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PUREX Deactivated End-State Hazard Analysis

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PUREX DEACTIVATED END-STATE HAZARD ANALYSIS

EXECUTIVE SUMMARY

A hazard analysis was performed for the Plutonium Uranium Extraction (PUREX) facility located in the 200 East Area of the Hanford Site. The purpose of the hazard analysis was to support development of a Basis for Interim Operation (BIO) for PUREX in the deactivated state. The hazard analysis was performed in accordance with the requirements of DOE Order 5480.23, *Nuclear Safety Analysis Reports*, and the guidance contained in DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*, DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, and HNF-PRO-704, *Hazard and Accident Analysis Process.*

The results of the hazard analysis determined that at the end of the deactivation project, the PUREX facility does not pose significant risks to the offsite public or onsite worker.

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LIST OF TERMS

Ag	silver
Am	americium
cfm	cubic feet per minute
Ci	curies
Cs	cesium
D&D	decontamination and decommissioning
dpm	disintegrations per minute
ECMP	East Crane Maintenance Platform
EDE	effective dose equivalent
FHA	fire hazard analysis
FSAR	Final Safety Analysis Report
ft	foot/feet
g	gram
g	seismic acceleration
HEPA	high-efficiency particulate air
HNO3	nitric acid
HSRCM	*Hanford Site Radiological Control Manual*
HVAC	heating, ventilating, and air conditioning
I	iodine
Kg	kilogram
kV	kilovolt
LSA	Low Specific Activity
MCM	minimum critical mass
mph	miles per hour
pCi	picocuries
PHA	Preliminary Hazard Analysis
Pu	plutonium
PUREX	Plutonium Uranium Extraction (Facility)
RRG	Radiological Risk Guide
SAR	Safety Analysis Report
Sr	strontium
SSC	systems, structures, and components
TBP	tributyl phosphate
TSR	technical safety requirement
UNH	uranyl nitrate hexahydrate

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1.0 INTRODUCTION

This report documents the hazards analysis for the Plutonium Uranium Extraction (PUREX) facility, at the end of the current deactivation project, in support of a basis for interim operation (BIO). The hazard analysis identifies potential hazards to the offsite public, onsite and facility workers, and/or the environment based upon the hazardous material inventory (radiological and non-radiological) and potential energy sources and initiating events leading to a release of this material. The hazard analysis also is an initial identification of the means of detecting the hazardous conditions and actions or safety significant systems, structures, and components (SSCs) required to prevent or mitigate the condition.

The hazard analysis uses a graded approach consistent with the intended use, complexity, and inventory at risk of the PUREX facility in its deactivated state. This approach allows use of qualitative methods for assessing likelihoods and consequences where the inventory is small or the facility configuration and operation is very simple. To augment the qualitative assessment, quantitative estimates of likelihoods and consequences are made for those situations judged to have the potential to release significant material outside the PUREX facility.

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2.0 BACKGROUND

The PUREX facility was designed and operated to recover plutonium, uranium, and neptunium from irradiated fuel elements received from N Reactor. Plutonium was recovered as an acidic solution of plutonium nitrate, which was transferred to Z Plant. Uranium was received as uranyl nitrate hexahydrate (UNH), which was transferred for further processing to the UO_3 Plant; neptunium was recovered and transferred to other sites.

Construction of PUREX began in 1952 and the facility began operating in 1956. The operation was shut down in September 1972. The facility was maintained in a wet-standby mode until 1978, with process and support equipment operated on a regular basis. Failed equipment was either upgraded or replaced. From 1978 to 1983, the plant proceeded through cold start-up tests to operation in November 1983. PUREX was fully operational until 1988 when it was again shut down. The facility was transitioned into a cold stand-by mode in October 1990, which was achieved in September 1992. In December 1992, planning was initiated to change the status of the PUREX facility from a cold-standby mode to a deactivation mode (or transition to shut-down).

The deactivation project established a passively safe and environmentally secure configuration for PUREX, which can be maintained for a 10-year horizon. The following criteria apply to PUREX at the time of deactivation and continue to the point of final decontamination and decommissioning (D&D) activities (WHC 1995):

- Major sources of radioactive and hazardous materials removed, reduced, and/or stabilized (reasonable best effort).
- Criticality Alarm System deactivated, residual fissionable material removed or left in a benign state (Stefanski 1995).
- The majority of buildings/structures have either No Access or only Quarterly Access (Routine) by surveillance personnel during routine facility inspections.
- PUREX utilities are isolated/removed except as described in Section 3.2.
- PUREX facilities are locked to prevent unauthorized access.

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3.0 DESCRIPTION

3.1 PUREX FACILITIES

The following is a description of the main PUREX structures remaining at the end of the deactivation project.

3.1.1 202-A Building

The 202-A Building is 1,005 ft by 199 ft by 100 ft high, with approximately 40 ft below grade and 60 ft above grade. This was the primary processing building for the PUREX operation.

The building's main structural components are (1) a thick-walled, heavily shielded concrete portion called the canyon, which contains processing equipment; (2) a section comprised of three gallery levels parallel to and isolated from the canyon; (3) a steel and transite annex to the north of the gallery section that houses offices, the laboratory, and a number of building service areas; and (4) a reinforced-concrete railroad tunnel forming a "T" at the east end. This tunnel is not included in the scope of this hazard analysis.

The canyon area proper is a narrow structure, 1,005 ft by 30.5 ft by 100 ft high. The canyon is subdivided into a single row of 12 process cells paralleled on the south side by a hot (radioactive) pipe trench with an air tunnel connected to the cells running underneath the pipe trench. Three gallery levels parallel to but isolated from the canyon on the north side of the structure contain service piping and process instrumentation equipment used in obtaining process samples and providing storage space for equipment and dry chemicals.

Two annex buildings are located on the north side of the canyon: the Office Annex and the Laboratory Annex.

The 271-AB Office/Maintenance Annex is a 32-ft by 105-ft by 28-ft-high two-story building located on the north side and at the west end of the 202-A Building. The exterior walls are steel-on-steel frame, a built-up roof on steel decking on steel frame, and interior gypsum board walls, wood doors, and carpeted floors. This annex contained operations offices and maintenance facilities.

The Laboratory Annex is a 60-ft by 180-ft two-story building. The first floor was occupied by numerous laboratories, with the second floor housing heating, ventilating, and air conditioning (HVAC) equipment for the Annex, as well as concrete high-efficiency particulate air (HEPA) filter enclosures for the hoods located in the laboratories below. There are several small steel-on-steel frame, transite-on-steel frame, and partially and fully enclosed structures located on the north side of this

annex. These structures housed flammable gas manifolds, compressed gas cylinder storage, and regulated/non-regulated drum storage.

3.1.2 203-A Storage Area

The 203-A Storage Area is a 123-ft by 103-ft by 6-ft-high reinforced concrete diked area surrounding storage tanks used for UNH and other acidic solutions. The area is located to the north of both the 202-A Building and the 211-A Liquid Chemical Tank Farm. The area is isolated from PUREX utilities and other structures remaining at the end of deactivation. There are four 100,000-gallon-capacity tanks located within individual diked sections, and three smaller capacity tanks within the diked area. All tanks have been emptied or flushed with only a minimum heel remaining at the completion of the deactivation project. Adjacent to this diked area is the 203-A Building. The 203-A Building is a 47-ft by 16-ft by 12-ft-high reinforced concrete structure used to house pumps and the control room for the 203-A storage tanks. A rail car and truck loading/unloading station are located on the west side of this area. To the east of the 203-A area is a 36-ft by 25-ft by 20-ft-high metal building used for the storage of empty metal drums.

3.1.3 204-A Building (U-Cell)

The 204-A Building "U-Cell" is a 76-ft by 20-ft by 35-ft-high concrete structure built below grade, with removable concrete cover blocks extending above grade forming the building roof. U-Cell contains four large tanks used for nitric acid recovery and laboratory waste collection and sampling. Currently, U-Cell is accessed through the 202-A sample gallery.

3.1.4 206-A Building (Fractionator)

The 206-A Building, commonly called the Fractionator Building, is a 30-ft by 24-ft building with a split-level roof having heights of 45 ft and 29 ft. The building walls, floor, and roof are constructed of reinforced concrete. This building is adjacent to U-Cell and contains a vacuum fractionator and associated equipment used for concentrating recycled nitric acid.

3.1.5 211-A Liquid Chemical Tank Farm

The 211-A Liquid Chemical Tank Farm was used to store bulk liquid chemicals used in PUREX operations. The area is located to the north of the 202-A Building and south of the 203-A Storage Area. This area is isolated from PUREX utilities and other structures remaining at the end of deactivation.

There are two tank areas; each has reinforced concrete diking to surround tanks used for storage of various chemicals. The north area has four tanks, each within an individual diked segment. The remaining (17) tanks are located in a common south

diked area. Tanks 40 and 41 in the north tank area were used to store approximately 21,500 gallons of slightly contaminated tributyl phosphate (TBP) organic solvent. All tanks were emptied or flushed with water and have only minimum heels remaining.

The 211-A Building is a 55-ft by 55-ft by 15-ft-high metal building. The walls are constructed of transite siding on a steel frame and the floor is concrete. The roof is concrete with a built-up tar and gravel covering. The building housed process pumps and motor control centers for two tank areas.

A rail car loading/unloading station is located on the west side of this area. A truck unloading station is located on the east side of this area.

3.1.6 276-A Building (R-Cell)

The 276-A Building "R-Cell" is a 65-ft by 23-ft by 35-ft-high concrete structure built below grade with removable concrete cover blocks extending above grade forming the building roof. R-Cell provided organic solvent decontamination and storage. Currently, R-Cell is accessed through the 202-A sample gallery (R-Cell centrifuge platform) or through the PR corridor (R-Cell vault floor).

3.1.7 Ventilation System Buildings/Structures

There are several buildings/structures associated with PUREX facilities ventilation systems. Buildings/structures associated with the active portion of the 202-A Building ventilation system include the #2 Deep-Bed Filter, the 291-AE (Fourth Filter Building), the 291-A (exhaust plenum and fan pad), the 291-A-1 (Main Stack), air tunnels, and the 292-AB (Main Stack Monitoring Building). These buildings are further described in Section 3.2.2 relative to their roles in providing ventilation for the 202-A, 204-A, and 276-A Buildings.

Buildings/structures associated with deactivated ventilation systems include Deep-Bed filters #1 and #3, 291-AB, 291-AC, 291-AD, 291-AG, 291-AH, 291-AJ, 291-AK, and multiple 296-A stacks.

