged waste.
2. Five events (loss of ventilation and loss of electric power, two water intrusion events, and spread of surface contamination [Items 4, 11, 12, 22, and 30]) were concluded to have only minor consequences based on previous experience.
3. Two external events (Items 5 and 31, airplane impact, and WESF accidents) were considered. The airplane impact is a low-probability event with consequences bounded by the seismic event; and, while the WESF accident might require evacuation of the B Plant facility, there would be no significant additional consequences for B Plant.
4. Three vehicle accidents were identified (vehicle impacts on canyon, retired filters and ACT filter [Items 6, 7, and 8]). With the exception of the vehicle impact on the canyon, which is bounded by the canyon load drop, these are analyzed events.
5. Two stack collapse events were identified (Items 9 and 10). These events are bounded by the seismic event and ACT filter impact with fire.
6. Five fire events were identified. (Fire in the canyon, fire in the retired filter and three staged waste fires [Items 14, 15, 16, 25, and 26]). These items were selected for additional analysis. The range fire is a potential initiator for other fires.
7. Five potential drop accidents were analyzed. (Items 17 through 21). These were bounded by the roof collapse, canyon load drop and the vehicle impact accidents.
8. A criticality (Item 23) was found to be beyond extremely unlikely due to the low amount of fissile material in the facility.

9. Two spill accidents were identified (Items 24 and 29). These were bounded by the canyon load drop.
10. Two events, exposure of worker to radiation and to toxic chemicals (Items 27 and 28), were found to be covered by institutional procedures and to not require additional controls or analysis.

Events were selected for detailed hazard evaluation with consideration to the risk bin values of Table 3-5. Risk values were found to be risk bin III or less for all events and no safety-class or safety-significant SSCs were identified. Detailed analyses of seven scenarios were evaluated to confirm these conclusions. The scenarios identified as candidates for quantitative consequence analysis are presented in Table 3-6. These were judged to have the highest potential consequences among all scenarios considered.

Table 3-6. Scenarios Selected for Quantitative Review

Seismic Event
Canyon Roof Collapse
Canyon Load Drop
Canyon Fire
Fire Involving Staged Waste
ACT Filter Impact with Fire
Fire in Retired Filter

These events are quantitatively analyzed in the next section.

3.4 Accident Analysis

The potential dose consequences of the selected accident analyses are determined using RADIDOSE, a dose consequence program for the Hanford Site. For each accident scenario, atmospheric dispersion coefficients were determined using RADIDOSE. The values within RADIDOSE are consistent with the values given in HNF-8739. The default values for breathing rate and atmospheric dispersion coefficient in RADIDOSE were used in evaluating the dose consequences. The material form is modeled as moderately soluble for all examined accident events. Moderate solubility class produces a higher dose for the CW, which is the limiting receptor for the 200 Area facilities. Inhalation of soluble aerosols produces higher doses than inhalation of oxide for TRU material. International Commission on Radiological Protection (ICRP) 68, *Dose Coefficients for Intakes of Radionuclides by Workers: A Replacement of ICRP Publication 61*, and ICRP 71, *Age Dependent Doses to Members of the Public from Intake of Radionuclides, Part 4, Inhalation Dose Coefficients*, dose conversion factors were used. Dose is reported as total effective dose (TED).

The dose to the CW is evaluated at 100 m (328 ft) from the facility. The nearest site boundary, 16,630 m (10.33 mi) to the southwest, was used as the minimum distance to the MOI receptor. Distances were taken from the Hanford Map, Version 2.0.

Copies of the output sheets from RADIDOSE calculations for the applicable accident analyses are attached in Appendix B. The dose consequences to the CW and MOI from the RADIDOSE sheets are presented in Chapter 3.0 with each accident analysis description. The dose consequences to the Onsite Public are reported for informational purposes in the RADIDOSE output sheets, but are not repeated in the Chapter 3.0 descriptions.

3.4.1 Seismic Event

The worst-case event is a seismic event of greater magnitude than the design basis. Examining the potential events analyzed in the HA, it is apparent that the seismic event may have the largest facility-wide impacts, potentially failing the canyon confinement structure, the retired filters, and the sand filter. No other event is likely to fail both simultaneously, resulting in impacts to the radioactive materials, a loss of confinement, and a loss of ventilation. However, detailed modeling of the seismic responses is not required since all the structures containing radioactive material are assumed to fail during the earthquake. The event frequency is classified as "unlikely," consistent with the guidance provided in HNF-8739, *Safety Analysis and Risk Assessment Handbook (SARAH)*. Other natural phenomena bounded by this event are airplane impacts, high winds or tornados, and floods. The seismic event is a conservative representation of other natural phenomena because it is a high-energy event that simultaneously affects multiple B Plant structures and is modeled as a ground-level, non-buoyant release with no plume meandering.

Scenario Development: For the seismic event, the following worst-case scenario development is assumed:

- Failure of the 221-B Canyon Building resulting in loss of the confinement function
- Complete failure of the 291-B retired filters and the sand filter
- Complete failure of the 212-B Cask Station
- Complete failure of the ACT filter
- Shock/vibration impacts to radioactive material in the canyon from seismic motions and displacement of equipment.

Source Term: The estimated inventory for the 221-B canyon and the retired filters is the significant inventory at risk from the seismic event. The inventory in the 212-B Cask Station and ACT filter is negligible compared to the canyon and retired filter inventory and is neglected in the source term for the seismic event.

The bulk of the canyon inventory at risk is adherent contamination confined in the process cells. Therefore, the seismic event assumes an airborne release fraction/respirable fraction (ARF/RF) of 1.0E-03/1.0E-01 (consistent with Section 5.1 of DOE-HDBK-3010-94, Table 3-4 of HNF-8739, and RADIDOSE default values for external impact on noncombustible contaminated solids). The seismic event is assumed to not initiate a fire since electrical power is isolated from the facility. The remaining electrical service, such as the liquid level detection in Cell 10 is not likely to create an ignition source.

Discussions in Section 5.1 of DOE-HDBK-3010-94 indicate that the release fraction for crushed filters varies from 1.0E-05 to 5.0E-05 with a bounding ARF of 5E-04 and RF of 1.0 recommended. However, the B Plant retired filters are located in concrete vaults below ground, which would limit impact loadings even assuming a collapse of the filters. Use of an ARF of

1.0E-04 and an RF of 1.0 is judged conservative since this ARF/RF envelopes the actual experimental data. The ARF/RF for both the canyon and the filter release is, therefore, assumed to be 1.0E-04.

Conservatively assuming no effects of damage ratios or leak path factors, the material at risk (MAR) used is summarized below in Table 3-7.

Table 3-7. Seismic Event Material at Risk

Isotope	Activity (Ci)	Mass (g)	Weight Fraction[c] (isotope mass/total mass)
^{137}Cs[a]	2.39E+05	2.75E+03	7.55E-01
^{90}Sr[a]	1.19E+05	8.69E+02	2.39E-01
^{90}Y[a]	1.19E+05	2.19E-01	6.01E-05
^{238}Pu[b] (0.08 %)	N/A	1.84E-02	5.06E-06
^{239}Pu[b] (83.95 %)	N/A	1.93E+01	5.31E-03
^{240}Pu[b] (12.97 %)	N/A	2.98E+00	8.20E-04
^{241}Pu[b] (1.1 %)	N/A	2.53E-01	6.95E-05
^{241}Am[b] (1.75 %)	N/A	4.03E-01	1.11E-04
Total		**3.64E+03**	

Notes:

[a] Inventory obtained from Table 3-1

[b] Isotope percentage obtained from HNF-SD-W059-CN-001, *Consequence Analysis of Certain Accidents Related to the Retired Filter System at B Plant*; mass obtained by multiplying isotope percentage by the total plutonium from Table 3-1 (23 g) (Example calc. for ^{238}Pu : 0.08% * 23 g = 1.84E-02 g)

[c] Used in RADIDOSE input file

Consequence Analysis: The following conservatisms were used in this analysis:

- The seismic event is conservatively assumed to catastrophically fail both the building and the retired filters.
- The analysis assumes an unfiltered ground level release with no building wake effect.
- The RADIDOSE calculations assume a point source distribution rather than an area source.

The RADIDOSE calculations are given in Appendix B. A summary of the calculated dose consequences for this event is provided below in Table 3-8.

Table 3-8. Seismic Event Consequences

Location	TED (rem)	Risk Bin
CW	2.23E+01	III
MOI	1.12E-02	III

Risk Bin Determination: The event is a natural phenomenon hazard (NPH) and the MAR is limited to the residual materials; therefore, no safety-significant or safety-class controls are identified. The 22 rem identified for the CW is less than the 25 rem value for moderate consequences identified in Table 3-4; therefore, the Risk Bin value for the CW is III. The doses approach the moderate consequence threshold but there is considerable conservatism in the modeling, such as assuming all activity is affected by the building collapse when significant quantities of radioactive material would be shielded by piping or vessels. This is a natural phenomenon event and cost-effective controls are not practical. The TED to the MOI is well below the 1 rem risk guidance, which corresponds to a low consequence class.

Control Set: Given the conservative assumptions of this analysis, the relative risk bin values, and the fact that this scenario is an NPH event, no safety-class or safety-significant SSCs and no TSRs to reduce potential consequences to the target receptors were identified for this event. Applicable SMPs include the Emergency Preparedness Program.

3.4.2 Canyon Roof Collapse

A new roof consisting of a steel structure with metal panels was installed on B Plant in 2002. The roof is sloped and was built over and encloses the old roof. The roof is designed to provide a slope that will drain any run off. It is possible that damage to or degradation of the roofing could occur from snow or water intrusion, which could cause degradation of the concrete roof. This could lead to a partial or complete collapse of the roof, although this is not expected. Collapse of the roof is analyzed to cover roof loading and structural aging because a significant amount of contamination remains in the canyon process cells.

Scenario Development: This scenario assumes that snow or ash loads or an impact from a crane operating in the vicinity of B Plant collapses the roof. A canyon roof collapse accident could cause a release to the environment through the roof opening, which could potentially result in some external contamination spread to WESF. Internal contamination spread to WESF is not anticipated as all physically interfaced systems between the two facilities have been isolated.

Source Term Analysis: The estimated inventory for the 221-B Canyon Building is the significant inventory at risk from the roof collapse event. The inventory in 212-B and the ACT filter is negligible compared to the canyon inventory and is neglected in the source term for the roof collapse event. The inventory in the retired filters is not affected by the roof collapse.

On a per curie basis, the bulk of the canyon inventory at risk is adherent contamination confined in the process cells. Therefore, the roof collapse event assumes an ARF/RF of 1.0E-03/1.0E-01 (consistent with Section 5.1 of DOE-HDBK-3010-94 and HNF-8739 for external impact on noncombustible contaminated solids). The roof collapse event is assumed to not initiate a fire since electrical power is isolated from the facility except for the surveillance path lighting, which is unlikely to initiate a fire due to lack of proximity to combustibles. The event is similar to the seismic event except the retired filters are not assumed to collapse in this event. A damage of ratio of 1.0 is assumed for this analysis. This is conservative since much of the activity is in cells or tanks and would not be impacted by the roof collapse.

The MAR used in this accident is given in Table 3-9.

Table 3-9. Roof Collapse Material at Risk

Isotope	Activity (Ci)	Mass (g)	Weight Fraction[c] (isotope mass/total mass)
^{137}Cs[a]	8.1E+04	9.31E+02	7.39E-01
^{90}Sr[a]	4.4E+04	3.21E+02	2.55E-01
^{90}Y[a]	4.4E+04	8.09E-02	6.42E-05
^{238}Pu[b] (0.08 %)	N/A	6.48E-03	5.14E-06
^{239}Pu[b] (83.95 %)	N/A	6.80E+00	5.40E-03
^{240}Pu[b] (12.97 %)	N/A	1.05E+00	8.34E-04
^{241}Pu[b] (1.1 %)	N/A	8.91E-02	7.07E-05
^{241}Am[b] (1.75 %)	N/A	1.42E-01	1.12E-04
Total		**1.26E+03**	

Notes:

[a] Inventory obtained from Table 3-1

[b] Isotope percentage obtained from HNF-SD-W059-CN-001, *Consequence Analysis of Certain Accidents Related to the Retired Filter System at B Plant*; mass obtained by multiplying isotope percentage by the canyon plutonium from Table 3-1 (8.1 g) (Example calc. for ^{238}Pu : 0.08% * 8.1 g = 6.48E-03 g)

[c] Used in RADIDOSE input file

Consequence Analysis: The following conservatisms were used in this analysis:

- The frequency is conservatively assumed to be anticipated.
- The analysis assumes an unfiltered ground-level release with no building wake effect.
- The RADIDOSE calculations assume a point source distribution rather than an area source.
- The entire roof is assumed to collapse affecting the entire inventory of the canyon.

A summary of the calculated dose consequences for this event is provided below in Table 3-10. The RADIDOSE output is given in Appendix B.

Table 3-10. Roof Collapse Consequences

Location	TED (rem)	Risk Bin
CW	8.02E+00	III
MOI	4.00E-03	III

Risk Bin Determination: The dose identified for the CW is less than the 25 rem threshold for moderate consequences identified in Table 3-4; therefore, the Risk Bin value for the CW is assigned as III. The TED to the MOI is well below the 1 rem risk guidance, which corresponds to a low-consequence class and Risk Bin III.

Control Set: Given the conservative assumptions of this analysis and the relative risk bin values, no safety-class or safety-significant SSCs and no TSRs to reduce potential consequences to the CW and MOI were identified for this event. Applicable SMPs include the Emergency Preparedness Program.

3.4.3 Canyon Load Drop

Disposition activities within the canyon may require the transport of heavy loads such as shielded drums or cover blocks. It is anticipated that a relatively heavy pick or lift could be accidentally dropped causing a release into the canyon air space. The load drop can impact contaminated waste and result in a release or the release can come from the radioactive material in the container. This event bounds a vehicle impact into the 221-B Canyon Building and galleries, a heavy object drop in the yard area, and container spills in the canyon.

Source Term: The entire canyon inventory is assumed to be contained in a single container, which is dropped. This is a very conservative assumption but is bounding. The MAR is, therefore, equal to the canyon inventory given in Table 3-9.

The bounding ARF/RF is defined by the default settings of RADIDOSE and Table 3-4 of HNF-8739 for impact of noncombustible contaminants. The applicable ARF/RF is 1.0E-03/1.0E-01. Table 3-3 of HNF-8739 recommends a damage ratio of 1.0E-01 for drum drops of less than 13 m (42.6 ft) or impacts involving a vehicle with a speed of less than 35 mph. Given the conservative assumptions on the source term, it is appropriate to apply a damage ratio of 1.0E-01 for this accident. Also, any drum involving B Plant waste will include significant radiation shielding material and thus would be of a robust construction. The shielding is required because of the strong gamma radiation from the decay of ^{137}Cs, which is a significant contributor to the source term. Since all of the material in the canyon is assumed to be involved in the accident, this accident bounds impacts on contaminated surfaces as well as releases from the dropped container. The application of a damage ratio of 1.0E-01 to the MAR for impacts on contaminated surfaces by containers is conservative since only a small fraction of the contaminated surfaces in the facility would be affected by any impact accident.

Consequence Analysis: The potential for a drop event in the 221-B Canyon Building is an anticipated event with activities associated with the movement of canyon cover blocks, lifts, and picks of staged equipment, size reduction, and waste packaging. Table 3-11 summarizes the unmitigated risks associated with the analyzed drop event. Since the accident involves waste of unknown origin and chemical form, moderate solubility is assumed. RADIDOSE outputs are shown in Appendix B.

Table 3-11. Canyon Load Drop Consequences

Location	TED (rem)	Risk Bin Values
CW	8.02E-01	III
MOI	4.00E-04	III

Risk Bin Determination: The TED for the CW is well below the threshold for a moderate consequence event. Similarly, the TED to the MOI is well below the 1 rem risk guidance, which corresponds to a low-consequence class.

The unmitigated risk bin values for the CW and MOI are both III.

Control Set: It is concluded that no safety-class or safety-significant SSCs or TSRs are required. The major person at risk is the facility worker in the canyon area. Applicable SMPs include the Operational Safety, Radiation Protection, and Initial Testing, In-Service Surveillance, and Maintenance Programs.

While no safety-class or safety-significant SSCs are required, the passive features of the canyon structure are recognized as DID SSCs that are important to maintain general confinement.

3.4.4 Canyon Fire

CP-41843 analyzed the fire hazards for B Plant during the S&M phase. That analysis showed that there are no potential fires that present a hazard to safety equipment. The remaining combustibles in the canyon are located on the canyon deck and in the canyon cells. The retired HEPA filters are isolated from the canyon and will not be impacted by a fire in the canyon. The ACT filters are located outside the canyon and will not be affected by a fire in the canyon.

Scenario Development: This scenario is derived from CP-41843 and is analyzed in this DSA. Combustibles are assumed to be located within the 221-B Canyon Building and could possibly ignite and burn. The combustibles remaining in the process cells are not expected to burn, but would be bounded by this analysis due to the limited volumes, the limited air flows, and the distances from, and arduous route to, the canyon exhaust system duct inlets and filters.

Two benchmark fuel packages were selected for the fire hazard analysis of a canyon deck fire. The fuel packages consisted of a 1.22 m by 1.22 m by 1.22 m (4 ft by 4 ft by 4 ft) stack of wood pallets, and a 38 L (10 gal) combustible liquid spill. The pallet fire was selected to analyze the impact on the canyon exhaust system following a prolonged fire in the canyon building. The flammable liquid fire was selected to evaluate the performance of the canyon exhaust filters under a short term, high-temperature condition. The 38 L (10 gal) flammable liquid fire was included in CP-41843 as a bounding fire and does not represent an actual liquid inventory in the canyon.

CP-41843 also considers a fire involving a crane truck containing 170 L (45 gal) of oil and hydraulic fluid along with rubber tires. A crane truck remains on the canyon deck. The truck is minimally contaminated (internally and externally) with radioactive materials. The truck contains 10 wheel-mounted tires (eight in the rear, two in the front), an upholstered interior, and approximately 170 L (45 gal) of hydraulic and engine oils. The propane fuel tank and the two batteries have been removed from the truck and the building. The truck is located at Cells 12 and 13 on the canyon deck. The truck and the pallet fuel packages are spatially separated and are not expected to burn simultaneously. The crane truck fire is the only possible flammable liquid fire since there are no flammable liquids in the canyon except those associated with the crane truck. Therefore, the crane truck fire and the wooden pallet fire bound all fires in the canyon. The consequences of the fires do not depend on the details of the fire scenario since the only parameters used for the fire analysis are a damage ratio, and the ARF and RF, which are selected from handbook values for fires. Therefore, this scenario would also bound fires involving staged contaminated equipment removed from the building.

Source Term Analysis: The inventory available for release would be the canyon surface contamination directly impacted by the fire and the contamination on the burning combustibles (inconsequential compared to the canyon surface contamination). The canyon fire MAR is the

same as for the roof collapse (Table 3-9). The fire would result in heating of the contamination in the canyon. The pallet fire discussed in the previous section covers a floor surface area of 1.2 m by 1.2 m (4 ft by 4 ft) or 1.4 m^2 (16 ft^2). The spill from the crane truck is the bounding liquid spill. The liquid will spread after the spill but the spill area will be limited because of the need for a minimum spill depth to sustain combustion, and the fact the floor is not perfectly flat which will result in pooling in low spots. The fire will affect a relatively small area of the canyon since the area of the 221B canyon is 247 m by 20 m (810 ft by 66 ft), or 4,940 m^2 (53,100 ft^2). Even though the area of the fire will be much smaller than the building area, and much of the contamination is located in tanks that would not be affected by the fire, the MAR is conservatively assumed to be the total inventory of the 221-B Canyon Building.

The ARF/RF assumed is 6.0E-03/1.0E-02 for the bounding release for thermal stress of surface contamination of noncombustible solids, as given in Section 5.1 of DOE-HDBK-3010-94 and Table 3-4 of HNF-8739. While burning of the contamination on the combustible material itself would typically have a different ARF/RF, the incidental contamination on the combustible material would be inconsequential compared to the canyon surface contamination. The scenario assumes an unfiltered, ground-level release. The released respirable material is modeled as moderately soluble.

Consequence Analysis: The potential of a fire event in the canyon is an anticipated event when considering the size reduction and waste management type of activities that are required for the preparations for the canyon demolition. Table 3-12 is a summary of the unmitigated dose consequences for the analyzed scenario. The RADIDOSE output is shown in Appendix B.

Table 3-12. Canyon Fire Consequences

Location	TED (rem)	Risk Bin Values
CW	4.81	III
MOI	2.40E-03	III

Risk Bin Determination: The TED for the CW is well below the upper limit for a low consequence event of 25 rem, which is the upper limit for a low consequence event. Similarly, the TED to the MOI is well below the upper limit for a low consequence event of 1 rem. The unmitigated risk bin values for the CW and MOI are both III.

Control Set: Therefore, it may be concluded that no safety-class or safety-significant SSCs and no TSRs are required for this event. The major person-at-risk is the facility worker in the canyon area.

Applicable SMPs include Hazardous Material Protection, Operational Safety, and Initial Testing, In-Service Surveillance, and Maintenance Programs.

It is also recognized that the building structure does serve a confinement function. As a result, the building structure is identified as a DID. The USQ Program and the Engineering Program are both applicable contractor SMPs that ensure configuration control of the confinement features.

3.4.5 Staged Waste Fire

Contaminated waste will result from S&M, waste removal, and demolition activities. These wastes will be in various waste packages staged for transport and disposal.

Scenario Development: For this event, the following conditions are assumed:

- A fire is assumed to occur that involves the entire staged waste.
- The waste will typically be staged in steel waste containers (e.g., steel waste disposal boxes [SWDBs], standard waste boxes and/or waste drums) as provided by waste-handling and disposal requirements.
- The metal waste boxes will typically be packaged prior to transporting to the staging area. The lids of a metal waste box will be placed on the SWDBs prior to removal from the canyon. Torqueing of the lid may be performed once the SWDBs has been removed from the canyon.
- Contamination control waste may be staged in drums or disposal boxes prior to transport to the designated staging area.
- For conservatism, no damage ratio is applied.

Source Term Analysis: B Plant is in the S&M mode and large amounts of radioactive material are not expected to be moved to the staging area. Radioactive waste removal during the S&M mode is expected to be low-level waste such as step-off pad waste. The maximum inventory of waste typically encountered during S&M activities is associated with replacement of the canyon exhaust pre-filters and HEPA filters. Based on recent surveys (June 2009) it is estimated that the filter loading equates to a maximum of 2.8 Ci of ^{137}Cs. For the analysis, it is conservatively assumed that the staged waste inventory is 1,000 times this amount plus proportional amounts of the other isotopes present in the canyon. The mixture of isotopes is the same as assumed in Table 3-9. An extremely bounding inventory of 2,800 Ci ^{137}Cs (plus proportional amounts of the other isotopes) was chosen so the inventory assumption would not require a TSR level control to protect.

This radioactive material is assumed to be combustible packaged waste. The ARF/RF assumed is 5.0E-04/1.0 for packaged waste, as given in Section 5.2.1.1 of DOE-HDBK-3010-94 and Table 3-4 of HNF-8739. The waste is modeled as moderately soluble.

This event bounds range fires affecting the 221-B Canyon Building and 291-B exhaust system as no significant release of facility inventory is expected because of the robust nature of the structures.

The release is modeled as a ground-level release with no plume meander, no plume rise, and no building wake.

Conservatively assuming no effects of damage ratios or leak path factors, the MAR used is summarized in Table 3-13.

Table 3-13. Staged Waste Fire Material at Risk

Isotope	Activity (Ci)	Mass (g)	Weight Fraction[b] (isotope mass/total mass)
^{137}Cs	2.80E+03	3.22E+01	7.38E-01
^{90}Sr	1.52E+03	1.11E+01	2.55E-01
^{90}Y	1.52E+03	2.80E-03	6.41E-05
^{238}Pu[a] (0.08 %)	N/A	2.24E-04	5.14E-06
^{239}Pu[a] (83.95 %)	N/A	2.35E-01	5.39E-03
^{240}Pu[a] (12.97 %)	N/A	3.63E-02	8.33E-04
^{241}Pu[a] (1.1 %)	N/A	3.08E-03	7.06E-05
^{241}Am[a] (1.75 %)	N/A	4.90E-03	1.12E-04
Total		**4.36E+01**	

Notes:

[a] Isotope percentage obtained from HNF-SD-W059-CN-001, *Consequence Analysis of Certain Accidents Related to the Retired Filter System at B Plant*; mass obtained by multiplying isotope percentage by the plutonium assumed present in canyon and ACT filters at a ratio of 10-4 g of Pu/Ci of ^{137}Cs (Example calc. for ^{238}Pu: .08% (2,800 Ci * 10-4 g Pu) = 2.24E-04 g)

[b] Used in RADIDOSE input file

Consequence Analysis: The postulated fire involving staged waste is an anticipated event that could occur during the preparations for final demolition of the B Plant canyon. Doses are calculated using RADIDOSE. Table 3-14 is a summary of the unmitigated doses and risk bins for the analyzed scenario. The RADIDOSE output is shown in Appendix B.

Table 3-14. Staged Waste Fire Consequences

Location	TED (rem)	Risk Bin
CW	1.39	III
MOI	6.93E-04	III

Risk Bin Determination: The TED for the CW is below the upper limit for a low consequence event of 25 rem. Similarly, the TED to the MOI is well below the upper limit for a low consequence event of 1 rem. The unmitigated risk bin values for the CW and MOI are both III.

Control Set: Since unmitigated risk bin values for the CW and MOI are both III, it is concluded that no safety-class or safety-significant SSCs and no TSRs are required for this event.

The major receptor at risk is the facility worker that may be in or near the staging area. Applicable SMPs that provide worker safety for these types of actions include the Radioactive and Hazardous Waste Management, Operational Safety (Fire Protection Program), and Initial Testing, In-Service Surveillance, and Maintenance Programs.

3.4.6 Air Cleaning Train Filter Impact with Fire

It is postulated that a vehicle impacts the HEPA filter housing of the B Plant canyon exhaust system ACT, causing the filter housing to rupture and the filters to be damaged. The impact is also assumed to release vehicle fuel, which causes a fire that affects the filter. This impact and fire bounds any similar event or initiator. This scenario is addressed in CP-41843. This event bounds failures of the ACT filters from other causes such as excessive loading or stack collapse on the filters. The event also bounds any handling accidents that might occur during filter change out, such as dropping a filter, since the impact and fire from a vehicle will be more severe than a drop accident. Accidents involving a spent filter being staged for removal from the facility are also covered since the release from an accident involving a staged filter would be the same as an accident involving a filter in the ACT, since no credit is taken in the analysis for the filter housing or duct work.

Scenario Development: This scenario has two release mechanisms. The first mechanism is caused by the energy of the vehicle impact. A bounding ARF and RF for the static pressure breaking of a HEPA filter are used for this initial release mechanism. The release duration is considered to be less than one hour.

The second release mechanism is caused by the thermal stress imparted onto the filter media from the burning of spilled fuel. Empirical data have shown that most of the contaminants are trapped in the filter melt.

As stated in CP-41843, the potential exists for debris or tumbleweeds to collect around the ACT filter. In addition, as stated in CP-41843, a lightning strike, range fire, or spontaneous combustion of combustibles accumulated around the canyon exhaust system could damage the ACT and/or the ACT filters. The B Plant canyon building is a massive concrete structure, which will not be significantly affected by the fire.

Source Term Analysis: The source term is determined considering both release mechanisms. The analysis takes no credit for the filter housing, i.e., the filter is conservatively assumed to be unenclosed. For a release from a HEPA filter experiencing damage, the bounding ARF and RF values are considered to be 1.0E-02 and 1.0, respectively (HNF-8739, Table 3-4). This release fraction is indicative of a large energy release (i.e., explosive release).

The ARF from heat-induced damage to HEPA filters is very small. The filter medium is very fine-diameter glass fiber that softens and melts when heated. This melt tends to retain or trap filtered particulate materials. For the impacts of heat upon a loaded HEPA filter, the ARF and RF values are considered to be 1.0E-04 and 1.0, respectively (HNF-8739, Table 3-4). This ARF is negligible compared to the ARF for the impact from the vehicle.

The observed ^{137}Cs activity loading on the filter accumulated at a rate of 7.8E-03 Ci per month. It is expected that the prefilters, which contain the majority of radioactive material, will be changed on an interval to minimize doses to workers changing the filters consistent with ALARA goals. The unmitigated case will assume buildup on the filters occurs over a 100-year period. This calculation does credit filter change out, but the assumed change out rate is judged conservative enough to bound operations since it is unlikely that B Plant could be kept in the current configuration with the ACT filter operating for 100 years. If build up occurs over a 100-year period, the ^{137}Cs activity would be 9.4 Ci. For additional conservatism, the ^{90}Sr activity will

be assumed to be equal to the ^{137}Cs activity with ^{90}Y assumed to be in equilibrium with the ^{90}Sr. The plutonium content in grams is assumed to be 1.0E-04 times the ^{137}Cs activity in curies as discussed in Section 3.1.

The MAR for the ACT Filter is shown in Table 3-15.

Table 3-15. ACT Filter Impact with Fire Material at Risk

Isotope	Activity (Ci)	Mass (g)	Weight Fraction[c]
^{137}Cs[a]	9.4 Ci	1.08E-01	6.08E-01
^{90}Sr[a]	9.4 Ci	6.86E-02	3.86E-01
^{90}Y[a]	9.4 Ci	1.73E-05	9.73E-05
^{238}Pu[b] (0.08 %)	N/A	7.52E-07	4.23E-06
^{239}Pu[b] (83.95 %)	N/A	7.89E-04	4.44E-03
^{240}Pu[b] (12.97 %)	N/A	1.22E-04	6.86E-04
^{241}Pu[b] (1.1 %)	N/A	1.03E-05	5.82E-05
^{241}Am[b] (1.75 %)	N/A	1.65E-05	9.26E-05
Total		**1.78E-01**	

Notes:

[a] Inventory obtained from Table 3-1.

[b] Isotope percentage obtained from HNF-SD-W059-CN-001, *Consequence Analysis of Certain Accidents Related to the Retired Filter System at B Plant*; mass obtained by multiplying isotope percentage by the total plutonium from Table 3-1 (9.40E-04 g) (Example calc. for ^{238}Pu : 0.08% * 9.40E-04 g = 7.52E-07 g).

[c] Used in RADIDOSE input file.

The potential exists for unfiltered releases from the canyon following the filter being damaged. The following section postulates consequences for this scenario, considering the accident causes the exhaust fans to stop running. If the fans continue to operate, the material released would be bounded by the 7.8E-03 Ci/month of ^{137}Cs that normally accumulates on the filter. The ^{137}Cs release from the filter failure is 9.4 Ci times an ARF /RF of 1.0E-02 or 9.4E-02 Ci. The other isotopes released in Table 3-15 would be proportional to the ^{137}Cs. The dose consequences from operation of the filters for a full month would be about 8 percent of the release from the filter failure. It will be seen that the filter failure scenario doses are over two orders of magnitude below the threshold for a moderate event. Including doses for an unfiltered release would not change that conclusion.

Consequence Analysis: The unmitigated event is assumed to have a likelihood of anticipated and the dose calculations confirm a low-consequence event. Doses are given in Table 3-16. The RADIDOSE output is given in Appendix B.

Table 3-16. ACT Filter Impact with Fire Consequences

Location	TED (rem)	Risk Bin
CW	1.48E-01	III
MOI	7.23E-05	III

A mitigated analysis could be performed that reflects the more realistic inventory based on a filter change out period of 18 months. The source term for an 18-month period is 1.4E-01 Ci. The doses based on an 18-month change out would be approximately a factor of 67 lower. This data is only provided to demonstrate analysis conservatism.

Risk Bin Determination: The TED for the CW is well below the 25 rem, which corresponds to a low-consequence class. Similarly, the TED to the MOI is well below the 1 rem risk guidance, which also corresponds to a low-consequence class.

The unmitigated risk bin values for the CW and MOI are both III.

Control Set: It is concluded that no safety-class or safety-significant SSCs and no TSRs are required to prevent or mitigate this event.

Applicable SMPs include the Operational Safety Program.

3.4.7 Fire in the Retired Filters

Scenario Development: The B Plant process ventilation system was equipped with HEPA filtration to reduce the release of radioactive particles to acceptable levels. The process ventilation filters are now isolated from the canyon and the fans and stack, but the filters still contain a significant inventory of radioactive material. Failure of the containment could result in a release of radionuclides to the environment. One possible failure mode is a fire that releases some fraction of the inventory of material that is captured in the filters. CP-41843 demonstrates a very low probability of a fire in these filter vaults. A vehicle impacting the filters could also initiate a fire. A filter collapse is unlikely since the filters are covered by a mound that would be difficult to drive over. There are many obstacles, formed by all the surrounding equipment abandoned in place. At the east end, there is a steep uphill grade over the filters, in loose soil. On the north side there is a concrete retaining wall. A vehicle impact is therefore unlikely. The seismic event (Section 3.4.1) considers collapse/impact that involves the entire filter and canyon inventory. The seismic event therefore bounds filter impact accidents. A vehicle-induced fire in the retired filters is analyzed in this section.

This scenario postulates that a vehicle attempts to drive over the vaults resulting in a breach of the vehicle gas tank. Burning fuel enters a vault containing a retired filter. The exhaust duct that originally connected the 221-B Canyon Building to the 291-B HEPA Filter Vaults is blocked with a concrete plug that was poured in place. The vault design, along with the concrete plug, will prevent a large sustained fire since there is no path for oxygen to enter or for combustion products to leave. However, the unmitigated analysis takes no credit for the vault structure mitigating the fire. This event bounds any initiator of a fire in the retired filters.

The analysis assumes that a fire will occur in only one vault at any one time because the vaults are isolated by concrete walls between them (except for the small opening between the vaults at their inlet ends). A fire in one vault is not expected to spread to another vault. B Filter vault contains the most significant inventory for a single vault event (Table 3-1).

Source Term Analysis: Table 3-17 shows the underground HEPA filter inventory. Section 3.4.6 identifies the ARF as 1.0E-04 for the impacts of heat on a loaded HEPA filter with a RF of 1.0. The material liberated and released from B filter by the fire is calculated as the MAR multiplied by the ARF and then multiplied by the RF.

There is currently a fence around the facility, so there is less traffic in the area around the vaults. Traffic will be limited by the frequency of S&M activities.

An unlikely event frequency was also chosen because a filter fire is not expected in the lifetime of the facility, since there is no ignition source available to start a fire, the filters contain very little combustible material, and the filters are fiberglass.

Table 3-17. B Filter Material at Risk

Isotope	Activity (Ci)	Mass (g)	Weight Fraction[c]
^{137}Cs[a]	4.3E+04	4.94E+02	6.99E-01
^{90}Sr[a]	2.9E+04	2.12E+02	2.99E-01
^{90}Y[a]	2.9E+04	5.33E-02	7.54E-05
^{238}Pu[b] (0.08 %)	N/A	8.00E-04	1.13E-06
^{239}Pu[b] (83.95 %)	N/A	8.40E-01	1.19E-03
^{240}Pu[b] (12.97 %)	N/A	1.30E-01	1.83E-04
^{241}Pu[b] (1.1 %)	N/A	1.10E-02	1.56E-05
^{241}Am[b] (1.75 %)	N/A	1.75E-02	2.48E-05
Total		**7.07E+02**	

Notes:

[a] Inventory obtained from Table 3-1

[b] Isotope percentage obtained from HNF-SD-W059-CN-001, *Consequence Analysis of Certain Accidents Related to the Retired Filter System at B Plant*; mass obtained by multiplying isotope percentage by the B Filter plutonium from Table 3-1 (1 g) (Example calc. for ^{238}Pu : 0.08% * 1 g = 8.00E-04)

[c] Used in RADIDOSE input file

Consequence Analysis: The analysis for this scenario is based upon the following assumptions:

- No releases are expected from the HEPA filters for temperatures below 150°C (302°F). The HEPA filter medium consists of glass fibers, which can melt and retain materials adhering to them. For this analysis, 1.0 is the assumed RF. The ARF of 1.0E-04 is recommended in HNF-8739 for the impact of heat on a fully loaded filter, and the material is modeled as moderately soluble.
- A ground release is analyzed since the underground filters are isolated from the canyon building and from the stack. Neither plume meander nor building wake is credited to mitigate the consequences. The passive vent system provides a ground-release path.

The ground release effective dose equivalent unmitigated consequences for a fire in B filter are shown in Table 3-18. The RADIDOSE outputs are given in Appendix B.