3.1.8 Other Buildings/Structures

At the end of the deactivation project several other smaller buildings are expected to remain. These buildings are generally classified as offices, instrument and equipment enclosures, or storage areas. These buildings are not expected to be accessed during the surveillance period and normally are either not contaminated or have only low-level fixed contamination. No significant hazards were identified for these buildings during the surveillance period.

3.2 UTILITIES

With the exception of electric power and the 202-A HVAC system as described below, all utilities to the PUREX will be isolated/blanked as described below:

- Steam - Isolated at facility boundary.
- Water - Isolated at facility boundary.
- Sewers - Capped/grouted at individual cell/room locations.
- Backup diesel generators - Removed.
- Liquid effluent lines - Capped/grouted/isolated as appropriate.
- Liquid transfer lines (product/waste) to Tank Farms - Isolated to prevent inadvertent transfers from Tank Farms.
- Electric - Isolated/disconnected with new system installed (see Section 3.2.1).
- HVAC/stacks - Isolated/capped except 291-A-1 (see Section 3.2.2).

3.2.1 Electrical

The current electrical distribution system to PUREX has been isolated/disconnected prior to the 252-A substation. A new substation/transformer was installed and provides power to the HVAC system and dedicated surveillance lighting and leak detection circuits.

Surveillance lighting is provided only to those PUREX buildings/areas requiring access by surveillance personnel. A leak detection probe will be provided for U-Cell to detect water inleakage. The surveillance lighting and leak detection circuits are provided with a disconnect external to the 202-A Building and will be energized only when performing the quarterly surveillances.

3.2.2 Ventilation System

With the exception of the active portions of the 202-A HVAC described here, all PUREX ventilation systems, including HEPAs and stacks, have been capped/isolated to prevent unintended releases to the atmosphere.

At deactivation, the 202-A Building is ventilated by cascading previously operational systems into the canyon ventilation system. The U-Cell and R-Cell are also ventilated through this system. This cascading was accomplished by opening doors or other

pathways as necessary to maintain the air flow from non-contaminated areas into increasing contamination zones through the main canyon until it is exhausted via the 291-A-1 stack. The air flow has been reduced to approximately 40,000 cfm for the surveillance period.

The major portions of the 202-A HVAC that will remain active are the #2 Deep-Bed filter, HEPA filters in the 291-AE Building, 291-A electric exhaust fans, 291-A-1 stack, air tunnels, 292-AB Building, and monitoring instrumentation.

An 8-ft-wide by 8-ft-high reinforced concrete exhaust air duct connects the 202-A Building to the #2 Deep-Bed filter located in the south yard area and is comprised of below grade concrete exhaust air treatment and discharge facilities. The overall dimensions of the filter area are 82 ft by 52 ft by 13 ft deep.

The #2 Deep-Bed filter was designed to remove 99.9% of the particulates from the air stream. The filter area has two glass-fiber bed sections: the prefilter and the cleanup filter. The prefilter bed consists of five separate layers, each packed with a different density of fiberglass. The cleanup filter beds consist of 132 American Air Filter Co. 1-in.-thick Deep-Bed filter units.

The 291-AE (Fourth Filter) Building is a 123-ft by 41-ft by 17-ft-high reinforced concrete building, which houses 10 modular filter units, each with upstream and downstream isolation dampers. A typical modular filter unit consists of a stainless-steel housing containing an inlet damper, an in-place-filter testing assembly, a 4 by 3 array of HEPA filters, an in-place-filter testing assembly, and an outlet damper. At deactivation, five filters are operational, with the remainder expected to be kept in reserve. There are two reinforced concrete air ducts located below 291-AE, parallel to each other and running in the north-south direction. The west duct is an inlet air duct connected to the underground air duct for the #2 filter. The east duct is the discharge air duct from the HEPA filter units and connects with the aboveground reinforced concrete exhaust air plenum. Attached to the south side of the building is a 24-ft by 12-ft by 9-ft-high metal building, which houses the mechanical and electrical equipment and is the entrance vestibule for the 291-AE Building.

The 291-A exhaust plenum and fan area consists of an underground air duct connected to the 291-AE discharge air duct and an aboveground segment that houses three electric motor driven ventilation fan units. The walls and floor are constructed of reinforced concrete. The 2.4 kV motor driven fans are located on the south side of the aboveground plenum segment.

The 291-A-1 Main Stack is of reinforced concrete construction and rises 200 ft above grade. The stack has a free-standing, 7-ft inner diameter, stainless steel liner. The top of the stack is capped to cover the annulus between the stack and the liner. Aircraft warning lights are provided.

The 292-AB Building is a 35-ft by 20-ft by 25-ft-high two-story metal building. The second floor is constructed on metal grate with a metal plate over approximately 80% of the floor area. The building is an enclosure for instrumentation and monitoring equipment.

3.3 HAZARDS

3.3.1 Hazardous Material

3.3.1.1 Non-Radiological Hazardous Material. The PUREX deactivation project removed, reduced, or stabilized the hazardous chemicals and waste within the PUREX facility.

All bulk chemicals have been removed; only residual quantities are present. These residuals are in the heels left in chemical and process tanks and dead-end legs of piping and material (primarily nitrate salts) resulting from spills and leaks. The hazards associated with these chemicals should be minimal as tanks and vessels have been drained and flushed until the samples meet the criteria specified in WHC-SD-WM-0053, Rev. 1. It is assumed that each flush reduces the concentration in the vessel by $10^{(n+1)}$ for one to three flushes (LATA 1993). Hazardous residual from spills or leaks is primarily found as dried salts or captured in cell debris or sludge and is normally assumed to be non-reactive and not readily mobile.

3.3.1.2 Radiological Hazardous Material. The PUREX deactivation project removed, reduced, or stabilized the major radioactive sources and waste within the PUREX facility. Radiological contamination exists throughout PUREX and consists of uranium, transuranics, and/or mixed fission products. The radioactive material inventory remaining at the end of deactivation is primarily in the form of contaminated equipment and surfaces, dust, debris, sludge, with some remaining Pu metal and oxide dust in gloveboxes.

Four areas were identified as containing significant quantities of Pu: L-Cell, which is estimated to contain between 3 and 4 Kg of Pu in sludge on the floor; Deep-Bed filters #1 and #2, each containing 100-200 g of Pu; and N-Cell, which contains 1-2 Kg of Pu material in gloveboxes.

Some areas (cells) within the PUREX canyon may have significant levels of surface contamination and quantities of radioactive debris. These areas are not provided with provisions for routine access. Release of radioactive material from these areas is included in the analysis of seismic and loss of ventilation events (see Section 5.0).

In areas with personnel access, the radiological contamination will be reduced, fixed, or shielded and the area posted in accordance with the *Hanford Site Radiological Control Manual* (HSRCM). One area with routine access, the Storage Gallery, has been

identified as posing a significant potential risk to surveillance workers. One area, the East Crane Maintenance Platform (ECMP), contains contaminated dust and may pose risk to onsite workers in the event of seismic activity.

The risks associated with these areas are further discussed in Section 5.0.

3.3.2 Energy Sources

The deactivation project removed existing energy sources and disconnected PUREX utilities (e.g., steam, gases). A new electrical substation serves the active portions of the 202-A Building ventilation system, new surveillance lighting, and U-Cell leak detection circuits.

Other potential energy sources include external events (lightning, vehicles) and transient combustibles.

Energy from potential criticality events were precluded as a concern for the following reasons:

- The sludge in L-Cell is chemically stable and has a wax-like consistency, preventing migration of the material to form a critical mass. Previous efforts to dissolve the sludge with nitric acid failed to remove the sludge.

- The #1 Deep-Bed filter is physically isolated from the remainder of the PUREX facility and contains less than the minimum critical mass (MCM) of material.

- The #2 Deep-Bed filter will remain active; however, no means of increasing the current content were identified. Currently, the filter has less than MCM of material.

- The material remaining in the N-Cell gloveboxes will be less than 450 grams per glovebox or otherwise in a form precluding criticality. Additionally, this material is fixed in place and the gloveboxes sealed, preventing migration of the material.

- The only mechanism for water to be introduced into these areas is through precipitation infiltration, which will not introduce sufficient quantities to act as a moderator.

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4.0 HAZARD ANALYSIS METHODOLOGY

This hazard analysis implements the requirements of DOE Order 5480.23 and guidance contained in DOE-STD-1027-92 and DOE-STD-3009-94 for conducting hazard analyses. The initial analysis effort focused on identifying facility operations, configuration, and inventory remaining in PUREX buildings and structures at the end of the deactivation project. This information was entered into a database (Appendix E), which was used as a baseline for the hazard analysis sessions. The initial end points were determined from the following documents:

- Letter, M.C. Hughes to W.A. Peiffer, "PUREX Deactivation Criteria for Acceptance by Decontamination and Decommissioning,"
- PUREX Shutdown Final Safety Analysis Report (FSAR) Scoping Matrix,
- PUREX FSAR,
- PUREX Deactivation End Point Criteria,
- PUREX Fire Hazard Analysis,
- Estimate of PUREX Plant Inventory of Chemicals and Radioactivity.

The initial end points were then refined through two hazard analysis sessions with PUREX staff and follow-up interviews.

After the facility deactivation end points were identified, the hazard analysis was performed in two steps. The first was a screening step to identify PUREX locations to be analyzed using the Preliminary Hazard Analysis (PHA) methodology. Locations were screened based on two criteria: (1) personnel access and (2) material inventory. All locations having significant material inventory or subject to personnel access were analyzed by PHA. In addition to areas with routine access or with significant quantities of material, the entire PUREX facility was analyzed for a seismic event and failures of the HVAC system. Table 4-1 provides a summary of initial facility deactivation end points and identifies those areas for which a PHA was performed.