Table 3-18. Retired B Filter Fire Consequences

Location	TED (rem)	Risk Bin
CW	4.90E+00	III
MOI	2.42E-03	III

Risk Bin Determination: The TED for the CW is well below the threshold for a moderate consequence event of 25 rem. Similarly, the TED to the MOI is well below the moderate consequence MOI threshold of 1 rem. The event is therefore a low-consequence event. The unmitigated risk bin values for the CW and MOI are both III. The unmitigated risk bin values for the CW and MOI would still be III if the frequency of the event were anticipated instead of unlikely.

Control Set: It is concluded that no safety-class or safety-significant SSCs and no TSRs are required to prevent or mitigate the event.

While no safety-class or safety-significant SSCs are required, the passive features of the retired filter structure are recognized as DID that provide confinement of hazardous materials and protection of filter material from impact.

Applicable SMPs include the Operational Safety Program.

3.5 Margin of Safety

This section addresses margins of safety to facilitate USQ evaluations for changes affecting B Plant. Based on the guidance in DOE G 424.1-1B, Appendix A, and PRC-PRO-NS-062, the safety basis was reviewed to determine if there were instances of DOE-defined functional requirements for equipment that would provide basis for the identification of margins of safety. There is no explicit margin of safety identified in the B Plant DSA. Margin of Safety must be an explicit function between a design or assumed failure point and its associated safety limit. This DSA does not contain safety limits and does not have safety class SSCs that if failed, would result in a potential release greater than 25 rem to the MOI. There are no implicit margins of safety for B Plant. Therefore, since there are no explicit or implicit margins of safety associated with this facility, the margin of safety question in USQ evaluations performed against this DSA should be answered "No."

Chapter 4.0

Hazard Controls

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4.0 Hazard Controls

This chapter identifies the building features and control elements required for authorized activities at B Plant. It provides details about building equipment and features that are necessary to provide DID, and contribute to worker safety. The controls presented here are based on the results of the HA and accident analysis for S&M activities at B Plant, as described in Chapter 3.0.

4.1 Safety Structures, Systems, and Components

There are no safety-class or safety-significant SSCs identified for S&M activities at B Plant. The bases for this determination are the current criteria for selecting safety systems identified in PRC-PRO-NS-700 and the guidance in HNF-8739. Specifically, any scenario with a risk bin value greater than III requires a safety-class or safety-significant SSC to reduce the risk bin value to III or less. Safety-class SSCs are identified to reduce risk to the MOI and safety-significant SSCs are identified to reduce the risk to the CW. SSCs are evaluated for DID status if they are below the criteria for safety-class and safety-significant SSCs discussed above.

Potential consequences calculated for the design basis accidents evaluated in Section 3.4 are presented in Table 4-1.

Table 4-1. Accident Scenario Summary

Scenario (unmitigated)	Frequency	Onsite (CW) TED (rem)	Offsite (MOI) TED (rem)	Risk Bin Values
Seismic Event (3.4.1)	Unlikely	2.23E+01	1.12E-02	III
Canyon Roof Collapse (3.4.2)	Anticipated	8.02E+00	4.00E-03	III
Canyon Load Drop (3.4.3)	Anticipated	8.02E-01	4.00E-04	III
Canyon Fire (3.4.4)	Anticipated	4.81E+00	2.40E-03	III
Staged Waste Fire (3.4.5)	Anticipated	1.39E+00	6.93E-04	III
ACT Impact with Fire (3.4.6)	Anticipated	1.48E-01	7.23E-05	III
Fire in Retired Filters (3.4.7)	Unlikely	4.90E+00	2.42E-03	III

All postulated accidents result in potential consequences that are much less than 1 rem TED to the MOI and less than 25 rem TED to the worker at 100 m from the facility. The seismic event results in consequences to the CW of 22.3 rem. Since the event is an NPH, no controls are practical. In all other events, the potential dose consequences are well below the threshold for a moderate consequence event, and result in a risk bin value of III for the unmitigated accidents to all receptors. All accident analyses are based on very conservative, bounding assumptions for the accident scenario, source term, and release fractions. There are no safety-class or safety-significant SSCs or TSRs required for the prevention or mitigation of accident releases postulated for the B Plant features or systems. The onsite public receptor dose consequences were all determined to be in the low millirem range and therefore did not provide any additional

information for consideration and identification of controls. Therefore, these values are captured in the RADIDOSE calculations in Appendix B, but not reported in the DSA discussion.

4.2 Design Features

There are no Design Features designated for the B Plant Facility.

4.3 Important to Safety Equipment

The 221-B Canyon Building structures, which include the canyon walls and roof, ACT filter structure, and the retired filters structure, (including the deactivated exhaust system after the concrete plug in the air tunnel and the retired filter vaults) are designated as providing DID. These structures provide safety functions, as passive SSCs, that are effective for multiple hazards, which is one of the characteristics listed in PRC-PRO-NS-700 for identifying ITS equipment. The structures and the retired filters structure are not credited in the accident analyses for providing a preventive or mitigative function; however, the structures provide confinement of hazardous materials and shielding for worker protection during normal operations and accidents and the retired filters structure provides confinement of hazardous materials and protection of filter material from impact. All changes or modifications to these structures are subjected to the USQ Process and the structures are not subject to change by operations personnel.

4.4 Administrative Controls

To assure continued safe management of the facility, the following AC is provided:

- AC C.5.1 is identified to ensure implementation and assessment of applicable SMPs.

This AC is not classified as a Specific Administrative Control because it does not meet the criteria described in DOE-STD-1186-2004, *Specific Administrative Controls*, Section 2.1, "Identification of SACs." That is, the AC is not needed to prevent or mitigate an accident scenario and the safety function would not be safety-class or safety-significant, if the function were provided by an SSC because all accidents analyzed in Section 3.4 resulted in CW and MOI risk bin determinations of III without the application of controls.

4.5 Derivation of Technical Safety Requirements

There are no safety limits, limiting control settings, or limiting conditions for operation applicable to B Plant in S&M mode.

4.6 Step Out Criteria

The basis for the classification of B Plant as a nuclear facility is the radioactive inventory in the 221-B Canyon Building and the retired filters (Table 3-2). The B Plant Facility can be reclassified as below Hazard Category 3 when sufficient radioactive material is removed to lower the radioactive material inventory below the Hazard Category 3 threshold. Reclassification of the B Plant Facility as a below Hazard Category 3 Facility will require DOE approval and a formal Implementation Verification Review.

Those buildings identified as Less Than Hazard Category 3 facilities within this DSA may undergo demolition and final remediation activities using an approved Health and Safety Plan and applicable SMPs. Likewise, utilities that exist in the facility 'yard' area (outside the Hazard Category 2 & 3 structures but within the facility boundary) that are determined to be Less Than Hazard Category 3 may also undergo demolition and final remediation. Demolition and remediation activities are anticipated to include the use of equipment such as dump trucks, front-end loaders, graders, fork lifts, cranes, etc. The activities may require the use of scaffolding or other temporary structures to facilitate demolition. Demolition and final remediation impacts on adjacent nuclear facilities shall be evaluated using the USQ process and may be pursued provided the USQ evaluation yields a negative USQ.

For buildings and utilities that are not designated as Less Than Hazard Category 3 in the existing DSA, a separate Final Hazard Categorization document demonstrating that the building/utilities are Less Than Hazard Category 3 shall be prepared and submitted to RL for approval. Upon approval, the demolition and final remediation activities associated with the buildings and utilities adjacent to the nuclear facilities shall be evaluated using the USQ process and, provided the USQ review yields a negative USQ, they may undergo demolition and final remediation using an approved Health and Safety Plan and applicable SMPs. Demolition and remediation activities are anticipated to include the use of equipment such as dump trucks, front-end loaders, graders, fork lifts, cranes, etc. The activities may require the use of scaffolding or other temporary structures to facilitate demolition. The applicable nuclear facility DSA will be revised to reflect this new hazard categorization and building status in the next annual update as appropriate.

Chapter 5.0

Safety Management Programs

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5.0 Safety Management Programs

The hazards and accidents are analyzed in Chapter 3.0, Appendix A, and applicable SMPs are summarized in discussions of hazard controls in Chapter 4.0. These programs identify the applicable key protective requirements and features required for the safe conduct of operations and activities planned for B Plant.

Site programs are implemented by the performing organization to fulfill the CHPRC commitments to the ISMS/Environmental Management System. Details of the approved system, especially for the work control processes, may be found in PRC-MP-MS-003, *Integrated Safety Management System/Environmental Management System Description (ISMSD)*.

Additional detail regarding the requirements and program descriptions may be found in HNF-11724, *CH2M HILL Plateau Remediation Company Safety Management Programs*.

5.1 Prevention of Inadvertent Criticality

The Hanford Site Criticality Safety Program (HNF-7098, *Criticality Safety Program*) is implemented through facility programs and procedures as described in Chapter 6.0 of HNF-11724. B Plant contains at most 23 g of plutonium (Section 3.1) and is, therefore, designated an isolated facility. An Isolated Facility contains greater than 3 percent but less than or equal to one-half of a minimum critical mass (greater than 15 g but less than or equal to 251 g of plutonium) and is physically isolated (6 ft minimum) from other facilities containing fissionable material. All entrances through which fissionable material can be brought into an Isolated Facility must be posted to identify the facility as an Isolated Facility and specify the individual to contact. Only exempt amounts of fissile material are permitted in or around B Plant. Due to the limited amount of fissionable material in these facilities, compliance with all of the CHPRC Criticality Safety Programmatic requirements is not required.

5.2 Radiation Protection

The Radiation Protection Program implements applicable regulatory (10 CFR 835, "Occupational Radiation Protection") and other contractual requirements. The program is based on functional or operational organizations implementing the necessary requirements. The Radiation Protection Program is described in Chapter 7.0 of HNF-11724. No exceptions are taken to the key attributes as described in HNF-11724.

5.3 Hazardous Material Protection

The Hazardous Material Control Program is found in Chapter 8.0 of HNF-11724. No exceptions are taken to the key attributes as described in HNF-11724.

5.4 Radioactive and Hazardous Waste Management

The Hazardous Material Control Program is found in Chapter 9.0 of HNF-11724. No exceptions are taken to the key attributes as described in HNF-11724.

5.5 Initial Testing, In-Service Surveillance, and Maintenance

Personnel do not occupy B Plant except as required to perform required S&M functions. The scope of activities performed in B Plant is summarized in Section 2.2. The S&M Program is described in Chapter 10.0 of HNF-11724. The descriptions provided in HNF-11724 generally apply with the exception of initial testing, which does not apply to facilities in a decommissioning mode. No exceptions are taken of the key attributes as described in HNF-11724.

5.6 Operational Safety

CHPRC nuclear facilities implement the requirements of DOE O 422.1, *Conduct of Operations*, and CHPRC nuclear facilities have an implementing matrix for the guideline specified in DOE O 422.1. The Operational Safety Program is described in Chapter 11.0 of HNF-11724. No exceptions are taken of the key attributes as described in HNF-11724.

5.7 Fire Protection

The fire hazards are identified and analyzed in Chapter 3.0 of this DSA and in CP-41843. Activities authorized by this DSA will be performed consistent with the requirements of the site Fire Protection Program. Facility-specific controls and recommendations are identified in CP-41843. The Fire Protection Program is described in a portion of Chapter 11.0 of HNF-11724. The key attributes pertaining to fire protection, as described in HNF-11724 apply except for attribute KA 11-5. There are no safety basis requirements for the deactivated facility fire suppression system. National Fire Protection Association (NFPA) inspection, testing, and maintenance requirements are not applicable to this deactivated system.

5.8 Procedures and Training

CHPRC implements a procedure and training program within the scope of the plateau remediation contract. The program ensures that work processes are controlled by approved documents, procedures are under change control, procedures are periodically reviewed, and training includes a formal lessons learned process. Training ensures that the work force has the necessary skills to perform their work safely. The procedure and training program is described in Chapter 12 of HNF-11724. No exceptions are taken of the key attributes as described in HNF-11724.

5.9 Human Factors

Chapter 13.0 of HNF-11724 has no application to B Plant. As a facility in S&M and waiting final disposition, human factors have no design application. The remaining portions of the SMPs described in HNF-11724 have applicability to the S&M activities that are described in Section 2.2, and the hazards that are evaluated in Appendix A of this DSA.

5.10 Quality Assurance

CHPRC implements a quality assurance (QA) program meeting the requirements of 10 CFR 830, Subpart A, "Quality Assurance Requirements." This program is described in a subsection of Chapter 14.0 of HNF-11724. The program includes processes to detect and prevent QA problems, documentation and record controls, procurements and acquisitions process monitoring including prevention of use of counterfeit items, instrument and equipment calibration and testing, computer software controls, management assessments, independent assessments, and QA audits. No exceptions are taken of the key attributes as described in HNF-11724.

5.11 Emergency Preparedness Program

CHPRC implements the DOE Emergency Management Plan through its Emergency Preparedness Program. The implementing organization prepares and maintains hazard assessments and response plans for applicable facilities. Facility staff is trained and practice drills are used to ensure a timely and effective response should an emergency occur. While the S&M Organization typically performs drills annually, drills will not be performed for every facility annually. The Emergency Preparedness Program is described in Chapter 15.0 of HNF-11724. No exceptions are taken of the key attributes as described in HNF-11724.

5.12 Provisions for Decontamination and Decommissioning

B Plant is in S&M mode rather than D&D mode. However, further changes to the facility will need to consider future D&D operations. The D&D programs are discussed in Chapter 16.0 of HNF-11724. No exceptions are taken of the key attributes as described in HNF-11724.

5.13 Management, Organization, and Institutional Safety Provisions

CHPRC has established and implemented management, organization, and institutional safety provisions. These programs are summarized in portions of Chapter 17.0 of HNF-11724. No exceptions are taken to the key attributes as described in HNF-11724.

Chapter 6.0

References

6.0 References

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Appendix A

B Plant Facility Hazards Identification and Analysis

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Appendix A
B Plant Facility Hazards Identification and Analysis

A.1 Hazards Identification

The methodology used to identify hazards at B Plant is described in Section 3.3 of this Documented Safety Analysis (DSA). The hazard evaluation has been revised to reflect current methodologies and rankings that are provided in HNF-8739, *Hanford Safety Analysis and Risk Assessment Handbook (SARAH),* and CH2M HILL Plateau Remediation Company's contractual requirements.

B Plant is now in surveillance and maintenance (S&M) mode. The facility description and the list of authorized operations are given in Section 2.0. The facility is not normally occupied, with entries being made only to conduct S&M activities. Principal hazards are associated with radioactive material (principally ^{137}Cs and ^{90}Sr) which is present in contamination on surfaces in the cells, piping, tank heels and in the retired filters. The air cleanup train (ACT) filter system is operational and principally prevents spread of airborne contamination from the B Plant Canyon.

The hazards analysis was reviewed in 2015 to ensure consistency and flow from the hazards analysis to the analyzed accidents in Chapter 3. The following disciplines reviewed and concurred with the revisions made to the hazards analysis and Chapter 3:

- Nuclear Safety – John Weidert
- Criticality Safety (when fissile materials are present) – Richard Stachowiak
- Fire Protection Engineering – Larry Anderlini
- Radiation Protection – Steve Tilton
- OS&IH – Garrett Knutson
- Facility Operations – Daniel Wieczorkowski
- Emergency Preparedness – Eric Kinnunen
- Engineering – Sam Wajeeh
- Environmental Protection – Daniel Turlington

The hazard analysis was conducted in the four steps as given below:

A.1.1 Step 1: Review of Table from Initial Hazard Analysis

A table listing potential hazards from the initial hazard analysis was reviewed. This table listed the hazard type, location, form, and quantitative data when available. The initial hazard analysis given in the previous DSA was examined and potential hazards were identified. The table is reproduced as Table A-1. Table A-1 has six columns. The column headings and contents are described below:

Column 1, Hazard Type

This column identifies the type of hazard investigated. Hazard types investigated included radioactive material, direct radiation, fissionable material, hazardous material (i.e., toxic or

carcinogenic), biohazards, asphyxiant, flammable/combustible material, reactive material, explosive material, electrical energy, thermal energy, kinetic energy, and high pressure.

Column 2, Location

This column identifies the location investigated for the presence of the hazard type. Refer to Section 2.2 in the main text of this DSA for facility description information.

Column 3, Form

This column specifies the form of the hazard type. For example, the hazard type "hazardous material" is present in the 221-B Canyon Building galleries in the form of sodium hydroxide. Note that this column is not intended to provide a detailed identification of the chemical (e.g., oxide) or physical (e.g., crystalline) form of the hazard type. Such detail is not considered at the hazard identification stage of a safety analysis.

Column 4, Quantity

This column quantifies the form of the hazard type. Measured values are presented when relevant and available.

Column 5, Remarks

This column presents information that provides for a better understanding of the hazard type, location, form, and quantity.

Column 6, References

This column lists the information sources used to identify the location, form, and quantity of a given hazard type.

This table was used as a starting point for the hazard analysis to make the participants aware of previous work.

A.1.2 Step 2: Completion of Hazards Identification and Energy Designators Table

Section 2.2 of HNF-8739 indicates that a fundamental step in the hazard analysis process is to identify and understand potential hazards and energy sources. The checklist given in Table 2-1 of HNF-8739, "Hazards Identification and Energy Designators," was therefore completed by the hazard analysis team. Approximately 300 potential hazards or energy designators were identified. This completed checklist is shown in Table A-2, "Hazard Initiator Checklist and Energy Designators."

A.1.3 Step 3: Disposition of Identified Hazard Identification Checklist Items

Table A-3, "Disposition of Energy Checklist Items," has been developed to address the requirements of HNF-8739, Section 2.2.1, "Screening of Standard Industrial Hazards." The objective of the table is to disposition each hazard identified in the checklist either to a program where it is addressed or to a preliminary hazards analysis table entry where the hazard is considered in more detail.

In developing this table, a number of options were available regarding the programs that were considered to address each specific item, many programs such as training, QA, and conduct of operations, etc., have cross-cutting elements. For example, conduct of operations addresses procedure development and procedure implementation. Those two elements can clearly impact any activity and the disposition of the hazards associated with the activity. However, where the applicability of the program is generic in nature and not specific to the hazard, the program has generally been excluded.