Table 4-1. PUREX Hazard Analysis Screening. (7 sheets)

Location	Access	Utilities	Inventory	PHA (Y/N)	Notes
202-A					
A-Cell	No Access	HVAC	Surface contamination (dust/debris, dried sludge etc.) Silver reactor typically containing Ag - 250 lb (670 g-mol), Silver salts: I-129, I-131, Chlorides, Fluorides, and Mercury	N	
AMU	Routine	HVAC Surveillance Lights	Some residual solid contamination in piping and/or tanks	Y	
B-Cell	No Access	HVAC	Surface contamination (dust/debris, dried sludge, etc.) Ag - 250 lb (670 g-mol), Silver salts: I-129, I-131, Chloride, Fluoride, Mercury	N	
Blower Room	Routine	HVAC Surveillance Lights	None identified.	Y	
C-Cell	No Access	HVAC	Surface contamination (dust/debris, dried sludge, etc.) Ag - 250 lb (670 g-mol), Silver salts: I-129, I-131, Chloride, Fluoride, Mercury	N	
Canyon Lobby	Routine	HVAC Surveillance Lights	None identified.	Y	
Change Rooms	Routine	HVAC Surveillance Lights	None identified.	Y	
Compressor Room	Routine	HVAC Surveillance Lights	None identified.	Y	

Table 4-1. PUREX Hazard Analysis Screening. (7 sheets)

Location	Access	Utilities	Inventory	PHA (Y/N)	Notes
Control Room-Central/ Power	Routine	HVAC Surveillance Lights	Radon	Y	
Control Room-Head End	Routine	HVAC Electrical Surveillance Lights	None identified.	Y	
Crane Gallery	Special	HVAC Surveillance Lights	Surface contamination (dust/debris, dirt, particulates)	Y	
D-Cell	No Access	HVAC	Surface contamination (dust/debris, dried sludge, etc.)	N	
E-Cell	No Access	HVAC	Surface contamination (dust/debris, dried sludge, etc.)	N	
F-Cell	No Access	HVAC	Open metal box with solids from E-Cell (contaminated concrete debris - contains chromium) Surface contamination (dust/debris, etc.)	N	
G-Cell	No Access	HVAC	Surface contamination (dust/debris, dried sludge, etc.) Oils in equipment	N	
H-Cell	No Access	HVAC	Surface contamination (dust/debris, dried sludge, etc.) Oils in equipment	N	
Hot Shop	No Access	HVAC	Surface contamination (dust/debris, dried sludge, etc.) Oils in equipment	N	
J-Cell	No Access	HVAC	Surface contamination (dust/debris, dried sludge, etc.) Oils in equipment	N	

Table 4-1. PUREX Hazard Analysis Screening. (7 sheets)

Location	Access	Utilities	Inventory	PHA (Y/N)	Notes
K-Cell	No Access	HVAC	Surface contamination (dust/debris, dried sludge, etc.) Oils in equipment	N	
L-Cell	No Access	HVAC	Pu - 3.9 Kg HNO_3 - trace TBP - trace	Y	
Laboratory	No Access	HVAC	Surface contamination fixed in place	N	
M-Cell/Pool Cell	No Access	HVAC	Surface contamination (dust/debris, dried sludge, etc.)	N	
N-Cell/PR Room	Routine	HVAC Surveillance Lights	Pu - 1-2 Kg inside gloveboxes Surface contamination (dust/debris, etc.)	Y	
P&O Gallery	Routine	HVAC Surveillance Lights	Low-level surface contamination with some floor dust/debris.	Y	
White Room	Routine	HVAC Surveillance Lights	Fixed surface contamination - Pu	Y	
Q-Cell	Routine	HVAC Surveillance Lights	Low-level surface contamination with some floor dust/debris. Protactinium primary daughter product.	Y	
RR Tunnels	—	—	—	—	Not included in scope.
Sample Gallery	No Access	HVAC	Surface contamination (dust/debris) Some high-level contamination inside hoods (fission products, west end Pu) Seal loops may contain acids	N	
Slug Storage Basin	No Access	HVAC	Low-level contamination (sand) in basin (may be fixed)	N	

Table 4-1. PUREX Hazard Analysis Screening. (7 sheets)

Location	Access	Utilities	Inventory	PHA (Y/N)	Notes
Storage Gallery/ PIV Room	Routine	HVAC Surveillance Lights	Surface contamination (dust/debris) Two known leaking expansion joints (B & F); maybe a few other spots (fixed contamination). Hot spots	Y	
203-A (UNH Storage)	No Access	None	Low-level contamination (fixed)	Y	
204-A (U-Cell)	No Access	HVAC Leak Detection	Surface contamination (dust/debris, dried sludge, etc.)	Y	
206-A (Fractionator)	No Access	None	Friable asbestos, floor ground level	Y	
211-A	No Access	None	TK-40/41 LSA internal contamination	N	
212-A	No Access	None	Surface contamination (<5 mrem/hr RA outside)	N	
213-A	No Access	None	Surface contamination (<5 mrem/hr RA outside)	N	
214-A/B/C/D	No Access	None	Potential hazardous contamination << low levels	N	
215-A	No Access	None	Potential contamination	N	
216-A	No Access	None	Surface contamination (fixed)	N	
216-A-42	No Access	None	Surface contamination (<5 mrem/hr)	N	
252-A	No Access	None	None identified	N	
2701-AB	No Access	None	None identified	N	
2701-AC	No Access	None	None identified	N	
2709-A	No Access	None	None identified	N	
271-AB	Routine	Surveillance Lights	None identified	Y	
2711-A	No Access	None	None identified	N	

Table 4-1. PUREX Hazard Analysis Screening. (7 sheets)

Location	Access	Utilities	Inventory	PHA (Y/N)	Notes
2712-A	No Access	None	None identified	N	
2714-A	No Access	None	Potential hazardous material residues	N	
2714-U	No Access	None	Surface contamination (fixed) Exterior designated as Rad Buffer Area	N	
276-A (R-Cell)	No Access	HVAC	Surface contamination (dust/debris, dried sludge, etc.) Oils in equipment	N	
281-A	No Access	None	None identified.	N	
292-AA	No Access	None	Low-level contamination potential	N	
293-A	No Access	None	Surface contamination (interior) Asbestos in basement Exterior meets criteria for contamination area	N	
294-A	No Access	None	Surface contamination (fixed)	N	
295 Process Distillate				N	
295-A	No Access	None	Surface contamination (fixed)		
295-AA	No Access	None	Surface contamination (fixed)		
295-AB	No Access	None	Surface contamination (fixed)		
295-AC	No Access	None	Surface contamination (fixed)		
295-AD	No Access	None	Surface contamination (fixed)		
295-AE	No Access	None	Surface contamination (fixed)		
302-A	No Access		Liquids from 302 diversion box	Y	~8,500-gallon capacity
Mobile Office				N	
MO-112	No Access	None	None identified.		
MO-325	No Access	None	None identified.		
MO-332	No Access	None	None identified.		
MO-540	No Access	None	None identified.		

Table 4-1. PUREX Hazard Analysis Screening. (7 sheets)

Location	Access	Utilities	Inventory	PHA (Y/N)	Notes
MO-993	No Access	None	None identified.		
P008	No Access	None	None identified.	N	
P009	No Access	None	None identified.	N	
P0010	No Access	None	None identified.	N	
Ventilation System (Active)				Y	
291-A	Routine	Electrical	Surface contamination		Fan Pad
291-A-1	Routine	Stack Monitors	Low-level contamination		Main Stack
291-AE	Routine	Surveillance Lights	Low-level contamination		HEPA filter building
292-AB	Routine	Surveillance Lights Electrical	None identified Sample/monitor equip.		Ventilation system monitoring building
Deep-Bed Filter #2	No Access	-----	100-200 g Pu 250,000 μCi Am 20-200 Ci Cs/Sr		Primary filter
TK-216-A-2	No Access	None	Condensate from Deep-Bed Filter		catch tank ~5,000-gallon capacity
TK-V11-1	No Access	None	Very low-level condensate from stack		catch tank ~3,344-gallon capacity
TK-V11-2	No Access	None	Very low-level condensate from stack		catch tank ~3,344-gallon capacity
Ventilation System (Inactive)				Y	
291-AB	No Access	None	None identified.		
291-AC	No Access	None	None identified.		
291-AD	No Access	None	None identified.		
291-AG	No Access	None	None identified.		
291-AH	No Access	None	None identified.		

Table 4-1. PUREX Hazard Analysis Screening. (7 sheets)

Location	Access	Utilities	Inventory	PHA (Y/N)	Notes
291-AJ	No Access	None	None identified.		
291-AK	No Access	None	Surface contamination		
296 - Stacks				N	
296-A-1	No Access	None	Surface contamination (fixed)		
296-A-2	No Access	None	Surface contamination (fixed)		
296-A-3	No Access	None	Surface contamination (fixed)		
296-A-5A	No Access	None	Surface contamination (fixed)		
296-A-5B	No Access	None	Surface contamination (fixed)		
296-A-6	No Access	None	Surface contamination (fixed)		
296-A-7	No Access	None	Surface contamination (fixed)		
296-A-8	No Access	None	Surface contamination (fixed)		
296-A-9	No Access	None	Surface contamination (fixed)		
296-A-10	No Access	None	Surface contamination (fixed)		
296-A-14	No Access	None	Surface contamination (fixed)		
Deep-Bed Filter #1	No Access	None	100-200 g Pu 250,000 μCi Am 20-200 Ci Cs/Sr		
Deep-Bed Filter #3	No Access	None	None identified (filters removed).		

In the second step, a PHA was performed for each of the locations identified in Table 4-1. The PHA was based on the following list of conditions with the potential to cause the release of material:

1. Fires, Explosions:

    - Flammable materials (liquids, vapors, gases, dust, bulk materials)
    - Chemical reactions
    - Electrical faults
    - External sources (vehicles, aircraft, lightning)

2. Temperature Extremes

    - Cryogenics
    - Steam
    - Radioactive decay
    - Climate extremes
    - Chemical reactions

3. Leaks of Material

    - Compressed gases
    - High pressure systems
    - Corrosion
    - Human error (inadvertent valve opening)
    - Handling error (dropping object)
    - Structural fatigue
    - Rotating machinery

4. Resuspension and/or Mobilization of Material

    - System activation (HVAC)
    - Internal flooding
    - High pressure systems
    - Seismic event
    - Fixative deterioration
    - Infiltration (precipitation)

5. Increased Concentration of Material

    - HVAC failure
    - Paint/fixative.

Based upon the inventory, location, form, and potential pathways to the environment, a qualitative estimate of the likelihoods and consequences was made for each hazardous condition resulting in a release of radioactive and/or non-radiological hazardous

material. The consequences were classified in accordance with Table 4-2 as to their potential impact to the offsite public, onsite worker, surveillance personnel (facility workers), or the environment. Qualitative likelihoods of releases were assigned in accordance with Table 4-3.

In addition, the hazard analysis identified means of detecting accidents and mitigating controls or systems used to prevent the occurrence or minimize the release of radioactive and/or non-radiological hazardous material. The PHA results were documented using the Preliminary Hazard Analysis Sheet shown in Figure 4-1. Completed Preliminary Hazard Analysis Sheets are contained in Appendix A.

No non-radiological hazard material releases were identified by the hazard analysis that impacted the offsite public, onsite worker, or surveillance personnel.

For radiological hazards associated with the release of material from the PUREX boundary (consequence I or II), additional analyses were performed to quantitatively determine the likelihood and consequences of the potential release. Appendix B provides quantitative support for the likelihood calculations, while Appendices C and D provide bounding consequence analyses for these events. The calculated releases and associated likelihoods were then compared to the Radiological Risk Evaluation Guidelines (RRG) contained in HNF-PRO-704.