The exception to this is the inclusion of the work management program. Work management is specified in the disposition of most hazards. This was done specifically in response to the expectation that DOE-STD-1120-2005, *Integration of Environment, Safety, and Health into Facility Disposition Activities*, safe harbor DSAs identify a "commitment to a task-level hazards screen and analysis…." The task level hazards analysis is captured in the work management program. The work management and automated job hazard analysis commitments are addressed in Chapter 8.0 of HNF-11724, *CH2M HILL Plateau Remediation Company Safety Management Programs*.

Part of the reason for the work management program and the task-based hazards analysis process in the DOE-STD-1120-2005 safe harbor methodology, is that specific activities other than routine S&M activities are not well defined. For example, it is expected that during the life cycle of long-term S&M, a piece of contaminated equipment may need to be removed from a facility for any one of many of reasons. However, it is not possible in the execution of the hazards analysis to specify what piece of equipment and what techniques might be used. Therefore, the approach in the hazards analysis process as discussed in PRC-PRO-NS-700, *Safety Basis Development*, is to identify "unmitigated bounding" accidents.

Since the hazards identification process is an integral part of the hazards analysis, the same approach is used in identification of energies/hazards in the completed checklist. For example, the hazards analysis team considers the spectrum of tools and methods that may be used to remove a piece of equipment. These energies are then considered with regard to the "unmitigated bounding" accidents. For the hazards analysis process, the scope of activities considered is the activities identified in Chapter 2.0 of the DSA. From that list the bounding and representative accidents were identified for additional analysis. These accidents were carried over to Table A-4.

A.1.4 Step 4: Completion of Preliminary Hazards Analysis

The methodology used to perform a preliminary evaluation of identified hazards was a "what if" methodology. An evaluation of the hazards was made by asking "what if" a certain event occurred. The potential frequency and consequences of the event were estimated. Consequence determination focused on the CW since the analyses of other central plateau facilities have determined the consequences to the CW is limiting. The distance from B Plant to the site boundary is approximately 11 kilometers, which significantly reduces the doses to the MOI. Therefore, the CW is limiting in determining consequence category. The detailed accident analyses will include both the CW and the MOI. Results of this hazard analysis are presented in Table A-4. The hazards were either identified as having no significant impact or were grouped to bounding accidents. Table A-4 shows the following structure:

Column 1, Item

This column sequentially numbers the table rows for ease of reference.

Column 2, Potential Event

This column identifies an event (e.g., fire) that, if it were to occur, could result in negative consequences to workers, the public, or the environment.

Column 3, Location

This column identifies the building (e.g., 221-B Canyon Building), or a specific location within a building (e.g., the galleries) impacted by the potential event. Refer to Chapter 2.0 for detailed information.

Column 4, Event and Possible Causes

This column describes the impact of the event at the location being evaluated and identifies possible causes. For example, a loss of electrical power caused by equipment failure can result in a loss of negative pressure differential leading to the migration of contamination.

Column 5, Structures, Systems, and Components (SSCs)

This column identifies the SSCs (e.g., sand filter) that potentially serve a preventive or mitigative function.

Column 6, Administrative

This column identifies administrative features (e.g., emergency procedures) that potentially serve a preventive or mitigative function.

Column 7, Consequences

This column is divided into three subcolumns and identifies the unmitigated consequences and risk bins for the CW. The consequences for the CW are more significant than the consequences for the MOI because of the large distances to the site boundary for B Plant. Facility workers are addressed in columns 10 to 12. The consequences are ranked as low (L), moderate (M) or high (H) as defined in Table 3-4 in Chapter 3.0.

Column 8, Frequency (Likelihood) Category

This column identifies the unmitigated likelihood ranking assigned to the event. The likelihoods are anticipated (A), unlikely (U), extremely unlikely (EU), or Beyond Extremely Unlikely (BEU) as defined in Table 3-3 in Chapter 3.0.

Column 9, Risk Bin Values and Selection for Additional Analysis

Risk bins are I, II, III or IV as defined in Table 3-5 in Chapter 3.0. This column also identifies if the event has been selected for additional evaluation/accident analysis.

Columns 10 and 11, Facility Worker

Columns 10 and 11 indicate if the hazard to the worker is beyond an industrial hazard and discusses the rationale for the decision. Since the facility is in S&M mode with no active systems and there are no unique hazards presented by the facility, these responses are all "No."

The preliminary hazards analysis results are shown in Table A-4. The analysis concluded that a more detailed analysis of seven bounding accidents is appropriate. The identified bounding accidents are:

1. Seismic event
2. Canyon roof collapse
3. Canyon fire
4. Staged waste fire
5. Canyon load drop
6. Retired filter fire
7. ACT filter vehicle impact and fire

These accidents are analyzed in Chapter 3.0.

Columns 10 and 11 have been added to document consideration of risks to facility workers. The analysis concludes that the risks to the workers are standard industrial hazards associated with operation of an industrial facility. The hazards to the workers who have made a building entry are principally nonnuclear industrial hazards. Worker protection during building entry is provided by the safety management programs (SMPs), and the procedures associated with the entry into the building.

A.2 References

CP-41843, *B Plant Fire Hazard Analysis*, as amended, CH2M HILL Plateau Remediation Company, Richland, Washington.

DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual*, as amended, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-STD-1120-2005, 2005, *Integration of Environment, Safety, and Health into Facility Disposition Activities*, U.S. Department of Energy, Washington, D.C.

HNF-8739, as amended, *Hanford Safety Analysis and Risk Assessment Handbook (SARAH)*, Fluor Hanford, Inc., Richland, Washington.

HNF-11724, *CH2M HILL Plateau Remediation Company Safety Management Programs*, as amended, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-NS-700, *Safety Basis Development*, CH2M HILL Plateau Remediation Company, Richland, Washington.

WHC-EP-0787, 1994, *Characterization of Decontamination and Decommissioning Wastes Effected from the Major Processing Facilities in the 200 Areas*, Westinghouse Hanford Company, Richland, Washington.

Table A-1 Hazards Identification for B Plant

Hazard Type	Location	Form	Quantity	Remarks	References
Radioactive material	221-B Canyon Building structures and systems; stored equipment; cells	Mixed fission products (^{90}Sr and ^{137}Cs) and possibly plutonium as surface contamination, packaged material, and material inside equipment and piping.	See Table 3-1. Several locations have fixed contamination.	See Table 3-1 in Chapter 3.0. There is a possibility that small quantities of radioactive material could migrate into the 271-B office area. This slow migration of radioactive material, including the small amount of material present in the galleries, is a minimal hazard.	See Table 3-1.
	212 B cask loading stations	Mixed fission products (^{90}Sr and ^{137}Cs) and possibly plutonium as surface contamination.	See Table 3-1.	The radioactive material in the galleries originated from spills and leaks from process lines and samples.	Facility surveys, process knowledge, and walkdown.
	A-E filters	Mixed fission products (^{90}Sr and ^{137}Cs) and small amounts of plutonium as contamination on the filter.	See Table 3-1.	Bounding estimate based on comparison with historical emissions.	See Table 3-1.
	Sand filter	Mixed fission products and possible plutonium from past plutonium storage.	See Table 3-1.		See Table 3-1.
	ACT filters	New filter operates and accumulates material.	See Table 3-1.		See Table 3-1.
Direct radiation	221-B Canyon Building	Mixed fission products (^{90}Sr and ^{137}Cs) as surface contamination, packaged material, and material inside equipment.	See Table 3-1.	Various radiological surveys have found areas of alpha, beta, and gamma surface contamination within the canyon. Direct radiation is not a hazard that extends beyond the facility.	WHC-EP-0787
	A-E filters and sand filter		See Table 3-1.		See Table 3-1.

Table A-1 Hazards Identification for B Plant

Hazard Type	Location	Form	Quantity	Remarks	References
		Mixed fission products (^{90}Sr and ^{137}Cs).		Filters are in below ground vaults and are not entered.	
Fissionable material	221-B Canyon Building plus filters	Fissionable material is less than 23 g.	See Table 3-1.	Criticality is not credible.	See Table 3-1.
Toxic material	221-B Canyon Building	Residues from former processes. See discussion in Section 3.1.	Liquid chemicals have been removed. Some dry trisodium phosphate remains. Other toxics include asbestos tile, lead in paint, plumbing mercury in thermostats or switches.	None.	See discussion in Section 3.1.
Carcinogen	All facilities	Asbestos insulation, tiling, friable if degraded or damaged.	Unknown quantities.	None.	See Section 3.1.
Biohazard	All buildings and areas	Rodents, insects, snakes.	Greater activity than in normally occupied facilities.	Because there is very little human activity in and around the B Plant buildings, increased rodent, insect, and snake activity can be expected.	
Asphyxiant	All buildings	None identified.	None identified.	None.	Records research.
Flammable material	All buildings	See CP-41843.	See CP-41843.	None.	See CP-41843.
Reactive material	221-B Canyon Building	No significant reactive material is expected.	As shown in Section 3.1 the types and quantities are small.	Sampling and manipulation of suspect and unknown containers by facility personnel is within the scope of this analysis.	See Section 3.1.
Explosive material	221B canyon	Miscellaneous residual chemicals in equipment stored in cells and on canyon deck.	No explosive materials are anticipated in the canyon or other covered facilities.	Hydrogen could be generated from radiolysis and chemical degradation. No significant accumulation is anticipated. Small quantities of hydrogen may be	See Section 3.1.

Table A-1 Hazards Identification for B Plant

Hazard Type	Location	Form	Quantity	Remarks	References
				present in waste containers.	
Explosive material	Yard Area	Fuel powered vehicles and tools.	Quantities are typical for fuel tanks on trucks and construction equipment.	Areas of concern include externally contaminated site and waste staging area	
Incompatible chemical reaction products	221-B Canyon Building	Miscellaneous residual chemicals in equipment stored in cells and on canyon deck.	As shown in Section 3.1, the types of chemicals in the 221-B Building are varied, but the quantities are small.	Introduction of new chemicals required during S&M work activities is controlled by the USQ program, Field Support and the Hazard Communication Program.	See Section 3.1.
Electrical energy	221-B Canyon Building and galleries	Electrical supply to surveillance lighting and leak detection.	Low voltages.	The electrical hazards present in the 221-B Canyon Building are equivalent to those routinely accepted by the general public.	Facility walkdown.
Thermal energy	221-B Canyon Building	Heat generation from chemical reaction.	Negligible.	There is no evidence of heat generation occurring in the tanks.	
Kinetic energy	221-B Canyon Building	Cell cover blocks, stored equipment, crane, 221-B Canyon Building structural components, deactivation activities, high winds.	Miscellaneous equipment: the equipment stored at B Plant varies in weight from several pounds to several tons (tanks, centrifuges, etc.).	Objects such as cover block have significant mass.	No lifting of heavy objects is planned for this phase of operation.
Kinetic energy	291-B exhaust fans and filter	Ground vehicles, 291-B-1 stack, high winds.	Not applicable.	None.	Facility walkdown.
	All buildings/ areas	Aircraft crash.	Aircraft.	Probability of such an event is extremely low.	
	221-B Canyon Building	If compressed gas cylinders are introduced, they are covered under kinetic energy hazards.	Compressed gas cylinders – covered under kinetic energy hazards.	Compressed gas cylinders – covered under kinetic energy hazards.	Compressed gas cylinders – covered under kinetic energy hazards.

Notes:

Table A-1 Hazards Identification for B Plant

Hazard Type	Location	Form	Quantity	Remarks	References

CP-41843, *B Plant Fire Hazard Analysis*

WHC-EP-0787, *Characterization of Decontamination and Decommissioning Wastes Effected from the Major Processing Facilities in the 200 Areas*

Table A-2. Hazard Identification Checklist and Energy Designators

LOTE Low Thermal Energy		AE Acoustic Energy		BIO Biological	
☒ 1	Cryogenic Systems	☐ 1	Equipment/Platform Vibration	☒ 1	Animal/Insect Hazard
☐ 1.1	Freeze Seal Equipment	☒ 2	Equipment Rooms	☒ 1.1	Dead Animals
☒ 1.2	Liquid N_2 in Dewars	☒ 2.1	Motor Rooms	☒ 1.2	Animal Droppings
☐ 1.3	Liquid N_2 in Tanks	☐ 2.2	Pump Rooms	☒ 1.3	Animal Bites
☐ 1.4	Liquid N_2 Production	☒ 2.3	Fan Rooms	☒ 1.4	Insect Bites
☐ 1.5	Other Cryogenic Systems	☐ 2.4	Compressor Rooms	☒ 1.5	Insect Stings
	_____	☐ 2.5	Other Equipment Rooms	☐ 2	Plant Hazards
☒ 2	Low Ambient Temperatures		_____	☐ 2.1	Allergens
☒ 2.1	Loss of HVAC [system impacts]	☒ 3	Decontamination & Size Reduction Tools	☐ 2.2	Toxins
☐ 2.2	Loss of HVAC [worker impacts]	☒ 3.1	Cutting Devices	☒ 3	Disease Related Hazards
☐ 2.3	Freezers/Chillers	☒ 3.2	Decontamination Devices	☒ 3.1	Bacteria
☐ 2.4	Other Low Temperatures	☒ 3.3	Abrading Devices	☒ 3.2	Viruses
	_____	☐ 3.4	Other AE Tools	☐ 3.3	Sewage
☐ 3	Other LOTE Hazards		_____	☐ 3.4	Blood/Body Fluids
	_____	☐ 4	Other AE Hazards	☐ 3.5	Medical Waste
			_____	☐ 4	Other BIO Hazards
					_____

NPH Natural Phenomena		OTH Other		KE Kinetic Energy	
☒ 1	Earthquakes	☒ 1	Inert/Low O_2 Atmosphere	☒ 1	Vehicle/Transport Devices in Motion
☒ 2	Natural Radiation	☒ 1.1	Dust [breathing]	☐ 1.1	Rail Cars/Trains
☒ 3	Lightning	☒ 1.2	N_2/He Atmosphere	☒ 1.2	Excavators/Backhoes
☒ 4	Solar/Heat Wave	☒ 1.3	Confined Spaces	☒ 1.3	Cranes/Crane Loads
☒ 5	Range Fire	☒ 1.3.1	Tanks	☒ 1.4	Trucks/Cars
☒ 6	Dust/Sand	☐ 1.3.2	Basins	☒ 1.5	Forklifts/Loaders
☒ 7	Fog	☒ 1.3.3	Manholes	☐ 1.6	Conveyors
☒ 8	Heavy Rain	☒ 1.3.4	Pits	☒ 1.7	Man-Powered Devices in Motion
☒ 8.1	Flooding [from rain]	☒ 1.4	Trench/Excavation Collapse	☒ 1.7.1	Hoists
☐ 8.2	Sediment Transport	☒ 1.5	Water in Confined Space	☒ 1.7.2	Carts/Dollies
☒ 9	Hail	☐ 1.6	Other Low O_2 Atmospheres	☒ 1.8	Other Device in Motion
☒ 10	Low Temperatures		_____		Drilling vehicle
☒ 11	Freeze	☒ 2	Inadequate Visibility	☒ 2	Loaded Transports in Motion
☒ 12	Heavy Snow	☒ 2.1	Respirator Fogging	☒ 2.1	Crane Loads [loaded]
☒ 13	High Winds	☒ 2.2	Dust [visibility]	☒ 2.2	Trucks [loaded]
☐ 14	Tornadoes	☒ 2.3	Glare	☒ 2.3	Forklifts [loaded]
☐ 15	Volcanoes	☐ 2.4	Other Impaired Visibility	☐ 2.4	Conveyors [loaded]
☒ 16	Volcanic Ash		_____	☒ 2.5	Loaded Man-Powered Transports in Motion
☐ 17	Other NPH	☒ 3	External/Offsite Event	☒ 2.5.1	Hoists [loaded]
	_____	☒ 3.1	Aircraft Crash	☒ 2.5.2	Pallet Jacks [loaded]
		☐ 3.2	Offsite Transportation Accident		
		☐ 3.3	Offsite Explosion		
		☒ 3.4	Major Fire		

Table A-2. Hazard Identification Checklist and Energy Designators

	☐ 3.5 Reservoir Failure ☐ 3.6 Other External Event _____ ☒ 4 Unknown Material ☒ 5 Unknown Configuration ☐ 6 Other OTH Hazards _____	☒ 2.5.3 Carts/Dollies [loaded] ☐ 2.6 Other Transport in Motion _____ ☒ 3 Decontamination & Size Reduction Tools ☒ 3.1 Impact Tools ☒ 3.2 Projectile Tools ☐ 3.3 Other KE Tools _____ ☐ 4 Relief Valve Blow-down ☐ 5 Other KE Hazards _____
LOEE Loss of Electrical Energy	**CM Chemical Materials**	**CE Chemical Energy**
☒ 1 Loss of Powered Equipment ☒ 1.1 Motor Stoppage ☒ 1.2 Pump Stoppage ☒ 1.3 Fan Stoppage in Areas with Differential Pressure ☐ 1.3.1 Flow Reversal ☐ 1.3.2 Supply Fan Pressurization ☒ 1.3.3 Static Air Situation ☒ 1.4 Fan Stoppage in Ventilated Areas ☐ 1.4.1 Accumulation of Hazardous Vapors ☐ 1.4.2 Accumulation of Asphyxiants ☐ 1.4.3 Accumulation of Flammable Gases ☐ 1.5 Compressor Stoppage ☐ 1.5.1 Loss of Air [dry-pipe] ☐ 1.5.2 Loss of Air [no inert] ☐ 1.5.3 Reduced PPE Pressure ☒ 1.6 Loss of Heaters ☒ 1.6.1 System Freeze Impacts ☐ 1.6.2 Worker Freeze Impacts ☒ 1.7 Loss of Coolers/Chillers ☒ 1.7.1 System Overheat Impacts ☐ 1.7.2 Worker Overheat Impacts ☐ 1.8 Misdirected Flow due to Loss of Valves/Dampers ☒ 1.9 Loss Instrumentation ☐ 1.10 Other Equipment Loss computer affected by temp variations_	☒ 1 Toxins ☐ 1.1 Hepatotoxins [Carbon Tetrachloride] ☐ 1.2 Nephrotoxins [Chloroform] ☒ 1.3 Neurotoxins [Mercury] ☒ 1.4 Reproductive Toxins [Lead] ☐ 1.5 Toxic Agents [Strychnine] ☒ 1.6 Agents that Attack the Lungs [Asbestos] ☒ 1.6.1 Ceiling Tiles/Insulation ☐ 1.7 Agents that Attack the Skin [Acetone] ☒ 1.8 Agents that Attack the Eyes [Organic Solvents] ☐ 1.9 Agents that Attack the Mucous Membranes [Ammonia] ☒ 1.10 Agents that Attack the Blood [Carbon Monoxide/ Cyanides] ☒ 1.11 Carcinogens [Carbon Tetrachloride, PCBs] ☐ 1.12 Sensitizers [Beryllium/Epoxy Resins] ☒ 1.13 Irritants [Calcium Chloride] ☒ 1.14 Pesticides/Insecticides ☒ 1.15 Herbicides ☐ 1.16 Other Toxins _____ ☐ 2 Asphyxiants ☒ 3 Miscellaneous Chemicals/Groups	☒ 1 Oxidizers ☐ 1.1 Organic Peroxides ☒ 1.2 Corrosives/Acids/Reagents/ Bleaches [in use] ☒ 1.3 Residual Corrosives/Acids ☐ 1.4 Battery Banks ☐ 1.5 Other Oxidizers _____ ☐ 2 Reactives ☐ 2.1 Water Reactives [Sodium] ☐ 2.2 Shock Sensitive Chemicals [Nitrates] ☐ 2.3 Peroxides/ Superoxides/Ethers ☐ 2.4 Explosive Substances ☐ 2.4.1 Electric Squibs ☐ 2.4.2 Dynamites/Caps/ Primer Cord ☐ 2.4.3 Dusts [explosive] ☐ 2.5 Other Reactives _____ ☒ 3 Other Chemical Energy Hazards ☒ 3.1 Corrosion/Oxidation [rust] ☒ 3.2 Bonding Agents ☒ 3.2.1 Sealants/Fixatives ☒ 3.2.2 Epoxies/Adhesives ☒ 3.3 Refrigerants/Coolants [Propylene Glycol] ☐ 3.4 Water Treatment Products ☒ 3.5 Decontamination Chemicals