Table 4-2. Consequence Classes.

Class	Description
I	Offsite Public Health Impacts
II	Onsite Worker Impacts, No Impacts Offsite
III	Facility Worker Impact, No Impacts Outside of Facility Boundary
IV	Environmental Impacts
IVa	Considerable
IVb	Minor
IVc	Negligible
V	No Significant Impact

Table 4-3. Likelihood Classes.

Descriptive Word	Class	Estimated Annual Likelihood of Occurrence	Description
Normal	A	$>10^{-1}$	Incidents that are expected to occur during the life cycle of the facility.
Anticipated	B	$10^{-1} \geq p > 10^{-2}$	Incidents that may occur during the life cycle of the facility.
Unlikely	C	$10^{-2} \geq p > 10^{-4}$	Incidents that are not anticipated to occur during the life cycle of the facility. Natural phenomena of the probability class include: UBC level earthquake, 100-year flood, maximum wind gust, etc.
Extremely Unlikely	D	$10^{-4} \geq p > 10^{-6}$	Incidents that will probably not occur during the life cycle of the facility. Includes DBAs.
Beyond Extremely Unlikely	E	$10^{-6} \geq p$	Incidents not considered credible and, therefore, not further analyzed.

Figure 4-1. Preliminary Hazard Analysis Sheet.

PUREX:

Preliminary Hazard Analysis Sheet

Location: _____

Facility Mode: _____

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS

5.0 HAZARD ANALYSIS RESULTS

Table 5-1 summarizes the results of the analyses for hazardous conditions resulting in the release of material. No offsite impacts were identified. The PHA identified three hazardous conditions (202A-1, AVS-4, and AVS-5a) with the potential for onsite worker impacts. These conditions were further analyzed to quantify likelihood and consequences. The consequences of these releases met the risk acceptance guidelines contained in HNF-PRO-704. One condition (AVS-3b) was identified with the potential for facility worker impacts. Two conditions (302A-3 and AVS-3a) were identified as having potential environmental impacts. These conditions leading to a release are further discussed in Section 5.1.

The study also identified several hazards related to surveillance activities. These hazards are further discussed in Section 5.2.

Table 5-1. Potential Releases from Deactivated PUREX Facilities.

Event ID	Hazardous Condition	Likelihood	Consequence Class	Calculated Exposure or Release 100 m		RRG 704 100 m (onsite)
202A-1	Seismic	C[a]	II	1.9 rem	19 mSv	250 mSv
AVS-4	Ventilation (loss of filtration)	B	II	4.6 E-02 rem[b]	4.6 E-01 mSv[b]	50 mSv
AVS-5a	Ventilation (loss of power)	B	II	4.8 E-02 rem[f]	4.8 E-01 mSv[f]	50 mSv
AVS-3b	Leak of Material (ventilation condensate)	D	III	3.6E-01 Ci[c]	___[d]	___[d]
302A-3	Leak of Material (catch tank)	C	Iva	N/A[e]	N/A[e]	___[d]
AVS-3a	Leak of Material (ventilation condensate)	C	IVb	4.4 E-01 Ci[c]	___[d]	___[d]

Notes:

[a] Bounding accident
[b] At 300 m for stack release
[c] Maximum curies at point of release
[d] No RRG for facility worker or environmental impacts
[e] Not available; see Section 5.1.5
[f] Area source, worst case meterology, 100% residence time.

5.1 RELEASE OF MATERIAL

5.1.1 Seismic

The event studied here is the failure of the ECMP due to a 0.10-g earthquake (202A-1). It is assumed the ECMP supports buckle, causing the ECMP to collapse to the ground. It is also assumed the Safety Class 3 202-A ventilation system (Siemer 1995) loses power. This event was analyzed in the PUREX FSAR and was found not to exceed offsite acceptance criteria, except for the case involving a uranium fire (which is not credible for the facility in the deactivated state).

The material at risk for this event was determined to be contaminated dust and debris contained on the floor of the ECMP. Additionally, the collapse of the ECMP provides a pathway for release of unfiltered air from the 202-A Building. The total material at risk was determined to be the sum of the following:

1. The high airborne concentration of radionuclides in the canyon as reported for an unfiltered release due to loss of HVAC (Siemer 1995). To these values were added the remaining Pu isotopes from the PUREX FSAR. These values are felt to be conservative as the majority of material remaining in the 202-A is contained in the PUREX canyon, which is assumed to survive with the cover blocks intact. The remainder of the 202-A Building also survives the earthquake; therefore, no motive force was identified to lift additional airborne material from the cell floors (40 ft below grade) through the cover blocks and out the opening left by the ECMP collapse.

2. The material at risk within the ECMP was estimated based upon a conservative average of samples taken from the ECMP. This average sample is 30,000 dpm alpha, 100,000 dpm beta, and 30,000 dpm gamma, with a sample size of 100 cm^2 (Berk 1995). It was conservatively assumed this activity resulted from Pu-239, Sr-90, and Cs-137 and was uniformly distributed on all ECMP interior surfaces. The interior surface area of the ECMP is estimated to be 1.1E+7 cm^2 (RHO-CD-1560). This yielded the following material at risk.

$$\mu Ci - Pu_{239} = 30{,}000\ dpm/100cm^2\ x\ 4.51E{-}7\ \mu Ci/dpm\ x\ 1.1E{+}7\ cm^2 = 1488\ \mu Ci$$

$$\mu Ci - Sr_{90} = 100{,}000\ dpm/100cm^2\ x\ 4.51E{-}7\ \mu Ci/dpm\ x\ 1.1E{+}7\ cm^2 = 4961\ \mu Ci$$

$$\mu Ci - Cs_{137} = 30{,}000\ dpm/100cm^2\ x\ 4.51E{-}7\ \mu Ci/dpm\ x\ 1.1E{+}7\ cm^2 = 1488\ \mu Ci$$

Modeling the material at risk (Appendix C) resulted in a total effective dose equivalent (TEDE) of 1.9 rem (19 mSv); much less than the 250 mSv RRG for an onsite (100 meters) worker for an accident of this likelihood.

5.1.2 Ventilation

Loss of PUREX ventilation was studied for two separate incidents:

1. Loss of power/fans resulting in the unfiltered release of contaminated air from the 202-A Building (AVS-5a).

2. Loss of filtration resulting in the unfiltered release of contaminated air out the 291-A-1 stack (AVS-4).

The first case (AVS-5a) was evaluated for dose consequences using the average concentrations from the sample probe data and the additional Pu isotopes from the PUREX FSAR. The doses associated with equipment (fan) failures are identified as 4.8 E-02 rem EDE for 100 meters, based on modeling as an area source, worst case meterology, and 100% residence time, and 3.0 E-04 rem EDE at the current offsite boundary.

Additionally, the unfiltered release of PUREX air out the stack was evaluated again using the average concentrations and additional Pu isotopes. The assumed air flow was 40,000 cfm for 24 hours. For this analysis, the unfiltered release accident was modified to include resuspension of contamination from failure of the filter media (AVS-4). From Hobart (1995), the filter loading of the Deep-bed filter is 100-200 g Pu, 2.5 E+5 μCi Am, and 20-200 Ci Cs/Sr. The filter loading on the final HEPA filters is considered negligible. From DOE-HDBK-3010-94, an airborne release fraction of 1 E-2 and respirable fraction of 1.0 was used to determine the material resuspended. It is assumed the Deep-bed filter fails, releasing 2 g Pu, 2.5 E+3 μCi of Am, and 2 Ci Cs/Sr to the HEPA filter bank, and that the airflow was 40,000 cfm for 24 hours. Assuming the entire released material is captured on one filter, which in turn fails, the material released out of the stack is 2 E-2 g Pu, 25 μCi Am, and 2 E-2 Ci of Cs/Sr, plus the building airborne contaminants released over a 24-hour period.

Modeling this release (Appendix D) resulted in a TEDE of 4.6 E-2 rem (4.6 E-1 mSv); much less than the 50 mSv RRG for an onsite worker (300 meters) from a stack release for an accident with an undetermined likelihood. This same modeling resulted in 7.2 E-03 rem (7.2 E-02 mSv) at the current site boundary.

5.1.3 Leak of Contaminated Liquids (Ventilation Condensate Collection)

Two release modes were identified resulting in a leak of contaminated liquids to the PUREX environment. The first mode is a leak during a tank draining operation and results in an aboveground leak and potential operator exposure (AVS-3b). The second is a tank failure resulting in an underground leak of material (AVS-3a).

Three tanks, TK-216-A, TK-V11-1, and TK-V11-2, are associated with the 202-A Ventilation System. TK-216-A is the 291-A-1 stack condensate catch tank and tanks TK-V11-1 and TK-V11-2 are condensate collection tanks for the Deep-bed filter. The contamination levels are expected to be greater for condensate in tanks TK-V11-1 and TK-V11-2.

The impacts associated with a leak of one of these tanks is a local environmental concern. The volume of material at risk for a leak of any one tank is 3,400 gallons. Such a leak would most likely not require immediate remediation actions but would most likely require pumping and isolation of the tank.

5.1.4 Leak of Contaminated Liquid (302-A Catch Tank)

The condition identified here (302A-3) is a leak from the 302-A Catch Tank, which collects spills and leaks from the 302-A Diversion Box.

As with the ventilation system catch tanks, there are two release modes resulting in a leak of contaminated liquid to the environment. However, the activity of the material in the 302-A catch tank is dependent upon the material being transferred through the 302-A diversion box. Therefore, the hazards associated with this task cannot be as readily quantified.

Thus, the following assumptions were made:

1. Prior to transferring liquids out of the 302-A catch tank, a hazard analysis will be performed, documenting the risks associated with this activity.

2. A leak from the catch tank would not require immediate remedial actions as the tank is located in a secure area and is not an imminent threat to groundwater. However, identification of a leak would result in pumping and isolation of the tank to minimize the impacts of the leak.

5.2 HAZARDS ASSOCIATED WITH PUREX SURVEILLANCES

The study was concerned with hazardous conditions potentially exposing surveillance personnel to unexpected or increased quantities of radioactive or hazardous material. As no risk acceptance guidelines are provided for individual exposures to facility workers, these hazards were not quantified with respect to probability or consequence. However, risks to individuals are required to be reduced and as such, are identified here to provide for protection, prevention, and mitigation activities to be fully defined.

For fires, the primary hazard is inhalation of contaminated smoke particles. The potential for fires in areas with routine access has been reduced by limitation of combustibles and potential ignition sources. However, as no fire protection equipment is expected to be readily available, personnel should be aware of the potential risk with

respect to exposure to flames and heat, as well as the potential inhalation of contaminated smoke particles.