Table A-2. Hazard Identification Checklist and Energy Designators

☒	2	Inadequate Light/Illumination	☒ 3.1	Hazardous Wastes [RCRA, TSCA]	☒ 3.6 Miscellaneous Laboratory Chemicals
☒	2.1	Operations Impacts	☒ 3.2	Creosote	☐ 3.7 Soil/Air/Water Reactions [Buried Materials]
☒	2.2	Worker Impacts	☐ 3.3	Other Miscellaneous Chemicals	☒ 4 Incompatible Wastes
☒	3	Loss of Batteries/Direct Current Systems		_____	☐ 5 High Temperature Wastes
☒	4	Other LOEE Hazards	☐ 4	Other CM Hazards	☐ 6 Other CE Hazards
		LOEE For portable Equipment		_____	_____
ME Mechanical Energy			**TP Thermal Potential Energy**		**EE Electrical Energy**
☒	1	Transverse [single direction] Motion Devices	☒ 1	Flammable Gases	☒ 1 High Voltage Equipment
☒	1.1	Forklift Tines [puncture]	☒ 1.1	Natural Gas/Propane	☒ 1.1 Power Transmission Equipment
☐	1.2	Piston Compressors [crush]	☒ 1.2	Welding/Cutting Gases	☒ 1.1.1 Wiring [high voltage]
☐	1.3	Presses [crush]	☐ 1.3	Laboratory/Calibration Gases	☒ 1.1.2 Overhead Transmission Lines
☒	1.4	Pinch Points [pinch]	☐ 1.3.1	Methane/Butane	☒ 1.1.3 Transformers [high voltage]
☒	1.5	Sharp Edges/Objects [cut]	☐ 1.3.2	H_2 [lab]	☒ 1.1.4 Switchgear [high voltage]
☒	1.6	Drills [puncture]	☐ 1.4	Process/Reaction Off-Gases	☐ 1.2 Capacitor Banks
☒	1.7	Sanders/Brushes [wear]	☐ 1.4.1	H_2 [containers]	☐ 1.3 Lightning Grids
☒	1.8	Shears/Pipe Cutters [shear]	☐ 1.4.2	H_2 [process]	☐ 1.4 Other High Voltage Hazards
☒	1.9	Grinders [crush/pinch/shear]	☐ 1.4.3	Sewer Gas	_____
☐	1.10	Other Transverse Motion	☐ 1.4.4	Carbon Monoxide	☒ 2 Low Voltage Equipment
		_____	☐ 1.5	Other Flammable Gases	☒ 2.1 480/240/120 Volt Equipment
☒	2	Reciprocating [back and forth] Motion Devices		_____	☒ 2.1.1 Wiring [low voltage]
☒	2.1	Vibration [wear]	☒ 2	Flammable/Combustible Liquids	☒ 2.1.2 Cable Runs
☒	2.2	Saws [cut]	☒ 2.1	HEPA Test Aerosol Fluid	☒ 2.1.3 Overhead Wiring
☐	2.3	Other Reciprocating Motion	☒ 2.2	Petroleum Based Products	☒ 2.1.4 Underground Wiring
		_____	☒ 2.2.1	Gasoline	☒ 2.1.5 Transformers [low voltage]
☒	3	Circular Motion Devices	☒ 2.2.2	Diesel Fuel	☒ 2.1.6 Switchgear [low voltage]
☒	3.1	Belts/Hoist Cables [pull/wrap]	☒ 2.2.3	Oils [lube, coolant]	☒ 2.1.7 Service Outlets
☒	3.2	Bearings/Shafts [wrap]	☒ 2.2.4	Grease	☒ 2.1.8 Other Electrical Equipment
☒	3.3	Gears/Couplings [pull]	☒ 2.3	Vehicle/Equipment Fuel Tanks	_____
☒	3.4	Diesel Generators/ Turbines [wrap]	☒ 2.3.1	Gasoline [tank]	☒ 2.2 Temporary Power Equipment
☒	3.5	Pumps [wrap]	☒ 2.3.2	Diesel Fuel [tank]	☒ 2.2.1 Diesel Units
☒	3.6	Fans [wrap]	☒ 2.4	Paint/Cleaning/ Decontamination Solvents	☐ 2.2.2 Battery Banks
☐	3.7	Rotary Compressors [wrap]	☒ 2.5	Paints/Epoxies/Resins	☐ 2.2.3 12-32 V DC Systems
☐	3.8	Centrifuges [wrap]	☐ 2.6	Other Flammable Liquids	☐ 2.2.4 Other Temporary Electrical
☒	3.9	Drills/Rotary Sanders [wrap]		_____	_____
☒	3.10	Grinders [wrap]	☒ 3	Combustible Solids	☒ 2.3 Electrical Equipment [low voltage]
☒	3.11	Other Circular Motion	☒ 3.1	Paper/Wood Products	☒ 2.3.1 Motors
		rotary cleaner	☒ 3.2	Cloth/Rags	☒ 2.3.2 Pumps

Table A-2. Hazard Identification Checklist and Energy Designators

☐ 4 Other ME Hazards _____	☒ 3.3 Rubber ☒ 3.4 Plastic Materials ☒ 3.4.1 Size Reduction Tents/ Permacons ☐ 3.4.2 Benelex/Lexan/HDPE ☒ 3.4.3 Rigid Liners/Poly-Liners/ Bagging Materials ☒ 3.5 Other Combustible Solids _containment tents_____	☒ 2.3.3 Fans ☒ 2.3.4 Compressors ☒ 2.3.5 Heaters ☐ 2.3.6 Valves/Dampers ☒ 2.3.7 Power Tools ☒ 2.3.8 Instrumentation ☐ 2.3.9 Other Electrical Use Equipment _____ ☐ 2.4 Grounding Grids ☐ 2.5 Static Charge ☐ 2.6 Other Low Voltage Hazards _____
RE Radiant Energy	**RM Radioactive Material**	**TE Thermal Energy**
☒ 1 Direct Radiation Sources ☒ 1.1 Calibration Sources ☒ 1.2 Other Radioactive Material ☒ 1.2.1 Fissile Material Storage/ Holdup ☐ 1.2.2 Actinide Solutions ☒ 1.2.3 Waste Containers ☒ 1.2.4 Contamination ☐ 1.3 Other Direct Radiation Hazards _____ ☐ 2 Ionizing Radiation Devices ☐ 2.1 Radiography Equipment ☐ 2.2 X-Ray Machines ☐ 2.3 Electron Beams ☐ 2.4 Ultra-Intense Lasers ☐ 2.5 Accelerators ☐ 2.6 Other Ionizing Hazards _____ ☒ 3 Non-Ionizing Radiation Sources ☐ 3.1 Electromagnetic Sources ☐ 3.1.1 Electromagnetic Communication Waves ☐ 3.1.2 Radio-Frequency Generators ☐ 3.1.3 Microwave Frequencies ☐ 3.1.4 Electromagnetic Fields ☐ 3.1.5 Electric Furnaces ☒ 3.1.6 Computers ☒ 3.2 Welding/Cutting Devices	☒ 1 Fissile Material [Metals/Oxides/Residues] ☐ 1.1 Bag ☐ 1.2 Glovebox [exposed] ☐ 1.3 Can ☐ 1.4 Welded Can ☐ 1.5 Drum ☐ 1.6 Overpack ☐ 1.7 Type B Shipping Container ☒ 1.8 Ducting [exposed] ☒ 1.9 Plenum [exposed] ☒ 1.10 Filter [exposed] ☐ 1.11 Cooler ☐ 1.12 Hood [exposed] ☐ 1.13 Other Solid Fissile Material _____ ☐ 2 Actinide Solution ☐ 2.1 Bottle ☐ 2.2 Drum ☒ 2.3 Piping ☐ 2.4 Tank ☐ 2.5 Other Liquid Fissile Material _____ ☒ 3 Waste [LLW, LLM, TRU, TRM] ☒ 3.1 Bag ☒ 3.2 Glovebox [exposed] ☒ 3.3 Drum ☒ 3.4 Metal Crate	☐ 1 Chemical Reactions ☐ 2 Pyrophoric Material ☐ 2.1 Plutonium/Uranium Metal ☐ 2.2 Pyrophoric Chemicals ☐ 2.3 Other Pyrophoric Material _____ ☒ 3 Spontaneous Combustion Material ☒ 3.1 Petroleum Based Products ☒ 3.2 Reactive Chemicals ☒ 3.3 Nitric Acids/Organics ☒ 3.4 Paint/Cleaning/ Decontamination Solvents ☒ 4 Open Flame Sources ☒ 4.1 Cutting Torches ☒ 4.2 Welding Torches ☐ 4.3 Laboratory Burners ☐ 4.4 Other Open Flames _____ ☒ 5 Heating Devices/Systems ☐ 5.1 Furnaces ☐ 5.2 Boilers ☒ 5.3 Heaters ☐ 5.4 Hot Plates ☐ 5.5 RTGs ☐ 5.6 Other Heating Equipment _____ ☐ 6 Radioactive Decay ☒ 7 High Temperature Items ☐ 7.1 Lasers

Table A-2. Hazard Identification Checklist and Energy Designators

☒ 3.2.1	Plasma Arc Magnetic Field	☒ 3.5	Pipe Overpack Container	☐ 7.2	Incinerators/Fire Boxes
☒ 3.2.2	Plasma Arc Infrared/Ultraviolet Light	☒ 3.6	Overpack	☒ 7.3	Engine Exhaust Surfaces
☒ 3.2.3	Welding	☒ 3.7	Shipping Cask	☐ 7.4	Steam Lines
☐ 3.3	Low Power Lasers	☒ 3.8	Ducting [exposed]	☒ 7.5	Electrical Equipment
☐ 3.4	Other Non-Ionizing Hazards	☒ 3.9	Plenum [exposed]	☐ 7.5.1	Electrical Wiring
	_____	☒ 3.10	Filter [exposed]	☒ 7.5.2	Portable Lamps/Lighting
☐ 4	Potential RE Sources	☒ 3.11	Hood [exposed]	☒ 7.6	Welding/Cutting/Grinding Surfaces
☒ 4.1	Critical Masses	☒ 3.12	Wooden Crate	☒ 7.6.1	Plasma Arc Surfaces
☒ 4.1.1	Solid Fissile Material	☒ 3.13	Cargo Container	☒ 7.6.2	Welding Surfaces
☐ 4.1.2	Liquid Fissile Material	☒ 3.14	Other Waste Material	☒ 7.6.3	Grinder/Saw Surfaces
☐ 4.1.3	Containerized Fissile Material		_____	☒ 7.7	Friction Heated Surfaces
☐ 4.2	Irradiated Equipment	☒ 4	General Contamination	☒ 7.7.1	Belts [friction]
☐ 4.3	Other Potential RE Hazards	☒ 4.1	Contaminated Soils	☒ 7.7.2	Bearings [friction]
	_____	☒ 4.2	Contaminated Water	☒ 7.7.3	Gears [friction]
☐ 5	Other RE Hazards	☒ 4.3	Contaminated Oil/Antifreeze	☒ 7.7.4	Power Tools [friction]
	_____	☒ 4.4	Other Contamination	☒ 7.7.5	Motors/Fans [friction]
			_Airborne Areas_____	☐ 7.8	Other High Temperature Items
		☐ 5	Burial Grounds		_____
		☐ 6	Other RM Hazards	☒ 8	High Ambient Temperature Areas
			_____	☐ 8.1	Loss of Ventilation
				☐ 8.2	Areas Around Furnaces/Boilers
				☒ 8.3	Multiple Layers PPE
				☐ 9	Other TE Hazards
					_____

PE Potential Energy		PE Potential Energy (cont'd)		PE Potential Energy (cont'd)	
☒ 1	Pressure-Related PE Hazards	☒ 2	Gravity-Related PE Hazards	☒ 3	Momentum-Related PE Hazards
☒ 1.1	Compressed Gases	☒ 2.1	Elevated Equipment/Structures	☒ 3.1	Moving Vehicle/Transport Devices
☒ 1.1.1	Breathing Air/Compressed Air/O_2	☒ 2.1.1	Cranes/Hoists	☐ 3.1.1	Rail Cars/Trains [in motion]
☒ 1.1.2	He/Argon/Specialty Gases	☒ 2.1.2	Ducting/Lights/Piping	☒ 3.1.2	Cranes [in motion]
☒ 1.1.3	Refrigerants/CO_2 Bottles	☒ 2.1.3	Rollup Doors	☒ 3.1.3	Trucks [in motion]
☒ 1.1.4	Other Bottled Gases	☒ 2.1.4	Elevators	☒ 3.1.4	Forklifts/Loaders [in motion]
☒ 1.1.5	Gas/Air Receivers/ Compressors	☒ 2.1.5	Roofs/Plenums	☐ 3.1.5	Other Moving Materials
☐ 1.1.6	Other Compressed Gas	☒ 2.1.6	Upper Floor Components		_____
	_____	☒ 2.1.7	Tanks/Solutions in Elevated Equipment	☒ 3.2	Rotating Equipment
☒ 1.2	High Pressure Gas Systems	☐ 2.1.8	Steam/Natural Gas Lines	☒ 3.2.1	Bearings/Rollers/Shafts
☐ 1.2.1	Pressure Vessels	☒ 2.1.9	Power Lines/ Transformers	☒ 3.2.2	Gears/Couplings/Pivot Joints
☐ 1.2.2	Instrument/Plant Air	☒ 2.1.10	Other Elevated Equipment	☒ 3.2.3	Diesel Generators/Turbines
☐ 1.2.3	Chemical Reaction Vessels/ Autoclaves		___stack_____	☒ 3.2.4	Pumps
				☒ 3.2.5	Fans/Air Movers

Table A-2. Hazard Identification Checklist and Energy Designators

☐ 1.2.4 Furnaces/Boilers	☒ 2.2 Elevated Hazardous Materials	☐ 3.2.6 Rotary Compressors
☐ 1.2.5 Steam Header/Lines	☒ 2.2.1 Crane Loads	☐ 3.2.7 Centrifuges
☒ 1.2.6 Pneumatic Lines	☒ 2.2.2 Truck Loads	☐ 3.2.8 Other Rotating Equipment
☒ 1.2.7 Impact Tools	☒ 2.2.3 Forklift/Other Lifts Loads	_____
☒ 1.2.8 Sand/CO_2 Blasting Equipment	☐ 2.2.4 Conveyor Loads	☐ 3.3 Other Momentum PE Hazards
☐ 1.2.9 Other Pressurized Gas	☒ 2.2.5 Hoist Loads	_____
_____	☒ 2.2.6 Cart Loads	☐ 4 Other PE Hazards
☒ 1.3 High Pressure Liquid Systems	☒ 2.2.7 Hand Carried Loads	_____
☐ 1.3.1 Water Heaters	☐ 2.2.8 Stacked Hazardous Materials	
☒ 1.3.2 Excavators/Backhoes [hydraulics]	☐ 2.2.9 Other Elevated Materials	
☒ 1.3.3 Cranes [hydraulics]	_____	
☒ 1.3.4 Trucks/Cars [hydraulics]	☒ 2.3 Pits/Trenches/ Excavations	
☒ 1.3.5 Forklifts [hydraulics]	☒ 2.4 Elevated Work Surfaces	
☐ 1.3.6 Conveyors [hydraulics]	☒ 2.4.1 Roofs/Elevated Doors/Loading Docks	
☒ 1.3.7 Hydrolazing Equipment	☒ 2.4.2 Stairs/Elevators	
☒ 1.3.8 Tool Hydraulic Lines	☒ 2.4.3 Ladders/Fixed Ladders	
☐ 1.3.9 Solution Transfer Systems	☒ 2.4.4 Cherry-Pickers/Hysters	
☐ 1.3.10 Other Pressurized Liquids	☒ 2.4.5 Scaffolding/Scissor Jack Scaffolds	
_____	☒ 2.4.6 Other Elevated Surfaces	
☐ 1.4 Pressurized Systems/ Components	_____	
☐ 1.4.1 Coiled Springs	☐ 2.5 Other Gravity PE Hazards	
☐ 1.4.2 Stressed Members	_____	
☐ 1.4.3 Torqued Bolts		
☐ 1.4.4 Gaskets/Seals/O-Rings		
☐ 1.4.5 Fire Suppression Systems		
☐ 1.4.6 Other Pressurized Systems		
☐ 1.5 Vacuum Systems		
☐ 1.6 Other Pressure PE Hazards		
_____		

Table A-3 Disposition of Energy Checklist Items

Hazards Checklist Item	Evaluation	SMP Disposition	HNF-11724 – Key Attribute
LOTE 1, 1.2	Liquid Nitrogen in dewars was identified as a possible hazard associated with NDA activities.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
LOTE 2, 2.1	Loss of HVAC – system impacts were considered.	Initial Testing, In-Service Surveillance, and Maintenance PHA ID 4, 21	Key Attribute 10-4
LOTE 2.2	Loss of HVAC – worker impacts are limited to working in high temperatures.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
AE (ALL)	Areas with operating equipment have acoustic energy considerations.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
BIO (ALL)	Biological hazards are an expected hazard, especially in non-occupied facilities in long term surveillance and maintenance.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
NPH 1, 12, 13, 16	Various NPHs that could result in failure of the building structure.	Initial Testing, In-Service Surveillance, and Maintenance PHA ID 1, 2, 3, 21	Key Attribute 10-4
NPH 2, 3, 4, 5	Various NPHs that could result in a building fire.	Operational Safety PHA ID 13	Key Attribute 11-3, 11-4, 11-5, 11-7
NPH 6, 7	Various NPHs that could contribute to a vehicle impact that could result in partial failure of the building structure.	Initial Testing, In-Service Surveillance, and Maintenance; Operational Safety PHA ID 6, 7, 8	Key Attribute 10-4 and discussion in Section 11.3 of DOE/RL-92-36
NPH 8, 8.1, 9	NPH considerations for water intrusion.	Initial Testing, In-Service Surveillance, and Maintenance PHA ID 11, 12	Key Attribute 10-4
NPH 10, 11	NPH considerations for low/freezing temperatures.	Initial Testing, In-Service Surveillance, and Maintenance; Management, Organization, and Institutional Safety Provisions	Key Attribute 10-4, 17-10
NPH 1, 12, 13, 16	NPHs that could contribute to a loss of confinement.	Initial Testing, In-Service Surveillance, and Maintenance PHA ID 1, 2, 3, 9, 10, 21, 30	Key Attribute 10-4
OTH 1 (All)	Potential confined space (low oxygen) hazards identified at the facility.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
OTH 2 (All)	Potential visibility hazards identified at the facility.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
OTH 3, 3.1	External event of an aircraft impact to the facility.	PHA ID 5	No SMP can prevent an aircraft impact.

Table A-3 Disposition of Energy Checklist Items

Hazards Checklist Item	Evaluation	SMP Disposition	HNF-11724 – Key Attribute
OTH 3.4	External event of a major fire impacting the facility.	Operational Safety PHA ID 13	Key Attribute 11-3, 11-4, and 11-7
OTH 4, 5	These items were checked by the HA team in recognition that the characterization information at the facility is not current and may be subject to change.	The hazard is dispositioned by use of conservative assumptions in modeling the accidents and by the identification of characterization activities as a primary authorized activity.	
KE 1 (All)	Vehicles in motion are an expected hazard for facilities in long-term S&M.	Operational Safety; Management, Organization, and Institutional Safety Provisions PHA IDs 6, 7, 8, 32	Key Attribute 17-10; also Key Attributes 11-3, 11-4, 11-5, and 11-7 and discussion in Section 11.3 of DOE/RL-92-36
KE 2 (All)	Vehicles in motion with loads.	Operational Safety; Management, Organization, and Institutional Safety Provisions PHA IDs 6, 7, 8	Key Attribute17-10; also Key Attributes 11-3, 11-4, and 11-7 and discussion in Section 11.3 of DOE/RL-92-36
KE 3 (All)	The tools are identified for use in decontamination and/or size reductions that may be performed under long-term S&M.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
KE 4	There are relief valves in B Plant.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
LOEE 1 TO 1.4 (All)	These items identify the potential hazards associated with a loss of the ventilation system.	Initial Testing, In-Surveillance, and Maintenance; Management, Organization, and Industrial Safety Provisions PHA IDs 4, 22	Key Attribute 17-10 and Key Attribute 10-4
LOEE 1.6, 1.7 (All)	Hazards associated with the loss of electrical power resulting in a lack of climate control for the workers.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
LOEE 1.9	Loss of electrical power leading to a loss of instruments at the facility.	The HA team identified the loss of instrumentation within the facility but no impacts beyond failure of the instrument were identified.	
LOEE 2, 3, and 4 (All)	Loss of electrical power including loss of portable equipment being used and worker lighting.	Management, Organization, and Institutional Safety Provisions PHA ID 4	Key Attribute 17-10

Table A-3 Disposition of Energy Checklist Items

Hazards Checklist Item	Evaluation	SMP Disposition	HNF-11724 – Key Attribute
CM (All)	From the facility history and conditions as well as past S&M activities performed by the HA team members these are the types of residual chemical materials that are expected within the facility. This addresses the potential for personnel exposure to the materials.	Management, Organization, and Institutional Safety Provisions PHA ID 28	Key Attribute 17-10
CE (All)	From the facility history and conditions as well as past S&M activities performed by the HA team members these are the types of chemical energies that are expected within the facility.	Radioactive and Hazardous Waste Management; Operational Safety; Management, Organization, and Institutional Safety Provisions PHA ID 25, 26, 28, 29	Key Attribute 17-10; also Key Attributes 11-3, 11-4, and 11-7; also Key Attributes 9-1, 9-3, and 9-6
ME (All)	Mechanical energy hazards associated with the current operating systems as well as the equipment associated with planned or authorized activities.	Radiation Protection; Hazardous Material Protection; Management, Organization, and Institutional Safety Provisions PHA ID 17, 18, 24	Key Attribute 17-10; also Key Attributes 7-1 through 7-8; also Key Attributes 8-5, 8-6 and 8-7
TP (All)	Thermal potential energy hazards associated with the current facility conditions and equipment as well as those associated with planned or authorized activities.	Operational Safety; Management, Organization, and Institutional Safety Provisions PHA ID 14, 15, 16	Key Attribute 17-10; also Key Attributes 11-3, 11-4, and 11-7
EE (All)	Electrical energy hazards associated with the current operating systems as well as the equipment associated with planned or authorized activities.	Operational Safety; Management, Organization, and Institutional Safety Provisions PHA ID 4, 14, 15, 16	Key Attribute 17-10. ; also
RE 1 (All)	Radiant energies associated with residual inventory and authorized activities.	Radiation protection PHA ID 27, 30, 31	Key Attributes 7-1 through 7-8
RE 3 (All)	Radiant energies associated with cutting and welding activities.	Operational Safety; Management, Organization, and Institutional Safety Provisions PHA ID 14, 15, 16	Key Attribute 17-10; also Key Attributes 11-3, 11-4, and 11-7
RE 4 (All)	Radiant energies associated with residual inventory and authorized activities.	Prevention of Inadvertent Criticality PHA ID 23	Key Attributes 6-1 through 6-6 – applicable based on the classification and activities at the facility
RM 1 (All)	Radioactive material associated with the residual inventory and the authorized activities.	Prevention of Inadvertent Criticality; Radiation Protection PHA ID 27	Key Attributes 7-1 through 7-8; also Key Attributes 6-1 through 6-6 – applicable based on the classification and activities at the facility

Table A-3 Disposition of Energy Checklist Items

Hazards Checklist Item	Evaluation	SMP Disposition	HNF-11724 – Key Attribute
RM 2.3	Radioactive material associated with residual inventory in piping	Radiation Protection; Management, Organization, and Institutional Safety Provisions PHA ID 32	Key Attributes 7-1 through 7-8; also Key Attribute 17-10
RM 3 (All)	Radioactive material associated with the residual inventory and the authorized activities as waste components.	Radiation Protection; Radioactive and Hazardous Waste Management; Operational Safety; Management, Organization, and Institutional Safety Provisions PHA ID 23, 24, 25, 26	Key Attributes 9-1, 9-3 and 9-6; also Key Attribute 17-10; also Key Attributes 11-3, 11-4, and 11-7; also Key Attributes 7-1 through 7-8
RM 4 (All)	Contaminated radioactive materials.	Radiation Protection; Management, Organization, and Institutional Safety Provisions PHA ID 27, 30	Key Attribute 17-10; also Key Attributes 7-1 through 7-8
TE 3, 4, 5, 7 (All)	Thermal energy hazards associated with the inventory, authorized activities and systems. Sources considered hot enough to result in ignition.	Operational Safety; Management, Organization, and Institutional Safety Provisions PHA ID 14, 15, 16	Key Attribute 17-10; also Key Attributes 11-3, 11-4, and 11-7
TE 8 (All)	Thermal energy hazards to the worker related to loss of ventilation and PPE.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
PE 1 (All)	Pressurized systems potential energy hazards.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
PE 2.1(except 2.1.1), 2.3 , 2.4 (All)	Potential energy hazards associated with elevated working surfaces.	Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10
PE 2.1.1, 2.2	Potential energy hazards associated with crane work.	Radiation Protection; Initial Testing, In-Service Surveillance, and Maintenance; Operational Safety; Management, Organization, and Institutional Safety Provisions PHA ID 17, 18, 19, 20, 21	Key Attribute 17-10; also Key Attributes 7-1 through 7-8; also Key Attribute 10-4; also discussion in Section 11.3 of DOE/RL-92-36
PE 3 (All)	Rotating devices potential energy associated with current systems or possible equipment.	Initial Testing, In-Service Surveillance, and Maintenance; Operational Safety; Management, Organization, and Institutional Safety Provisions	Key Attribute 17-10; also Key Attribute 10-4; also discussion in Section 11.3 of DOE/RL-92-36; also Key Attributes bullets 11-3, 11-4.

Table A-3 Disposition of Energy Checklist Items

Hazards Checklist Item	Evaluation	SMP Disposition	HNF-11724 – Key Attribute

Notes:

DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual*

AE acoustic energy
BIO biological
CE chemical energy
CM chemical material
EE electrical energy
HA hazard analysis
HVAC heating, ventilation, and air conditioning
IS industrial safety
IH industrial hygiene
KE kinetic energy
LOEE loss of electrical energy
LOTE low thermal energy
ME mechanical energy
NDA nondestructive assay
NPH natural phenomena hazard
OTH other
PE potential energy
PHA preliminary hazards analysis
PPE personal protective equipment
RE radiant energy
RM radioactive material
TE thermal energy
TP thermal potential energy

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
1.	Seismic event	221-B Canyon Building, 291-B retired filters, and sand filter	The worst-case event is a seismic event of greater magnitude than the design basis. After examining the potential events analyzed in the hazard analysis, it is apparent that the seismic event may have the largest facility-wide impacts, potentially failing the canyon confinement structure, the retired filters, and the sand filter. No other event is likely to fail both simultaneously, resulting in impacts to the radioactive materials, a loss of confinement, and a loss of ventilation.	221-B Canyon Building and 291-B passive structures	Initial Testing, In-Service Surveillance, and Maintenance; Emergency Preparedness Program	L	U	L	U	Risk Bin III Seismic event selected as analyzed accident.	No	Risk to the facility worker is a standard industrial hazard since the dominant hazard from seismic is building collapse, which applies to all facilities. No additional controls beyond SMPs are required.
2.	High wind event	221-B Canyon Building and 291-B retired filters	High wind event that causes damage and loss of confinement to the 221-B Canyon Building and 291-B retired filters. (Damage to the ACT filters is	221-B Canyon Building structure 291-B-1 stack	Initial Testing, In-Service Surveillance, and Maintenance; Emergency	L	U	L	U	Risk Bin III Bounded by seismic event.	No	Risk to the facility worker is a standard industrial hazard since the dominant hazard from wind is building collapse, which applies to all facilities. No

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
			bounded by the vehicle collision accident.)		Preparedness Program							additional controls beyond SMPs are required.
3.	Ash and snow loading	221-B Canyon Building	Failure of the canyon roof due to overloading of ash or snow on the roof or a crane impact.	221-B Canyon Building structure Filter covers	Initial Testing, In-Service Surveillance, and Maintenance; Emergency Preparedness Program	L	A	L	A	Risk Bin III Bounded by canyon roof collapse.	No	Risk to the facility worker is a standard industrial hazard since the dominant hazard from roof loading is building collapse, which applies to all facilities. No additional controls beyond SMPs are required.
4.	Loss of electric power	221-B Canyon Building, galleries, ACT exhaust system	Loss of electric power leads to loss of ventilation in canyon and galleries; migration of contamination from the canyon to the galleries and the building might occur over an extended period of time; accumulation of toxic vapors is possible. Stack effect, whereby pressure differential across stack would tend to pull	None	Initial Testing, In-Service Surveillance, and Maintenance, Hazardous Material Protection	L	A	L	A	Risk Bin III No significant consequences.	No	No significant consequences

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
			airflow from the canyon through the ACT filter, would tend to reduce this hazard. Possible causes: loss of electrical feed to the facility, component or system failure, human error, planned outages.									
5.	Airplane impact	221-B Canyon Building and galleries or filters	Aircraft impact into the 221-B Canyon Building structure causes failure of structure and suspension of radioactive and toxic materials.	221-B Canyon Building structure Filter cover	Initial Testing, In-Service Surveillance, and Maintenance; Emergency Preparedness Program	L	EU	L	EU	Risk Bin IV Consequences are bounded by the seismic event.	No	Risk to the facility worker is a standard industrial hazard since the dominant hazard from airplane impact is building collapse, which applies to all facilities. No additional controls beyond SMPs are required.
6.	Vehicle impact	221-B Canyon Building and galleries	Ground vehicle or crane impact into the 221-B Canyon Building structure. Possible causes: vehicle failure, human error, or blowing dust.	221-B Canyon Building structure	Initial Testing, In-Service Surveillance, and Maintenance; Hazardous	L	A	L	A	Risk Bin III Bounded by canyon load drop.	No	Risk to the facility worker is a standard industrial hazard since the dominant hazard is vehicle impact, which applies to all facilities. No additional controls

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
					Material Protection							beyond SMPs are required.
7.	Vehicle impact	ACT filters	Ground vehicle and crane impacts to the ACT filter failing cover and filter structure. Fuel from vehicle is assumed to initiate a fire.	Passive structures	Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection	L	A	L	A	Risk Bin III Analyzed event	No	Risk to the facility worker is a standard industrial hazard since the dominant hazards are vehicle impact and fire, which applies to all facilities. No additional controls beyond the SMPs are required.
8.	Vehicle impact and fire	291-B retired filters	Ground vehicle or crane impacts the retired filter covers, damaging the cover. Below-ground filter location and mound around makes impact of filter unlikely but fuel from the vehicle is assumed to initiate a fire.	Filters are below ground in passive structures that are not accessible to vehicles	Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection	L	U	L	U	Risk Bin III Analyzed event	No	Risks to the facility worker are standard industrial hazards since the dominant facility hazards are vehicle impact and fire, which applies to all facilities. No controls beyond the SMPs are required.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
9.	Stack collapse	221-B, retired filters	Stack collapses and impacts 221-B Canyon Building or retired filters.	Filters are below ground. The 221-B Canyon Building is robust structure	Management, Organization, and Institutional Safety Provisions	L	A	L	A	Risk Bin III Bounded by seismic event.	No	Risks to the facility worker are standard industrial hazards since the dominant hazard is a stack impact which applies to industrial facilities. No controls beyond SMPs are required.
10.	Stack collapse	ACT filters	Stack collapses and impacts ACT filter releasing radioactive material.	Stack is anchored to building	Management, Organization, and Institutional Safety Provisions	L	A	L	A	Risk Bin III Bounded by vehicle impact on ACT filter.	No	Risk to the facility worker is a standard industrial hazard since the dominant hazard is stack impact, which applies to industrial facilities. No controls beyond SMPs are required.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
11.	Water intrusion	221-B Canyon Building and galleries	Water intrusion into the canyon leads to a spread of contamination. Possible causes: structural failure that leads to flooding or leakage into soil under filter structure, e.g., leakage through roof.	None	Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection	L	A	L	A	Risk Bin III No significant consequences	No	No significant consequences
12.	Water intrusion	291-B retired filters and sand filter	Water intrusion in the retired filters leads to a spread of contamination. Possible causes: degradation of the sand filter cover.	Filter vaults	Initial Testing, In-Service Surveillance, and Maintenance	L	A	L	A	Risk Bin III No significant consequences	No	No significant consequences