Loss of HVAC has been addressed previously (Siemer 1995) and determined not to exceed RRG limits for exposure to onsite workers. However, the loss of HVAC would also cause the spread of contamination into previously uncontaminated areas of the 202-A Building. In the event of a loss of HVAC, surveillance personnel need to be made aware of the potential for new surface contamination. Although the hazard involved with loss of HVAC during surveillance of the 202-A Building was determined to be non-credible, personnel should not be allowed to enter the 202-A Building during such an event without proper protective clothing and equipment.

Loss of shielding over surface contamination in the Sample and Storage Gallery is of concern due to the relatively high exposure levels associated with contamination due to leaks between cells in this area.

With respect to hazardous material or chemicals, there were no events identified that would impact surveillance personnel beyond normal industrial hazards.

With respect to radioactive material, several events could potentially transport material into unexpected areas, increase localized and airborne concentrations of material, or expose personnel to unexpected levels of radiation. Contributing causes of these events include leaks of contaminated material or uncontaminated liquids across a known surface contamination, deterioration or flaking of fixative on a surface contamination area, fire, loss of HVAC (also addressed in Section 5.1.2), and loss of shielding.

Loss of HVAC and loss of shielding within the Sample and Storage Gallery are discussed individually. Leaks, fixative failures, and fires are discussed generally, as the events are considered to cause only localized concerns and are similar for all areas identified.

For areas with routine access, a leak of contaminated liquid or uncontaminated liquid across surface contamination could potentially spread the surface contamination. The hazard associated with this event is minor as the contamination spread is expected to be minimal and of low activity. However, this event could lead to additional spread of contamination by surveillance personnel and should be avoided.

Fixative failures in areas of routine access are of concern as they may increase levels of radiation (alpha), and may provide paint chips, which could be spread or become airborne to be potentially inhaled by surveillance personnel.

The mechanism for inhalation is the resuspension of flaked chips via surveillance personnel performing rounds.

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6.0 CONCLUSIONS

The results of this study determined that the hazards associated with the PUREX facility in its deactivated state are within RRG for the offsite public and onsite workers. The hazard analysis identified potential concerns related to leaks of material to the environment within the PUREX boundary and to surveillance personnel performing onsite inspections.

It is concluded that:

- No TSRs or safety significant SSCs are required.
- Facility aging does not result in offsite or onsite worker impacts; however, the potential exists for these conditions to impact industrial safety of surveillance personnel.
- Radiological hazards to the surveillance personnel can be mitigated by proper protective clothing, monitoring, and standard work practices.
- There are no significant environmental impacts.

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APPENDIX A

PRELIMINARY HAZARD ANALYSIS SHEETS

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PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: AMU

Facility Mode: Routine Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
AMU-1	Fires/explosion	Transient combustibles/ignition	Release smoke into building ventilation system	D	III	Visual observation	Minimize combustibles	
AMU-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No impacts identified
AMU-3	Leaks of material	Corrosion Structural fatigue Temperature cycling (freezing/thawing)	Leak of radioactively contaminated liquid into room	C	III	Detection of radioactivity	Repair leak Clean spill Fixative as necessary	Residual contamination in piping and TK-113
AMU-4	Resuspension/mobilization of material	N/A	N/A	---	---	N/A	N/A	No fixed/solid material identified
AMU-5	Increased concentration of material	Leak of radioactively contaminated liquid	Vaporization of droplets	D	III		Minimize access	Also see HVAC failure. Requires personnel to be present to be hazardous.

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: Blower Room

Facility Mode: Routine Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
BR-1	Fires/explosion	Transient Ignition Source (electric) Building Load (combustibles)	Smoke released into building ventilation system	D	III	Visual observation	Minimize potential ignition source and transient combustibles	Acceptable release of contaminates from burning building load
BR-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
BR-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
BR-4	Resuspension/mobilization of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
BR-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	See HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: Canyon Lobby

Facility Mode: Routine Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
CL-1	Fires/explosion	Transient Ignition Source (electric) Building Load (combustibles)	Smoke released into building ventilation system	D	III	Visual observation	Minimize potential ignition source and transient combustibles	Acceptable release of contaminates from burning building load
CL-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CL-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CL-4	Resuspension/mobilization of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CL-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	See HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A; Change Rooms

Facility Mode: Routine Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
CHGRM-1	Fires/explosion	Transient Ignition Source (electric) Building Load (combustibles)	Smoke released into building ventilation system	D	III	Visual observation	Minimize potential ignition source and transient combustibles	Acceptable release of contaminates from burning building load
CHGRM-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CHGRM-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CHGRM-4	Resuspension/mobilization of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CHGRM-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	See HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: Compressor Room

Facility Mode: Routine Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
CMPRM-1	Fires/explosion	Transient Ignition Source (electric) Building Load (combustibles)	Smoke released into building ventilation system	D	III	Visual observation	Minimize potential ignition source and transient combustibles	Acceptable release of contaminates from burning building load
CMPRM-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CMPRM-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CMPRM-4	Resuspension/mobilization of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CMPRM-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	See HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: Control Room - Central Power

Facility Mode: Routine Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
CR-CP-1	Fires/explosion	Transient Ignition Source (electric) Building Load (combustibles)	Smoke released into building ventilation system	D	III	Visual observation	Minimize potential ignition source and transient combustibles	Acceptable release of contaminates from burning building load
CR-CP-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CR-CP-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CR-CP-4	Resuspension/mobilization of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CR-CP-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	See HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: Control Room - Head End

Facility Mode: Routine Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
CR-HE-1	Fires/explosion	Transient Ignition Source (electric) Building Load (combustibles)	Smoke released into building ventilation system	D	III	Visual observation	Minimize potential ignition source and transient combustibles	Acceptable release of contaminates from burning building load
CR-HE-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CR-HE-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CR-HE-4	Resuspension/mobilization of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
CR-HE-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	See HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: Crane Gallery

Facility Mode: Special Access (~1 every 3 yrs)

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
CGAL-1	Fires/explosions	Transient combustibles Transient ignition source	Radioactively contaminated smoke enters building ventilation system	D	III	Visual observation	Minimize potential ignition source and transient combustibles	
CGAL-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No impacts identified
CGAL-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No hazards liquid inventory identified
CGAL-4a	Resuspension and/or mobilization	Roof leak	Movement of material within crane gallery/CMPs	A	V	Personnel observation	Repair roof	No personnel hazard; assumes gallery is radiation area and material is not fixed in place
CGAL-4b		Human intrusion	Resuspension of material Tracking of material	A	V	Exit survey per RWP	Fix loose material (dust) if required	No personnel hazard; assumes gallery is radiation area and material is not fixed in place
CGAL-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	See loss of HVAC

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: L-Cell

Facility Mode: No Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
L-1	Fires/explosion	N/A	N/A	---	---	N/A	N/A	No ignition source identified
L-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No impacts identified
L-3	Leaks of material	Corrosion Structural fatigue Temperature cycling (freezing/thawing)	Leak potentially contaminated liquid into cell	C	V	None	None required	< 15 gallons available for release
L-4	Resuspension/mobilization of material	Structural equipment failure (collapse)	Resuspends contaminants into air	C	V	Stack monitor	HVAC	
L-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	Requires personnel access to be of concern

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: N-Cell/PR Room

Facility Mode: Routine Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
N-1	Fires/explosion	Room combustibles (shrink wrap) Transient ignition source	Radioactively contaminated smoke into building ventilation system	D	III	Visual observation	Minimize combustibles transient ignition source	
N-2	Temperature extremes	Shrink wrap and stubby bag fail (catastrophic) and fixative failure	Pu from glovebox enters cell	D	III	Visual observation	HVAC system	Shrink wrap specification -120°F to 120°F
N-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No liquid hazardous inventory identified
N-4a	Resuspension and/or mobilization of material	Glovebox leakage • seal/stubby bag failure • shrink wrap failure • fixative failure	Pu escapes into room/building ventilation	D	III	Stack monitor	HVAC system	Requires multiple failures
N-4b		Fixative failure and human activity	Solid particulates momentarily suspended attached to clothing	B	III	Exit survey per RWP	Minimize access	
N-5	Increased concentration of material	Fixative deteriorates	Increased levels of alpha	B	III	Visual observation	Repaint affected surfaces	Also see HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A; P&O Gallery

Facility Mode: Routine Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
P&O-1	Fires/explosion	Transient Ignition Source (electric) Building Load (combustibles)	Smoke released into building ventilation system	D	III	Visual observation	Minimize potential ignition source and transient combustibles	Acceptable release of contaminates from burning building load
P&O-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
P&O-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
P&O-4	Resuspension/mobilization of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
P&O-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	See HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: White Room

Facility Mode: Routine Access (Quarterly)

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
WR-1	Fires/explosions	Transient combustible & ignition source	Radioactively contaminated smoke released into building ventilation system	D	III	Visual observation	Minimize combustibles Ignition source	
WR-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No impacts identified
WR-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No liquid hazardous material identified
WR-4a	Resuspension and/or mobilization of material	Leaks of acidic/caustic liquids <5 liter heel total remaining volume	Mobilization of liquid across contaminated area	C	III	Visual observation	Repair leak Clean spill Repaint affected surfaces	Assume any released particulates negligible in total particulate sample at filters
WR-4b		Fixative failure (chipping/flaking)	Tracking of paint chips by surveillance personnel	B	III	Exit survey per RWP	Contain/fix chips Repaint surface	
WR-5	Increased concentration of material	Fixative failure (deterioration/ chipping)	Increase in radiation field	B	III	Visual observation	Repaint affected surfaces	Also see HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: Q-Cell

Facility Mode: Routine Access (Quarterly)

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
Q-1	Fires/explosion	Room combustibles (shrink wrap) Transient ignition source	Radioactively contaminated smoke released into building ventilation system	D	III	Visual observation	Minimize combustibles Ignition source	
Q-2	Temperature extremes	Shrink wrap and stubby bag fail (catastrophic)	Pu from glovebox enters cell	D	III	Visual observation	HVAC	Shrink wrap specification -120°F to 120°F
Q-3	Leaks of material	Corrosion Structural fatigue Temperature cycling (freezing/thawing)	Leak of potentially contaminated liquid into cell	C	III	N/A	N/A	<5 L liquid available as heels
Q-4a	Resuspension/mobilization of material	Glovebox leakage • seal/stubby bag failure • shrink wrap failure • fixative failure	Pu/contaminants escape into room and building ventilation system	D	III	Stack monitor	HVAC	Requires multiple failures
Q-4b		Fixative failure and human activities	Solid particulates momentarily suspended attached to clothing	B	III	Exit survey per RWP	Minimize access	
Q-5	Increased concentration of material	Fixative deterioration	Increased levels of alpha radiation	B	III	Visual observation	Repaint affected surfaces	Also see HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A: Storage Gallery/PIV Room

Facility Mode: Routine Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
SGAL-1	Fires/explosion	Transient combustibles Transient ignition source	Radioactively contaminated smoke enters building ventilation	D	III	Visual observation	Minimize transient combustibles	
SGAL-2	Temperature extremes	Expansion joints expand/fail	Migration of contaminants from canyon cells to gallery	B	III	Radiation detected	Provide additional shielding	
SGAL-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No liquid hazardous material identified
SGAL-4	Resuspension/mobilization of material	Fixative fails	Migration of contamination from paint chips	B	III	Exit survey per RWP	Minimize access	
SGAL-5	Increased concentration of material	Shielding fails	Increased levels of radiation in cell	B	III	Radiation detected	Shielding as required	Also see HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 203-A UNH Storage Area

Facility Mode: No Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
203A-1	Fires/explosion	Transient combustibles	Potential release of contamination via smoke	D	IVc	Personnel observation (non-facility)	HFD	
203A-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No impacts identified
203A-3	Leaks of material	Corrosion Structural fatigue	Leak contaminated heel to diked area	C	IVc	Visual observation	Dike	Assumed solar evaporation of liquid and transportation of contaminants
203A-4	Resuspension/mobilization of material	Leaks acidic/caustic heels	Mobilization of liquid across contaminated area	C	V	Visual observation	None required	
203A-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	203-A area is outside and posted per HSRCM. No impacts identified.

PUREX:

Preliminary Hazard Analysis Sheet

Location: 206-A Fractionator

Facility Mode: No Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
206A-1	Fires/explosion	Vehicle accident	Radioactive/asbestos containing material released via smoke particles	D	II	Personnel observation	Restrict vehicle traffic/speed HFD	
206A-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No impacts identified
206A-3	Leaks of material	Corrosion Structural fatigue Temperature cycling (freezing/thawing)	Leak contaminated liquid into cell out through cell door	D	III	Quarterly surveillance	Seal doors	~580 gallons of liquid available in heels
206A-4	Resuspension/mobilization of material	Animal intrusion	Potential loss of confinement of radioactive/asbestos containing material	C	IVb	Quarterly surveillance	Repair intrusion sites	
206A-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	Requires personnel access to be of concern

PUREX:

Preliminary Hazard Analysis Sheet

Location: 211-A: Bulk Liquid Chemical Storage

Facility Mode: No Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
211A-1	Fires/explosion	Lightning strike TK-40/41	LSA smoke released to environment	D	IVb	Non-facility personnel observation	HFD	LSA contamination
211A-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No impacts identified
211A-3	Leaks of material	Corrosion Structural fatigue	Leak contaminated diesel to diked area	C	IVc	Quarterly surveillance	Dike	Assumed solar evaporation of liquid and transportation of contaminants
211A-4	Resuspension/mobilization of material	N/A	N/A	---	---	N/A	N/A	No solid inventory identified
211A-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	211-A Area posted per HSRCM. No additional impacts identified

PUREX:

Preliminary Hazard Analysis Sheet

Location: 271-AB Maintenance Facility

Facility Mode: Routine Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
271AB-1	Fires/explosion	Transient Ignition Source (electric) Building Load (combustibles)	Smoke released into building ventilation system	D	IV	Visual observation	Minimize potential ignition source and transient combustibles	Acceptable release of contaminates from burning building load
271AB-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
271AB-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
271AB-4	Resuspension/mobilization of material	N/A	N/A	---	---	N/A	N/A	No hazardous material identified
271AB-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	See HVAC failure

PUREX:

Preliminary Hazard Analysis Sheet

Location: 302-A Diversion Box Catch Tank

Facility Mode: No Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
302A-1	Fires/explosion	N/A	N/A	---	---	N/A	N/A	Non-flammable
302A-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No impacts identified
302A-3	Leaks of material	Corrosion Structural fatigue	Leak contaminated liquid to the soil surrounding the tank	C	IVa	Quarterly monitoring	TBD per activity specific HA	
		Leak during pumping operation	Leak to ground surface	D	III	Operator observation	TBD per activity specific HA	Perform HA prior to pumping
302A-4	Resuspension/mobilization of material	N/A	N/A	---	---	N/A	N/A	Leak collection tank for 302-A Diversion Box
302A-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	Leak collection tank for 302-A Diversion Box

PUREX:

Preliminary Hazard Analysis Sheet

Location: 202-A

Facility Mode: Seismic

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
202A-1	ECMP fails	Seismic event	Release of radionuclides to the atmosphere	C	II			

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Preliminary Hazard Analysis Sheet

Location: Active Ventilation System: 202-A, 291-A, 291-A1, 291-AE, 291-AK, 292-AB, Deep Bed Filter, TK-216-A-2, TK-V11-1/-V11-2

Facility Mode: Routine Access/No Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
AVS-1	Fires/explosion	Building load ignition source	Smoke (uncontaminated)	C	III	Visual observation	Minimize combustibles	292-AB Building
AVS-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No impacts identified
AVS-3a	Leaks of material	Corrosion Structural fatigue	Leak underground	C	IVa	Quarterly monitoring		Catch tanks
AVS-3b		Leak during pumping operation	Leak to ground surface	D	III	Operator observation	Stop pumping	* DSI, Eiholzer to Wollam
AVS-4	Resuspension/mobilization of material	Filter failure	Contamination out the stack	C	II	Stack monitors	Stop fans	Requires breach of fourth filter building filters * See JMS-8M400-95-001
AVS-5	Increased concentration of material	Electrical failure	Contamination outleakage through building	B	II	Personnel observation Electrical outage	Restore power	* See JMS-8M400-95-001
			Contamination spread throughout building	B	III	Personnel observation Electrical outage	Restore power	

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Preliminary Hazard Analysis Sheet

Location: Inactive Ventilation System

Facility Mode: No Access

IDENTIFIER	HAZARDOUS CONDITION	CONTRIBUTING EVENTS	NATURE OF RELEASE	LIKELIHOOD	CONSEQUENCE	DETECTION	MITIGATION	REMARKS
IVS-1	Fires/explosion	N/A	N/A	---	---	N/A	N/A	No ignition source identified
IVS-2	Temperature extremes	N/A	N/A	---	---	N/A	N/A	No impacts identified
IVS-3	Leaks of material	N/A	N/A	---	---	N/A	N/A	No liquid hazardous material identified
IVS-4	Resuspension/mobilization of material	Flood of deep bed filter	Release Pu contaminated liquid to underground	E	IVa	Personnel observation of flood		Requires flooding 206-A building basement
IVS-5	Increased concentration of material	N/A	N/A	---	---	N/A	N/A	N/A. No access. Isolated from building HVAC.

APPENDIX B

LIKELIHOOD CALCULATIONS

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APPENDIX B

LIKELIHOOD CALCULATIONS

LEAKS

This calculation addresses the potential for leaks of material from tanks containing heels. *No credit was taken for reducing the amount of liquids in the tanks via evaporation.*

P_L = Probability of leak from all identified contributing events multiplied by a factor of 10 to address no maintenance or upkeep of the tanks, and considering time at risk.

= (1.0 E-7/hr + 5.0 E-9/hr)[1] x 10

= 1.1 E-6/hr x 8760 hr/yr = 9.64 E-3/yr = Likelihood Class C

LEAKS DURING PUMPING

From Eiholzer 1995 1.05 E-5 = Likelihood Class D

LIKELIHOOD CALCULATIONS

Fires (Transient Combustibles/Transient Ignition Sources)

This likelihood is for fires in rooms with routine access. The term transient combustibles refers to combustible material introduced into the room by other than normal building loads (wiring insulation, combustible construction materials, etc.). It is felt that additional material would be required to initiate and sustain a fire of concern.

The likelihood of this event = $P_C \times P_I$

Probability of additional combustibles times likelihood of an ignition source.

P_C = Requires a failure to reduce combustibles in the room assumed at 10^{-1} due to number of rooms and potential number of sources not removed (e.g., boxes, woods, rags, papers, etc.).

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[1] From Savannah River Site Generic Database for Chemical Process System Nonpressurized Vessel Leaks.

P_I = Probability of an electrical short to ground initiated by 8 hours of surveillance 4 times per year.

= 3.0 E-6/hr[2] x 8 hr/surveillance x 4 surveillances/yr

= 9.6 E-6/yr = Likelihood Class D

Note: Conservatively assuming sufficient combustibles are present in the area of concern results in a likelihood of 9.6 E-5/yr = Likelihood Class D.

FIXATIVE FAILURE

The likelihood of the fixative deteriorating or flaking was qualitatively classified as an anticipated event (B) for the following reasons: (1) the atmosphere of the PUREX building will be subjected to wider ranges and uncontrolled levels of temperature and humidity; (2) as the concrete surfaces age, the water concrete decreases, thereby increasing the likelihood of the fixative failing; (3) wear due to surveillance activities (walking).

Anticipated Likelihood Class B.

EXPANSION JOINTS EXPAND

The likelihood of the expansion joints seals failing was qualitatively classified as an anticipated event (B) due to the joints being subjected to wide ranges of temperatures and humidity and previous failures of expansion joints.

Anticipated Likelihood Class B.

206-A LIKELIHOOD DETERMINATIONS

Vehicle Accidents Resulting in Fires

Qualitatively determined as extremely unlikely, Likelihood Class D, due to restricted access to area, vehicle speeds are expected to be less than 25 miles per hour (mph) and the accident would have to breach the building and result in a fire.

---

[2] WASH-1400

Leaks of Material to Environment

The condition is a subset of leaks of material. Because there will be no access to the 206-A Building, only this subset was analyzed.

The likelihood of a leak to the environment, 9.64 E-3, was modified to address a sufficient quantity of material leaked to challenge the door seal and a failure of the seal, a factor of 10^{-1}, was used for both modifiers to obtain an overall likelihood of 9.64 E-5 = Likelihood Class D.

Mobilization Due to Animal Intrusions

This event was qualitatively assigned a likelihood classification of C related to a significant (detectable) mobilization of material due to animal intrusions.

Anticipated Likelihood Class C.

RESUSPENSION OF MATERIAL DUE TO STRUCTURAL EQUIPMENT FAILURE

This calculation addresses the resuspension of material due to a structural failure resulting in a piece of equipment falling and impacting the sludge contained in L-Cell.

The assumed failure rate is equivalent to rupture of a vessel, modified by a factor of 10 to account for no upkeep of the equipment.