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
13.	Range fire	221-B Canyon Building and 291-B exhaust system	Range fire occurs and response does not occur or is not able to inhibit the spread to the facility. Waste site and minor contamination is released. However, no significant release of facility inventory because of the robust nature of the structures.	Passive structures	Operational Safety; Emergency Preparedness Program; Fire Protection	L	A	L	A	Risk Bin III Bounded by fire involving staged waste.	No	Risk to the facility worker is a standard industrial hazard since the dominant hazard is fire, which applies to all facilities. No controls beyond SMPs are required.
14.	Fire	221-B Canyon Building	Fire in canyon results in suspension of radioactive or toxic materials. Possible causes: electrical service, mechanical sparks near flammable materials, adverse chemical reactions from incompatible chemicals coming together, human error and size reduction activities.	ACT filter and exhaust fans	Fire Protection; Operational Safety; Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection; Procedures and Training	L	A	L	A	Risk Bin III Analyzed event	No	Risk to the facility worker is a standard hazard since the dominant hazard is fire, which applies to all facilities. No controls beyond the SMPs are required.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
15.	Fire	291-B	Fire in retired filters.	Filter covers	Fire Protection; Operational Safety; Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection; Procedures and Training	L	U	L	U	Risk Bin III Analyzed event	No	Risks to the facility worker are a standard hazard since the dominant hazard is fire, which applies to all facilities. No controls beyond the SMPs are required.
16.	Fire	Yard Area	Waste-staging activities provide the opportunity to accumulate combustible and radiological materials prior to shipping. Possible causes: chemical reactions, handling accidents, vehicular/equipment events (including fires initiated from	None	Fire Protection; Operational Safety; Hazardous Materials Protection; Radiation Protection; Procedures and Training	L	A	L	A	Risk Bin III Analyzed event (staged waste fire)	No	Risk to the facility worker is a standard hazard since the dominant hazard is fire, which applies to all facilities. No controls beyond the SMPs are required.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
			nearby/parked vehicles) and human error. No significant release of canyon inventory because of the robust nature of the canyon structure.									
17.	Heavy object drop	221-B Canyon Building	A heavy object drop in the canyon causes structural/equipment failure and suspension of hazardous material. Exhaust fans and ACT filter action would cause the removal of radioactive material provided canyon confinement boundary is maintained. Possible causes: cover block drop while moving, equipment drop while moving, crane failure, canyon or cover block structural degradation, drop of tank or waste container and rigging failure.	Canyon structure design ACT filters	Operational Safety; Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection; Radiation Protection; Emergency Preparedness	L	A	L	A	Risk Bin III Bounded by canyon load drop.	No	Risk to the facility worker is a standard hazard since the dominant hazard is heavy object impact, which applies to all facilities. No controls beyond SMPs are required.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
18.	Heavy object drop	Retired filters	A heavy object drop onto the filters resulting in suspension of hazardous material. Possible causes: structural degradation and failure of vault roof, cover block drop, heavy equipment drop and crane work.	Filter covers.	Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection	L	A	L	A	Risk Bin III Bounded by seismic event.	No	Risk to the facility worker is a standard hazard since the dominant hazard is heavy object impact, which applies to all facilities. No controls beyond SMPs are required.
19.	Heavy object drop	Yard Area	A heavy object drop onto the staged waste (i.e., SWB, SWDB, drum, etc.) container causes suspension of hazardous material. Possible causes: Crane or lifting failure, human error.	None	Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection; Radiation Protection; Operational Safety	L	A	L	A	Risk Bin III Bounded by canyon load drop	No	Risk to the facility worker is a standard hazard since the dominant hazard is heavy object impact, which applies to all facilities. No controls beyond SMPs are required.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
20.	Heavy object drop	ACT filters	Heavy object is dropped onto ACT filter causes filter failure. Possible causes: Crane work or other demolition activities.	None	Hazardous Material Protection; Initial Testing, In-Service Surveillance, and Maintenance; Operational Safety	L	A	L	A	Risk Bin III Bounded by vehicle impact on ACT filter	No	Risks to the facility worker are a standard industrial hazard since the dominant hazard is heavy object impact, which applies to all facilities. No controls beyond SMPs are required.
21.	Roof Collapse	221-B Canyon Building	Roof of canyon collapse leads to impact on radioactive contamination and releases to the environment.	None	Initial Testing, In-Service Surveillance, and Maintenance; Emergency Preparedness	L	A	L	A	Risk Bin III Analyzed event	No	Risk to the facility worker is a standard industrial hazard since the dominant hazard is roof impact, which applies to all facilities. No additional controls beyond the SMPs are required.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
22.	Loss of ventilation (loss of confinement)	221-B Canyon Building and galleries	Loss of ACT ventilation system results in a loss of confinement for the hazardous materials in the 221-B Canyon Building; see discussion under loss of electric power event; this event has already occurred without a release, but the consequence rank assigned is bounding. Planned activities as part of preparation for the CDI include the possible installation of a bubble or bubbles in the canyon. The bubbles are related confinement and loss of confinement as part of the installation or use of the bubbles is captured in this event. Possible causes: exhaust fan failure, loss of electrical power, intentional shutdown, work activities, and human error.	None	Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection; Procedures and Training; Operational Safety; Radiation Protection	L	A	L	A	Risk Bin III No significant consequences	No	No significant consequences

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
23.	Criticality	221-B Canyon Building	Movement of cover blocks or equipment in the canyon results in an inadvertent concentration of fissionable materials. The total inventory of fissile material is 23 g, which is much less than one-half of a minimum critical mass. Criticality is not possible.	None	Prevention of Inadvertent Criticality; Hazardous Material Protection	L	BEU	L	BEU	Risk Bin IV Not credible event	No	Not a credible event
24.	Container spill	221-B Canyon Building	Mixed waste container fails, or is manipulated such that its contents are spilled. Possible causes: degradation of container; human error; container pressurization.	None	Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection; Management, Organization, and Institutional Safety Provisions	L	A	L	A	Risk Bin III Consequence bounded by canyon load drop.	No	Risk to the facility worker is a standard hazard since the dominant hazard is a spill which applies to all standard industrial facilities. No additional controls are required.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
25.	Container fire/ explosion	221-B Canyon Building	Container overpressure is vented when container is manipulated, causing release of container contents and possible explosion. Since radioactive material in containers will be limited during S&M phase, hydrogen deflagration is not expected. Container fire accident is bounding.	None	Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection; Operational Safety; Management, Organization, and Institutional Safety Provisions; Fire Protection	L	A	L	A	Risk Bin III Bounded by canyon fire.	No	Risk to the facility worker are a standard hazard since the dominant hazard is a fire/explosion, which applies to standard industrial facilities. No additional controls beyond the SMPs are required.
26.	Container fire/ explosion	Yard Area	Container overpressure is vented when container is manipulated causing release of container contents and possible explosion. Since	None	Initial Testing, In-Service Surveillance, and Maintenance;	L	A	L	A	Risk Bin III Bounded by staged waste fire.	No	Risks to the facility worker are a standard hazard since the dominant hazard is a fire which applies to all standard industrial. No

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
			radioactive material in containers will be limited during S&M phase, A hydrogen deflagration is not expected. Container fire accident is bounding.		Hazardous Material Protection; Management, Organization, and Institutional Safety Provisions; Operational Safety; Fire Protection							controls beyond the SMPs are required.
27.	Facility worker exposure to external radiation	All radiation areas	Facility worker resides in radiation or high-radiation area for extended period of time. Possible causes: human error in surveying and/or posting of radiation or high-radiation areas, radiation survey instrument failure, characterization excavation activities.	Shielding, physical access control of high-radiation areas	Radiation Protection, Initial Testing, In-Service Surveillance, and Maintenance; Hazardous Material Protection	L	A	L	A	Risk Bin III Industrial hazard	No	Radiation exposure is an industrial hazard covered by SMPs.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
28.	Facility worker exposure to toxic materials	221-B Canyon Building	Breach of process piping/equipment results in spread of residual quantities of process chemicals. Possible causes: corrosion, human error.	None	Hazardous Material Protection; Management, Organization, and Institutional Safety Provisions Initial Testing, In-Service Surveillance, and Maintenance	L	A	L	A	Risk Bin III Industrial hazard	No	Industrial hazard covered by SMPs.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
29.	Chemical reaction	221-B Canyon Building	Uncontrolled chemical reaction occurs in residual chemicals in the 221-B Canyon Building. Possible causes: spill during container handling, wetting from water intrusion, over-concentration due to evaporation.	None	Hazardous Material Protection; Initial Testing, In-Service Surveillance, and Maintenance; Management, Organization, and Institutional Safety Provisions	L	A	L	A	Risk Bin III Bounded by canyon load drop.	No	Industrial hazard covered by SMPs.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
30.	Spread of external surface contamination	All outdoor surface contamination areas	Surface contamination is spread from designated areas. Possible causes included high wind, biological agents (e.g., birds, rodents, etc.) human intrusion.	None	Initial Testing, In-Service Surveillance, and Maintenance; Radiation Protection; Hazardous Material Protection	L	A	L	A	Risk Bin III No significant consequences	No	No significant consequences.
31.	External accident	Accident at WESF that releases radioactive material or gamma radiation	Accident at WESF results in high radiation levels at B Plant.	WESF is isolated from B Plant	B Plant is not normally occupied. Emergency Preparedness Program	L	A	L	A	Risk Bin III See WESF DSA	No	Risk to the facility worker is mitigated since emergency preparedness procedures provide responses to accident at nearby facilities.
32.	External Accident	221-B Canyon Building	WESF grouting activities breach pipes connected to B Plant and fill B Plant cells with grout. Possible causes: operator error, equipment failure; pipes assumed to be	None	Initial Testing, In-Service Surveillance, and Maintenance; Radiation Protection;	L	A	L	A	Risk Bin III No significant consequences	No	No significant consequences.

Table A-4. B Plant Preliminary Hazards Analysis

Item	Hazard/Event Summary			Preventive and Mitigative Features		Event Rank				Risk Bin Values and Selection for Additional Analysis	Facility Worker	
						MOI/ CW*		Environmental			Hazard to the worker beyond standard industrial hazard	Comments
	Potential Event	Location	Event and Possible Causes	SSCs	Admin	C	L	C	L			
			isolated have not been capped off.		Hazardous Material Protection							

Notes:

* The ranking applies to the MOI and the CW.

DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual*

A	anticipated
BEU	beyond extremely unlikely
C	consequences
CDI	canyon disposition initiative
EU	extremely unlikely
L	likelihood
MOI	maximally-exposed offsite individual
NA	not applicable
SWB	standard waste box
SWDB	steel waste disposal box
U	unlikely
WESF	Waste Encapsulation and Storage Facility

Appendix B

RADIDOSE Output Sheets

Table B-1. RADIDOSE Calculations for B Plant Seismic Event

RADIDOSE Version 3.0 (5-18-2005)

Input Parameter	User Input	Default	Description (based on user input)
Facility/Material (1-14):	13		User-defined mixture ("InSource" page)
Form of Material (1-10):	3		Non-combustible Contaminated Solids
Accident Type (1-6):	2		External Impact
Quantity at Risk (MAR):	3.64E+03		g
Damage Ratio:		1	
Airborne Release Fraction:	1.00E-04		ARF
Respirable Fraction:	1		RF
Leak Path Factor:		1	LPF (applies to particulate only)
HEPA Filter Factor:	1		DF = 1 (applies to particulate only)
Collocated Worker Dose Factor:		3	ICRP 68, 5 µm AMAD
Onsite & Offsite Public Dose Factor:		7	ICRP 72 for Adult
Material Solubility Class:		2	compounds are generally soluble
Hanford Processing Area (1-4):		2	200 Area
Distance or X/Q for Collocated Worker:		100	meters
Distance or X/Q for Onsite Public:	8260		meters
Distance or X/Q for Offsite Public:	16630		meters
Emission Source Type (1-4):		1	Point source at ground level
Release Duration (0 to 8760 h):		0.5	hours

Description of Accident Scenario: Edit using function key F2. Carriage returns are not allowed.

B Plant seismic

Dose Results for the Postulated Accident:

User-defined mixture ("InSource" page)
Non-combustible Contaminated Solids
Point Source At Ground Level **200 Area**

Material source amounts ar listed on the "UnitDF" page.

Total Respirable Release: 3.64E-01 g

Dose Factors:	ICRP 68, 5µm	ICRP 72 for Adult		Release
Receptor:	**Collocated Worker**	**Onsite Public**	**Offsite Public**	Duration 0.5 h
Distance:	100 m	8,260 m	16,630 m	
X/Q:	3.28E-02	3.20E-05	1.32E-05	s/m3
Breathing Rate:	3.35E-04	3.29E-04	3.29E-04	m3/s
Unit DCF:	5.57E+06	7.07E+06	7.07E+06	rem/g
Total Dose:	**2.23E+01**	**2.71E-02**	**1.12E-02**	**rem**
Consequence:	Low	na	Low	

Nuclide	Grams per g	Specific Activity, Ci/g
Cs-137	7.55E-01	8.70E+01
Sr-90	2.39E-01	1.37E+02
Y-90	6.01E-05	5.44E+05
Pu-238	5.06E-06	1.71E+01
Pu-239	5.31E-03	6.21E-02
Pu-240	8.20E-04	2.28E-01
Pu-241	6.95E-05	1.03E+02
Am-241	1.11E-04	3.43E+00

Table B-2. RADIDOSE Calculations for B Plant Roof Collapse

RADIDOSE Version 3.0 (5-18-2005)			
Input Parameter	**User Input**	**Default**	**Description (based on user input)**
Facility/Material (1-14):	13		User-defined mixture ("InSource" page)
Form of Material (1-10):	3		Non-combustible Contaminated Solids
Accident Type (1-6):	2		External Impact
Quantity at Risk (MAR):	1.26E+03		g
Damage Ratio:		1	
Airborne Release Fraction:		1.00E-03	ARF from SARAH Table 3-4 (ARF page)
Respirable Fraction:		0.1	RF from SARAH Table 3-4 (ARF page)
Leak Path Factor:		1	LPF (applies to particulate only)
HEPA Filter Factor:	1		DF = 1 (applies to particulate only)
Collocated Worker Dose Factor:		3	ICRP 68, 5 µm AMAD
Onsite & Offsite Public Dose Factor:		7	ICRP 72 for Adult
Material Solubility Class:		2	compounds are generally soluble
Hanford Processing Area (1-4):		2	200 Area
Distance or X/Q for Collocated Worker:		100	meters
Distance or X/Q for Onsite Public:	8260		meters
Distance or X/Q for Offsite Public:	16630		meters
Emission Source Type (1-4):	1		Point source at ground level
Release Duration (0 to 8760 h):		0.5	hours

Description of Accident Scenario: Edit using function key F2. Carriage returns are not allowed.

B Plant roof collapse

Dose Results for the Postulated Accident:

User-defined mixture ("InSource" page)

Non-combustible Contaminated Solids

Point Source At Ground Level **200 Area**

Total Respirable Release: 1.26E-01 g

Dose Factors:	ICRP 68, 5µm	ICRP 72 for Adult		Release
Receptor:	**Collocated Worker**	**Onsite Public**	**Offsite Public**	Duration 0.5 h
Distance:	100 m	8,260 m	16,630 m	
X/Q:	3.28E-02	3.20E-05	1.32E-05	s/m3
Breathing Rate:	3.35E-04	3.29E-04	3.29E-04	m3/s
Unit DCF:	5.79E+06	7.32E+06	7.32E+06	rem/g
Total Dose:	**8.02E+00**	**9.70E-03**	**4.00E-03**	**rem**
Consequence:	Low	na	Low	

Material source amounts ar listed on the "UnitDF" page.

Nuclide	Grams per g	Specific Activity, Ci/g
Sr-90	2.55E-01	1.37E+02
Y-90	6.42E-05	5.44E+05
Cs-137	7.39E-01	8.70E+01
Pu-238	5.14E-06	1.71E+01
Pu-239	5.40E-03	6.21E-02
Pu-240	8.34E-04	2.28E-01
Pu-241	7.07E-05	1.03E+02
Am-241	1.12E-04	3.43E+00

Table B-3. RADIDOSE Calculations for B Plant Canyon Load Drop

RADIDOSE Version 3.0 (5-18-2005)			
Input Parameter	**User Input**	**Default**	**Description (based on user input)**
Facility/Material (1-14):	13		User-defined mixture ("InSource" page)
Form of Material (1-10):	1		Packaged Waste (bags, drums, boxes)
Accident Type (1-6):	2		External Impact
Quantity at Risk (MAR):	1.26E+03		gram
Damage Ratio:	1.00E-01		
Airborne Release Fraction:		1.00E-03	ARF from SARAH Table 3-4 (ARF page)
Respirable Fraction:		0.1	RF from SARAH Table 3-4 (ARF page)
Leak Path Factor:		1	LPF (applies to particulate only)
HEPA Filter Factor:	1		DF = 1 (applies to particulate only)
Collocated Worker Dose Factor:		3	ICRP 68, 5 µm AMAD
Onsite & Offsite Public Dose Factor:		7	ICRP 72 for Adult
Material Solubility Class:		2	compounds are generally soluble
Hanford Processing Area (1-4):		2	200 Area
Distance or X/Q for Collocated Worker:		100	meters
Distance or X/Q for Onsite Public:	8260		meters
Distance or X/Q for Offsite Public:	16630		meters
Emission Source Type (1-4):	1		Point source at ground level
Release Duration (0 to 8760 h):		0.5	hours

Description of Accident Scenario: Edit using function key F2. Carriage returns are not allowed.

B-plant Canyon Load Drop - A DR of 0.1 is applied

Dose Results for the Postulated Accident:

User-defined mixture ("InSource" page)				Material source amounts ar
Packaged Waste (bags, drums, boxes)				listed on the "UnitDF" page.
Point Source At Ground Level			**200 Area**	
Total Respirable Release:	1.26E-02	gram		
Dose Factors:	ICRP 68, 5µm	ICRP 72 for Adult	Release	
Receptor:	**Collocated Worker**	**Onsite Public**	**Offsite Public**	Duration 0.5 h
Distance:	100 m	8,260 m	16,630 m	
X/Q:	3.28E-02	3.20E-05	1.32E-05	s/m3
Breathing Rate:	3.35E-04	3.29E-04	3.29E-04	m3/s
Unit DCF:	5.79E+06	7.32E+06	7.32E+06	rem/gram
Total Dose:	**8.02E-01**	**9.70E-04**	**4.00E-04**	**rem**
Consequence:	Low	na	Low	

Nuclide	Grams per gram	Specific Activity, Ci/g
Sr-90	2.55E-01	1.37E+02
Y-90	6.42E-05	5.44E+05
Cs-137	7.39E-01	8.70E+01
Pu-238	5.14E-06	1.71E+01
Pu-239	5.40E-03	6.21E-02
Pu-240	8.34E-04	2.28E-01
Pu-241	7.07E-05	1.03E+02
Am-241	1.12E-04	3.43E+00

Table B-4. RADIDOSE Calculations for B Plant Canyon Fire

RADIDOSE Version 3.0 (5-18-2005)

Input Parameter	User Input	Default	Description (based on user input)
Facility/Material (1-14):	13		User-defined mixture ("InSource" page)
Form of Material (1-10):	3		Non-combustible Contaminated Solids
Accident Type (1-6):	1		Fire
Quantity at Risk (MAR):	1.26E+03		Gram
Damage Ratio:		1	
Airborne Release Fraction:		6.00E-03	ARF from SARAH Table 3-4 (ARF page)
Respirable Fraction:		0.01	RF from SARAH Table 3-4 (ARF page)
Leak Path Factor:		1	LPF (applies to particulate only)
HEPA Filter Factor:	1		DF = 1 (applies to particulate only)
Collocated Worker Dose Factor:		3	ICRP 68, 5 µm AMAD
Onsite & Offsite Public Dose Factor:		7	ICRP 72 for Adult
Material Solubility Class:	2		compounds are generally soluble
Hanford Processing Area (1-4):		2	200 Area
Distance or X/Q for Collocated Worker:		100	meters
Distance or X/Q for Onsite Public:	8260		meters
Distance or X/Q for Offsite Public:	16630		meters
Emission Source Type (1-4):	1		Point source at ground level
Release Duration (0 to 8760 h):		0.5	hours

Description of Accident Scenario: Edit using function key F2. Carriage returns are not allowed.

Dose Results for the Postulated Accident:

User-defined mixture ("InSource" page)

Non-combustible Contaminated Solids

Point Source At Ground Level — 200 Area

Total Respirable Release: 7.56E-02 Gram

Dose Factors:	ICRP 68, 5 µm	ICRP 72 for Adult		Release Duration
Receptor:	Collocated Worker	Onsite Public	Offsite Public	0.5 h
Distance:	100 m	8,260 m	16,630 m	
X/Q:	3.28E-02	3.20E-05	1.32E-05	s/m3
Breathing Rate:	3.35E-04	3.29E-04	3.29E-04	m3/s
Unit DCF:	5.79E+06	7.32E+06	7.32E+06	rem/Gram
Total Dose:	**4.81E+00**	**5.82E-03**	**2.40E-03**	**rem**
Consequence:	Low	na	Low	

Material source amounts are listed on the "UnitDF" page

Nuclide	Grams per gram	Specific Activity, Ci/g
Sr-90	2.55E-01	1.37E+02
Y-90	6.42E-05	5.44E+05
Cs-137	7.39E-01	8.70E+01
Pu-238	5.14E-06	1.71E+01
Pu-239	5.40E-03	6.21E-02
Pu-240	8.34E-04	2.28E-01
Pu-241	7.07E-05	1.03E+02
Am-241	1.12E-04	3.43E+00

Table B-5. RADIDOSE Calculations for B Plant Staged Waste Fire

RADIDOSE Version 3.0 (5-18-2005)			
Input Parameter	**User Input**	**Default**	**Description (based on user input)**
Facility/Material (1-14):	13		User-defined mixture ("InSource" page)
Form of Material (1-10):	1		Packaged Waste (bags, drums, boxes)
Accident Type (1-6):	1		Fire
Quantity at Risk (MAR):	4.36E+01		Gram
Damage Ratio:		1	
Airborne Release Fraction:		5.00E-04	ARF from SARAH Table 3-4 (ARF page)
Respirable Fraction:		1	RF from SARAH Table 3-4 (ARF page)
Leak Path Factor:		1	LPF (applies to particulate only)
HEPA Filter Factor:	1		DF = 1 (applies to particulate only)
Collocated Worker Dose Factor:		3	ICRP 68, 5 µm AMAD
Onsite & Offsite Public Dose Factor:		7	ICRP 72 for Adult
Material Solubility Class:	2		compounds are generally soluble
Hanford Processing Area (1-4):		2	200 Area
Distance or X/Q for Collocated Worker:		100	meters
Distance or X/Q for Onsite Public:	8260		meters
Distance or X/Q for Offsite Public:	16630		meters
Emission Source Type (1-4):	1		Point source at ground level
Release Duration (0 to 8760 h):		0.5	hours

Description of Accident Scenario: Edit using function key F2. Carriage returns are not allowed.

Dose Results for the Postulated Accident:

User-defined mixture ("InSource" page)				
Packaged Waste (bags, drums, boxes)				
Point Source At Ground Level				**200 Area**
Total Respirable Release:	2.18E-02	Gram		
Dose Factors:	ICRP 68, 5µm	ICRP 72 for Adult		Release Duration 0.5 h
Receptor:	**Collocated Worker**	**Onsite Public**	**Offsite Public**	
Distance:	100 m	8,260 m	16,630 m	
X/Q:	3.28E-02	3.20E-05	1.32E-05	s/m3
Breathing Rate:	3.35E-04	3.29E-04	3.29E-04	m3/s
Unit DCF:	5.79E+06	7.32E+06	7.32E+06	rem/Gram
Total Dose:	**1.39E+00**	**1.68E-03**	**6.93E-04**	**rem**
Consequence:	Low	na	Low	

Material source amounts ar listed on the "UnitDF" page.

Nuclide	Grams per g	Specific Activity, Ci/g
CS-137	7.38E-01	8.70E+01
SR-90	2.55E-01	1.37E+02
Y-90	6.41E-05	5.44E+05
Pu-238	5.14E-06	1.71E+01
Pu-239	5.39E-03	6.21E-02
Pu-240	8.33E-04	2.28E-01
Pu-241	7.06E-05	1.03E+02
Am-241	1.12E-04	3.43E+00

Table B-6. RADIDOSE Calculations for B Plant ACT Impact and Fire

RADIDOSE Version 3.0 (5-18-2005)

Input Parameter	User Input	Default	Description (based on user input)
Facility/Material (1-14):	13		User-defined mixture ("InSource" page)
Form of Material (1-10):	3		Non-combustible Contaminated Solids
Accident Type (1-6):	2		External Impact
Quantity at Risk (MAR):	1.78E-01		g
Damage Ratio:		1	
Airborne Release Fraction:	1.00E-02		ARF
Respirable Fraction:	1		RF
Leak Path Factor:		1	LPF (applies to particulate only)
HEPA Filter Factor:	1		DF = 1 (applies to particulate only)
Collocated Worker Dose Factor:		3	ICRP 68, 5 µm AMAD
Onsite & Offsite Public Dose Factor:		7	ICRP 72 for Adult
Material Solubility Class:		2	compounds are generally soluble
Hanford Processing Area (1-4):		2	200 Area
Distance or X/Q for Collocated Worker:		100	meters
Distance or X/Q for Onsite Public:	8260		meters
Distance or X/Q for Offsite Public:	16630		meters
Emission Source Type (1-4):		1	Point source at ground level
Release Duration (0 to 8760 h):		0.5	hours

Description of Accident Scenario: Edit using function key F2. Carriage returns are not allowed.

B Plant ACT filter impact with fire

Dose Results for the Postulated Accident:

User-defined mixture ("InSource" page) — Material source amounts ar listed on the "UnitDF" page.

Non-combustible Contaminated Solids

Point Source At Ground Level — **200 Area**

Total Respirable Release: 1.78E-03 g

Dose Factors:	ICRP 68, 5µm	ICRP 72 for Adult		Release
Receptor:	**Collocated Worker**	**Onsite Public**	**Offsite Public**	Duration 0.5 h
Distance:	100 m	8,260 m	16,630 m	
X/Q:	3.28E-02	3.20E-05	1.32E-05	s/m3
Breathing Rate:	3.35E-04	3.29E-04	3.29E-04	m3/s
Unit DCF:	7.58E+06	9.35E+06	9.35E+06	rem/g
Total Dose:	**1.48E-01**	**1.75E-04**	**7.23E-05**	**rem**
Consequence:	Low	na	Low	

Nuclide	Grams per g	Specific Activity, Ci/g
Sr-90	3.86E-01	1.37E+02
Cs-137	6.08E-01	8.70E+01
Pu-238	4.23E-06	1.71E+01
Pu-239	4.44E-03	6.21E-02
Pu-240	6.86E-04	2.28E-01
Pu-241	5.82E-05	1.03E+02
Am-241	9.26E-05	3.43E+00
y-90	9.73E-05	5.44E+05

Table B-7. RADIDOSE Calculations for B Plant Fire in Retired Filters

RADIDOSE Version 3.0 (5-18-2005)

Input Parameter	User Input	Default	Description (based on user input)
Facility/Material (1-14):	13		User-defined mixture ("InSource" page)
Form of Material (1-10):	3		Non-combustible Contaminated Solids
Accident Type (1-6):	1		Fire
Quantity at Risk (MAR):	7.07E+02		g
Damage Ratio:		1	
Airborne Release Fraction:	1.00E-04		ARF
Respirable Fraction:	1		RF
Leak Path Factor:		1	LPF (applies to particulate only)
HEPA Filter Factor:	1		DF = 1 (applies to particulate only)
Collocated Worker Dose Factor:		3	ICRP 68, 5 µm AMAD
Onsite & Offsite Public Dose Factor:		7	ICRP 72 for Adult
Material Solubility Class:	2		compounds are generally soluble
Hanford Processing Area (1-4):		2	200 Area
Distance or X/Q for Collocated Worker:		100	meters
Distance or X/Q for Onsite Public:	8260		meters
Distance or X/Q for Offsite Public:	16630		meters
Emission Source Type (1-4):	1		Point source at ground level
Release Duration (0 to 8760 h):		0.5	hours

Description of Accident Scenario: Edit using function key F2. Carriage returns are not allowed.

B Plant Fire Accident in the Retired Filters

Dose Results for the Postulated Accident:

User-defined mixture ("InSource" page)				
Non-combustible Contaminated Solids				
Point Source At Ground Level				**200 Area**
Total Respirable Release:	7.07E-02 g			
Dose Factors:	ICRP 68, 5µm	ICRP 72 for Adult		Release Duration 0.5 h
Receptor:	**Collocated Worker**	**Onsite Public**	**Offsite Public**	
Distance:	100 m	8,260 m	16,630 m	
X/Q:	3.28E-02	3.20E-05	1.32E-05	s/m3
Breathing Rate:	3.35E-04	3.29E-04	3.29E-04	m3/s
Unit DCF:	6.31E+06	7.87E+06	7.87E+06	rem/g
Total Dose:	**4.90E+00**	**5.86E-03**	**2.42E-03**	**rem**
Consequence:	Low	na	Low	

Material source amounts ar
listed on the "UnitDF" page.

Nuclide	Grams per g	Specific Activity, Ci/g
Sr-90	2.99E-01	1.37E+02
Cs-137	6.99E-01	8.70E+01
Pu-238	1.13E-06	1.71E+01
Pu-239	1.19E-03	6.21E-02
Pu-240	1.83E-04	2.28E-01
Pu-241	1.56E-05	1.03E+02
Am-241	2.48E-05	3.43E+00
y-90	7.54E-05	5.44E+05

Appendix C

B Plant Technical Safety Requirements

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Appendix C
B Plant Technical Safety Requirements

C.1 Use and Applications

This section contains basic information and instructions for using and applying the technical safety requirements (TSRs) and complies with the relevant sections of 10 CFR 830, "Nuclear Safety Management," as implemented by CH2M HILL Plateau Remediation Company agreements and procedures.

C.1.1 Definitions

NOTE: Defined terms in this list appear in uppercase type throughout these TSRs.

Term	Definition
ACTIVITY(IES)	An ACTIVITY is the term representing the collection of tasks or steps commonly associated with a process.
ADMINISTRATIVE CONTROLS (ACs)	A provision relating to organization and management, procedures, record keeping, assessment, and reporting necessary to ensure safe operation of a facility.
DESIGN FEATURE	DESIGN FEATURES of the facility specified in the TSRs that, if altered or modified, would have a significant effect on the safe operation.
IMMEDIATE/ IMMEDIATELY	Term used as a completion time for actions when a step is to be initiated as soon as possibly achievable after discovery without creating a less stable condition and continuously and aggressively pursued until complete.
LIMITING CONDITION FOR OPERATION (LCO)	The lowest functional capability or performance levels of essential safety-related hardware.
LIMITING CONTROL SETTING (LCS)	Setting on safety systems that controls process variables to prevent exceeding SAFETY LIMITS.
NORMAL OPERATIONS	See Section C.1.2, "Operational Modes."

Term	Definition
OPERABLE/ INOPERABLE/ OPERABILITY	A system, subsystem, train, component, or device SHALL be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s), and when all necessary attendant instrumentation, controls, electrical power, cooling or seal water, lubrication, or other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its function(s) are also capable of performing their related support function(s).
OPERATING LIMITS	LIMITING CONTROL SETTINGS and LIMITING CONDITIONS FOR OPERATION.
OPERATIONAL MODES	OPERATIONAL MODES for B Plant are NORMAL OPERATIONS. See Section C.1.2, "OPERATIONAL MODES."
SAFETY LIMITS (SLs)	Limits on process variables associated with those physical barriers that are necessary for the intended facility function and are found to be required to guard against the uncontrolled release of radioactive and other hazardous materials.
SHALL	Denotes a mandatory requirement that must be complied with to maintain the requirements, assumptions, or conditions of the facility safety basis.
SURVEILLANCE REQUIREMENTS (SRs)	Requirements related to testing, calibration, or inspection to ensure OPERABILITY of safety-related equipment and required support systems, or to ensure that operations are within the specified LCO.
VIOLATION	See Section C.1.5, "TSR AC VIOLATION."

C.1.2 OPERATIONAL MODES

The OPERATIONAL conditions and MODES that apply to B Plant and its operations are defined as follows:

Term	Definition

NORMAL OPERATIONS	Surveillance and maintenance (S&M) ACTIVITIES are performed. The radioactive material inventory meets or exceeds the Hazard Category 3 threshold as defined in DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.*

C.1.3 Alternate Emergency Actions

Emergency actions may be taken in special circumstances. In an emergency, if a situation develops that is not addressed by the TSRs, staff members are expected to use their training, expertise, and applicable emergency response procedures to take actions to correct or mitigate the situation. Also, staff may take actions that depart from a requirement in the TSRs provided that the following conditions apply:

- An emergency situation exists,
- These actions are needed IMMEDIATELY to protect the public health and safety, and
- No action consistent with the TSR can provide adequate or equivalent protection.

Such actions SHALL be approved, as a minimum, by the Facility Manager or the B Plant Building Emergency Director. If emergency actions are taken, verbal notifications SHALL be made to the U.S. Department of Energy (DOE), Richland Operations Office (RL) Facility Representative as soon as practicable (10 CFR 830.205 [b]).

C.1.4 AC Element Not Met

Deficiencies in a program or procedure non-compliances that indicate a programmatic breakdown significant enough to render the safety analysis invalid, or failure to comply with a Safety Management Program (SMP) key attribute. Isolated discrepancies in a program or procedure do not, by themselves, constitute a TSR AC VIOLATION.

If an AC element is discovered not to have been performed or not have been followed, this would not necessarily result in a TSR AC VIOLATION. If failure to meet an AC element does not result in a TSR AC VIOLATION based on any one of the criteria listed in Table C-1, then this would be reported as a noncompliance with a hazard control (occurrence reporting severity category SC3). If the failure to meet an AC element results from any one of the criteria listed in Table C-1, then this constitutes a TSR AC VIOLATION and the steps in Section C.1.5, "TSR AC Violation," SHALL be completed.

Table C-1. Criteria Constituting TSR AC VIOLATIONS

• A required program has not been established
• The program has been established but the facility has not attempted to implement the program.
• Time frames or actions specified upon failure to meet an AC element are not met.
• Failure to comply with the program requirements specified in this document results in multiple recurrences of a specific key element not being met indicating a programmatic breakdown.

C.1.5 TSR AC VIOLATION

The following actions SHALL be taken in the event that a TSR AC VIOLATION occurs:

1) Terminate affected ACTIVITY(IES) IMMEDIATELY except as necessary to achieve a safe configuration.
2) Take the following reporting actions:
   2.1) Make appropriate entries documenting the failure to meet the AC element(s) in the facility record, indicating any operational areas affected and restrictions imposed. Maintain the status of restrictions and operational areas affected in the facility as recovery progresses.
   2.2) Notify RL in accordance with DOE occurrence reporting requirements.
   2.3) Prepare an Occurrence Report and implement the corrective action management process, as required.
3) Restore administrative element within 10 working days.
4) If the AC element(s) cannot be restored within 10 working days, notify RL Facility Representative within the 10 working days, develop a facility-approved recovery plan, and initiate actions of the recovery plan within the 10 working days.
5) Affected ACTIVITY(IES) may be resumed at any time when the relevant AC element(s) have been restored OR as specified by the recovery plan.

C.2 Safety Limits

There are no SLs, and thus no LCS, for B Plant.

C.3 Limiting Conditions of Operation

There are no LCOs for B Plant.

C.4 Operating Limits and Surveillance Requirements

There are no SRs identified for the B Plant.

C.5 Administrative Controls

This section presents the ACs for B Plant. The ACs are provisions relating to organization and management, procedures, record keeping, assessment, and reporting necessary to ensure the safe operation of the facility.

C.5.1 Safety Management Programs (AC)

C.5.1.1 Applicability

This AC applies to the planned ACTIVITIES (e.g., S&M**)** until such time as the facility inventory is reduced and the facility can be re-categorized as less than a Hazard Category 3 nuclear facility.

C.5.1.2 Requirements

a. The following SMPs, as described in HNF-11724, *CH2M HILL Plateau Remediation Company Safety Management Programs*, SHALL be established, implemented, and maintained as applicable, unless otherwise noted in the Documented Safety Analysis (DSA).

   Prevention of Inadvertent Criticality* - as applicable per HNF-7098, *Criticality Safety Program* (Chapter 6)

   Radiation Protection* (Chapter 7)

   Hazardous Material Protection* (Chapter 8)

   Radioactive and Hazardous Waste Management* (Chapter 9)

   Initial Testing, In-Service Surveillance, and Maintenance (Chapter 10)

   Operational Safety* (Conduct of Operations/Fire Protection/Hoisting and Rigging) (Chapter 11)

   Procedures and Training (Chapter 12)

   Human Factors - Not applicable to the B Plant facility

   Quality Assurance* (Chapter 14)

   Emergency Preparedness Program* (Chapter 15)

   Provisions for Decontamination and Decommissioning (Chapter 16)

   Management, Organization, and Institutional Safety Provisions (Chapter 17)

   Note: Program key element c, listed below, only applies to those SMPs identified by an asterisk (*).

b. B Plant facility management SHALL ensure that the overall safety function of each SMP (identified above) is maintained through implementation of all applicable key program elements identified in HNF-11724, as modified in Chapter 5 of the B Plant DSA. They will also ensure that facility-level assessments are performed as required by the continuous improvement process of the Integrated Environment, Safety and Health Management System (ISMS) on those SMPs identified above.

c. For those SMPs identified above by an asterisk (*), facility management SHALL ensure that the data from the facility-level ISMS assessments will be provided to the appropriate program manager for tracking and trending, and corrective action

management required by PRC-PRO-QA-052, *Issues Management*, or successor document.

C.5.1.3 Responsibility

Facility management is responsible to ensure that the applicable commitments of the SMPs are implemented and that the continuous improvement commitment of the ISMS is maintained.

C.5.1.4 Recovery

See Section C.1.4, "AC Element Not Met."

C.5.1.5 Basis

These SMPs provide significant contributions to worker safety and are an integral part of safe S&M operations at B Plant.

C.6 Design Features

No DESIGN FEATURES are identified for B Plant.

C.7 References

10 CFR 830, "Nuclear Safety Management," Code of Federal Regulations, as amended.

DOE-STD-1027-92, 1997, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, Change 1, U.S. Department of Energy, Washington, D.C.

HNF-11724, *CH2M HILL Plateau Remediation Company Safety Management Programs*, as amended, CH2M HILL Plateau Remediation Company, Richland, Washington.

HNF-7098, *Criticality Safety Program*, as amended, CH2M HILL Plateau Remediation Company, Richland, Washington.

PRC-PRO-QA-052, *Issues Management*, as amended, CH2M HILL Plateau Remediation Company, Richland, Washington.