5.09 E-9/hr[3] x 10 x 8760 hr/yr

4.4 E-4/yr = Likelihood Class C.

INCREASED CONCENTRATION DUE TO VAPORIZATION OF DROPLETS (AMU-5)

This event requires a leak of material and the presence of surveillance personnel.

Pu = 1.1 E-6/hr[4] x 8 hr/surveillance x 4 surveillances/yr

= 3.5 E-5/yr = Likelihood Class D.

---

[3] From Savannah River Site Generic Database for Chemical Process System Nonpressurized Vessel Leaks.

[4] See likelihood calculation for leaks of material.

FILTER FAILURE

This calculation addresses the likelihood on a filter failure resulting in the release of contaminants out the 291-A-1 Stack. To be completely unmitigated (maximum consequence) requires both the failure of the #2 Deep-Bed filters and failure of one of the five active HEPA filters in the 4th filter building.

The probability of this event is expressed as

$$(1-e^{-\lambda fa^t})\,((1-e^{-\lambda fb^t}) + (1-e^{-\lambda fb^t})_2 + \ldots (1-e^{-\lambda fb^t})_5)$$

where

L_{fa} = Failure of Deep-Bed filter = 5 E-7/hr[5] (rupture)

L_{fb1} = Failure of HEPA filter = 5 E-7/hr[5] (rupture)

t = 8760

$$(1-e^{-5\ E\text{-}7/hr\ (8760\ hr)})\ (5)\ (1-e^{-5\ E\text{-}7/hr\ (8760\ hr)}) = (4.4\ E\text{-}3)\ (5)\ (4.4\ E\text{-}3)$$

Probability = 9.7 E-5

~ 1 E-4 = Likelihood Class C

FLOODING OF #1 DEEP-BED

This event was qualitatively classified as beyond extremely unlikely, Likelihood Class E, as no significant source of liquids to flood the deep-beds was identifiable.

SEISMIC EVENT

From PUREX FSAR, Rev. 5, the frequency of a UBC earthquake of 0.10 g is 3.3 E-3/yr = Likelihood Class C.

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[5] SRS Generic Database for HEPA filters.

APPENDIX C

TOTAL EFFECTIVE DOSE EQUIVALENT CALCULATIONS FOR SEISMIC FAILURE OF ECMP

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APPENDIX C

TOTAL EFFECTIVE DOSE EQUIVALENT CALCULATIONS FOR SEISMIC FAILURE OF ECMP

The following are calculations of dose (in 50 yr TEDE) for receptors located at 100 meters from the PUREX boundary, a receptor located at the current site boundary, and a receptor located at the proposed site boundary after the seismic failure of the ECMP.

Assumptions

1. The release source term is equal to the sum of the airborne contaminants released from within the building, due to the failure of the structure and the ventilation system, and the portion of the surface contamination caused to become airborne due to the collapse of the structure.

2. The airborne contaminants available for release are the high values given in Table 2, Unmitigated Release from the PUREX Facility under Ventilation Failure Conditions, from WHC Internal Memo, JMS-8M400-95-001. To these values other Pu isotopes were added based on the ratios from the PUREX FSAR.

3. The GENII code was used to perform the dispersion calculations.

4. The X/Q values given in Table 3 of WHC memo JMS-8M400-95-001, dated July 27, 1995, were used for performing these calculations.

5. As conservative assumption, surface contamination is taken to be uniformly distributed on all ECMP interior surfaces.

6. ECMP interior surface area was estimated using drawings from, "Seismic and Tornado Evaluations of 202-A PUREX Building." Result is approximately 1.1 E7 cm^2.

7. The airborne release fraction (ARF) and respirable fraction (RF) for the surface contamination dislodged during the structure collapse were obtained from "DOE Handbook: Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities." There were no data specifically for this case, so a condition which yielded a conservative estimate was chosen. The resulting values were taken from Section 4.4.3.3.2, "Large Falling Object Impact or Induced Air Turbulence," Table 4-15, "Measured ARFs and Rfs from the Impact of Structural Debris on Powders." The most conservative values were chosen: ARF = 1.2 E-3 and RF = 0.27 (ARF x RF = 3.24 E-4).

Source Calculations

μCi-Pu-239 (3.0 E+4 dpm/100 cm^2)(4.51 E-7 μCi/dpm)(1.1 E+7 cm^2) = 1488 μCi

μCi-Sr-90 (1.0 E+5 dpm/100 cm^2)(4.51 E-7 μCi/dpm)(1.1 E+7 cm^2) = 4961 μCi

μCi-Cs-137 (3.0 E+4 dpm)(4.51 E-7 μCi/dpm)(1.1 E+7 cm^2) = 1488 μCi

Multiplied by ARF x RF:

Pu-239 = 4.82 E-1 μCi
Sr-90 = 1.6 μCi
Cs-137 = 4.82 E-1 μCi

These source terms and previously noted X/Q values were then used as input to the attached GENII runs, producing the following results.

Results

Results in 50-year TEDE for seismic failure of ECMP.

	REM	mSv
Onsite	1.9	19
Offsite (current boundary)	7.4 E-04	7.4 E-03
Offsite (proposed boundary)	9.6 E-04	9.6 E-03

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Seismic Failure of PUREX ECMP - Onsite 100 m

Executed on: 02/05/98 at 14:07:56 Page A. 1

This is a far-field (wide-scale release, multiple site) scenario.
Release is acute
Individual dose

THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
Air

THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
Infinite plume, external
Inhalation uptake

THE FOLLOWING TIMES ARE USED:
Intake ends after (yr): 1.0
Dose calculations ends after (yr): 50.0

========== FILENAMES AND TITLES OF FILES/LIBRARIES USED ==========

Input file name: \GEN2RUNS\PURXTUN1\prxecmp1.in
GENII Default Parameter Values (28-Mar-90 RAP)
Radionuclide Master Library (11/28/90 RAP)
External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R
Worst-Case Solubilities, Yearly Dose Increments (23-Jul-93 PDR)

Release Radio-nuclide	----Release Terms------ Air uCi/yr	Surface Water uCi/yr	Buried Source uCi/m3
NA22	8.2E-03	0.0E+00	0.0E+00
CO60	1.6E-02	0.0E+00	0.0E+00
SR90	1.7E+03	0.0E+00	0.0E+00
Y 90	1.7E+03	0.0E+00	0.0E+00
RU106	1.2E+00	0.0E+00	0.0E+00
SB125	5.8E+00	0.0E+00	0.0E+00
CS134	2.0E-02	0.0E+00	0.0E+00
CS137	1.1E+01	0.0E+00	0.0E+00
PB212	1.3E+00	0.0E+00	0.0E+00
BI212	1.3E+00	0.0E+00	0.0E+00
PU238	4.1E+01	0.0E+00	0.0E+00
PU239	1.3E+02	0.0E+00	0.0E+00
PU240	7.6E+01	0.0E+00	0.0E+00
PU241	7.0E+03	0.0E+00	0.0E+00
PU242	2.8E-02	0.0E+00	0.0E+00
AM241	1.8E+01	0.0E+00	0.0E+00

========== AIR TRANSPORT ==========
3.4E-02 Input E/Q value (s/m3)

========== EXTERNAL EXPOSURE ==========
1.0E+00 Fraction of time spent in cloud

========== INHALATION ==========
Resuspension not considered

Input prepared by: _____ Date: _____

Input checked by: _____ Date: _____

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Seismic Failure of PUREX ECMP - Onsite 100 m

Executed on: 02/05/98 at 14:07:58 Page C. 1

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	5.1E-01	2.5E-01	1.3E-01
Breast	5.4E-05	1.5E-01	8.1E-06
R Marrow	2.8E+00	1.2E-01	3.4E-01
Lung	2.0E-01	1.2E-01	2.3E-02
Thyroid	4.6E-05	3.0E-02	1.4E-06
Bone Sur	3.6E+01	3.0E-02	1.1E+00
Liver	6.1E+00	6.0E-02	3.6E-01
LL Int.	1.5E-03	6.0E-02	9.0E-05
UL Int.	5.9E-04	6.0E-02	3.5E-05
S Int.	1.5E-04	6.0E-02	9.2E-06
Stomach	9.4E-05	6.0E-02	5.6E-06
Internal Effective Dose Equivalent			1.9E+00
External Dose			1.7E-07
Annual Effective Dose Equivalent			1.9E+00

Controlling Organ:	Bone Sur
Controlling Pathway:	Inh
Controlling Radionuclide:	PU239
Total Inhalation EDE:	1.9E+00
Total Ingestion EDE:	0.0E+00

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Seismic Failure of PUREX ECMP - Onsite 100 m

Executed on: 02/05/98 at 14:07:58 Page C. 2

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

	Dose Commitment Year 1	2	3	...			
Internal Intake Year: 3			0.0E+00	...			
			+				
2		0.0E+00	0.0E+00	...			Internal Effective Dose Equivalent
		+	+				
1	5.9E-02 +	4.2E-02 +	4.2E-02 +	...	=	1.9E+00	
	||	||	||				
Internal Annual Dose	5.9E-02 +	4.2E-02 +	4.2E-02 +	...	=	1.9E+00	Cumulative Internal Dose
	+	+	+			+	
External Annual Dose	1.7E-07	0.0E+00	0.0E+00	...		1.7E-07	
	||	||	||			||	
Annual Dose	5.9E-02 +	4.2E-02 +	4.2E-02 +	...	=	1.9E+00	Cumulative Dose
						5.9E-02	Maximum Annual Dose Occurred In Year 1

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Seismic Failure of PUREX ECMP - Onsite 100 m

Executed on: 02/05/98 at 14:07:58 Page C. 3

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
NA 22	6.5E-10	0.0E+00	1.3E-10	6.5E-10	7.8E-10
CO 60	3.6E-08	0.0E+00	2.7E-10	3.6E-08	3.6E-08
SR 90	3.9E-03	0.0E+00	2.3E-09	3.9E-03	3.9E-03
Y 90	1.7E-04	0.0E+00	8.5E-08	1.7E-04	1.7E-04
RU 106	6.1E-06	0.0E+00	2.0E-09	6.1E-06	6.1E-06
SB 125	8.2E-07	0.0E+00	2.0E-08	8.2E-07	8.4E-07
TE 125M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CS 134	9.4E-09	0.0E+00	2.4E-10	9.4E-09	9.6E-09
CS 137	3.6E-06	0.0E+00	4.4E-08	3.6E-06	3.6E-06
PB 212	2.7E-06	0.0E+00	1.2E-09	2.7E-06	2.7E-06
BI 212	3.4E-07	0.0E+00	1.4E-08	3.4E-07	3.5E-07
PU 242	1.3E-04	0.0E+00	2.4E-14	1.3E-04	1.3E-04
NP 238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PU 238	1.8E-01	0.0E+00	4.4E-11	1.8E-01	1.8E-01
PU 240	3.7E-01	0.0E+00	7.9E-11	3.7E-01	3.7E-01
PU 241	6.5E-01	0.0E+00	1.8E-14	6.5E-01	6.5E-01
AM 241	8.9E-02	0.0E+00	1.3E-09	8.9E-02	8.9E-02
PU 239	6.5E-01	0.0E+00	9.4E-11	6.5E-01	6.5E-01

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-----------------------------------------------------------------------------
                        GENII  Dose Calculation Program
                           (Version 1.485 3-Dec-90)

Case title:   Seismic Failure of PUREX ECMP - Offsite Current Bdry

Executed on:  02/05/98 at 14:08:03                                Page A.  1
-----------------------------------------------------------------------------

          This is a far-field (wide-scale release, multiple site) scenario.
          Release is acute
          Individual dose

          THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
               Air

          THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
               Infinite plume, external
               Inhalation uptake

          THE FOLLOWING TIMES ARE USED:
               Intake ends after (yr):                  1.0
               Dose calculations ends after (yr):      50.0

========== FILENAMES AND TITLES OF FILES/LIBRARIES USED =======================

 Input file name: \GEN2RUNS\PURXTUN1\prxecmp2.in
 GENII Default Parameter Values (28-Mar-90 RAP)
 Radionuclide Master Library   (11/28/90 RAP)
 External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R
 Worst-Case Solubilities, Yearly Dose Increments (23-Jul-93 PDR)

=============================================================================

          -------- ----Release Terms------
          Release          Surface Buried
          Radio-   Air     Water   Source
          nuclide  uCi/yr  uCi/yr  uCi/m3
          -------- ------- ------- -------
          NA22     8.2E-03 0.0E+00 0.0E+00
          CO60     1.6E-02 0.0E+00 0.0E+00
          SR90     1.7E+03 0.0E+00 0.0E+00
          Y 90     1.7E+03 0.0E+00 0.0E+00
          RU106    1.2E+00 0.0E+00 0.0E+00
          SB125    5.8E+00 0.0E+00 0.0E+00
          CS134    2.0E-02 0.0E+00 0.0E+00
          CS137    1.1E+01 0.0E+00 0.0E+00
          PB212    1.3E+00 0.0E+00 0.0E+00
          BI212    1.3E+00 0.0E+00 0.0E+00
          PU238    4.1E+01 0.0E+00 0.0E+00
          PU239    1.3E+02 0.0E+00 0.0E+00
          PU240    7.6E+01 0.0E+00 0.0E+00
          PU241    7.0E+03 0.0E+00 0.0E+00
          PU242    2.8E-02 0.0E+00 0.0E+00
          AM241    1.8E+01 0.0E+00 0.0E+00

========== AIR TRANSPORT ======================================================
1.3E-05   Input E/Q value (s/m3)

========== EXTERNAL EXPOSURE ==================================================
 1.0E+00  Fraction of time spent in cloud

========== INHALATION =========================================================
          Resuspension not considered

=============================================================================


Input prepared by: _____________________________        Date: _____________

Input checked by:  _____________________________        Date: _____________

=============================================================================
```

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Seismic Failure of PUREX ECMP - Offsite Current Bdry

Executed on: 02/05/98 at 14:08:05 Page C. 1

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	2.0E-04	2.5E-01	4.9E-05
Breast	2.1E-08	1.5E-01	3.1E-09
R Marrow	1.1E-03	1.2E-01	1.3E-04
Lung	7.4E-05	1.2E-01	8.9E-06
Thyroid	1.8E-08	3.0E-02	5.3E-10
Bone Sur	1.4E-02	3.0E-02	4.1E-04
Liver	2.3E-03	6.0E-02	1.4E-04
LL Int.	5.8E-07	6.0E-02	3.5E-08
UL Int.	2.3E-07	6.0E-02	1.4E-08
S Int.	5.9E-08	6.0E-02	3.5E-09
Stomach	3.6E-08	6.0E-02	2.2E-09
Internal Effective Dose Equivalent			7.4E-04
External Dose			6.5E-11
Annual Effective Dose Equivalent			7.4E-04

Controlling Organ:	Bone Sur
Controlling Pathway:	Inh
Controlling Radionuclide:	PU241
Total Inhalation EDE:	7.4E-04
Total Ingestion EDE:	0.0E+00

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Seismic Failure of PUREX ECMP - Offsite Current Bdry

Executed on: 02/05/98 at 14:08:05 Page C. 2

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

	Dose Commitment Year 1	2	3	...		
Internal Intake Year: 3			0.0E+00	...		
			+			
2		0.0E+00	0.0E+00	...		Internal Effective Dose Equivalent
		+	+			
1	2.2E-05 +	1.6E-05 +	1.6E-05 +	...	= 7.4E-04	
	||	||	||			
Internal Annual Dose	2.2E-05 +	1.6E-05 +	1.6E-05 +	...	= 7.4E-04	Cumulative Internal Dose
	+	+	+		+	
External Annual Dose	6.5E-11	0.0E+00	0.0E+00	...	6.5E-11	
	||	||	||		||	
Annual Dose	2.2E-05 +	1.6E-05 +	1.6E-05 +	...	= 7.4E-04	Cumulative Dose
					2.2E-05	Maximum Annual Dose Occurred In Year 1

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Seismic Failure of PUREX ECMP - Offsite Current Bdry

Executed on: 02/05/98 at 14:08:05 Page C. 3

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
NA 22	2.5E-13	0.0E+00	4.9E-14	2.5E-13	3.0E-13
CO 60	1.4E-11	0.0E+00	1.1E-13	1.4E-11	1.4E-11
SR 90	1.5E-06	0.0E+00	9.1E-13	1.5E-06	1.5E-06
Y 90	6.4E-08	0.0E+00	3.3E-11	6.4E-08	6.4E-08
RU 106	2.4E-09	0.0E+00	7.5E-13	2.4E-09	2.4E-09
SB 125	3.2E-10	0.0E+00	7.5E-12	3.2E-10	3.2E-10
TE 125M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CS 134	3.7E-12	0.0E+00	8.9E-14	3.7E-12	3.7E-12
CS 137	1.4E-09	0.0E+00	1.6E-11	1.4E-09	1.4E-09
PB 212	1.0E-09	0.0E+00	4.5E-13	1.0E-09	1.0E-09
BI 212	1.3E-10	0.0E+00	5.6E-12	1.3E-10	1.3E-10
PU 242	4.9E-08	0.0E+00	9.7E-18	4.9E-08	4.9E-08
NP 238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PU 238	7.1E-05	0.0E+00	1.7E-14	7.1E-05	7.1E-05
PU 240	1.4E-04	0.0E+00	3.0E-14	1.4E-04	1.4E-04
PU 241	2.5E-04	0.0E+00	7.0E-18	2.5E-04	2.5E-04
AM 241	3.4E-05	0.0E+00	5.1E-13	3.4E-05	3.4E-05
PU 239	2.4E-04	0.0E+00	3.6E-14	2.4E-04	2.4E-04

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-----------------------------------------------------------------------------
                        GENII  Dose Calculation Program
                           (Version 1.485 3-Dec-90)

Case title:   Seismic Failure of PUREX ECMP - Offsite Proposed Bdry

Executed on:  02/05/98 at 14:08:11                                Page A.  1
-----------------------------------------------------------------------------

          This is a far-field (wide-scale release, multiple site) scenario.
          Release is acute
          Individual dose

          THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
               Air

          THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
               Infinite plume, external
               Inhalation uptake

          THE FOLLOWING TIMES ARE USED:
               Intake ends after (yr):                  1.0
               Dose calculations ends after (yr):      50.0

========== FILENAMES AND TITLES OF FILES/LIBRARIES USED =======================

Input file name: \GEN2RUNS\PURXTUN1\prxecmp3.in
GENII Default Parameter Values (28-Mar-90 RAP)
Radionuclide Master Library   (11/28/90 RAP)
External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R
Worst-Case Solubilities, Yearly Dose Increments (23-Jul-93 PDR)

=============================================================================

          -------- ----Release Terms------
          Release          Surface Buried
          Radio-   Air     Water   Source
          nuclide  uCi/yr  uCi/yr  uCi/m3
          -------- ------- ------- -------
          NA22     8.2E-03 0.0E+00 0.0E+00
          CO60     1.6E-02 0.0E+00 0.0E+00
          SR90     1.7E+03 0.0E+00 0.0E+00
          Y 90     1.7E+03 0.0E+00 0.0E+00
          RU106    1.2E+00 0.0E+00 0.0E+00
          SB125    5.8E+00 0.0E+00 0.0E+00
          CS134    2.0E-02 0.0E+00 0.0E+00
          CS137    1.1E+01 0.0E+00 0.0E+00
          PB212    1.3E+00 0.0E+00 0.0E+00
          BI212    1.3E+00 0.0E+00 0.0E+00
          PU238    4.1E+01 0.0E+00 0.0E+00
          PU239    1.3E+02 0.0E+00 0.0E+00
          PU240    7.6E+01 0.0E+00 0.0E+00
          PU241    7.0E+03 0.0E+00 0.0E+00
          PU242    2.8E-02 0.0E+00 0.0E+00
          AM241    1.8E+01 0.0E+00 0.0E+00

========== AIR TRANSPORT ======================================================
1.7E-05   Input E/Q value (s/m3)

========== EXTERNAL EXPOSURE ==================================================
 1.0E+00  Fraction of time spent in cloud

========== INHALATION =========================================================
          Resuspension not considered

=============================================================================


Input prepared by: _____________________________        Date: _____________

Input checked by:  _____________________________        Date: _____________

=============================================================================
```

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Seismic Failure of PUREX ECMP - Offsite Proposed Bdry

Executed on: 02/05/98 at 14:08:13 Page C. 1

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	2.5E-04	2.5E-01	6.4E-05
Breast	2.7E-08	1.5E-01	4.0E-09
R Marrow	1.4E-03	1.2E-01	1.7E-04
Lung	9.7E-05	1.2E-01	1.2E-05
Thyroid	2.3E-08	3.0E-02	7.0E-10
Bone Sur	1.8E-02	3.0E-02	5.3E-04
Liver	3.0E-03	6.0E-02	1.8E-04
LL Int.	7.5E-07	6.0E-02	4.5E-08
UL Int.	2.9E-07	6.0E-02	1.8E-08
S Int.	7.7E-08	6.0E-02	4.6E-09
Stomach	4.7E-08	6.0E-02	2.8E-09
Internal Effective Dose Equivalent			9.6E-04
External Dose			8.5E-11
Annual Effective Dose Equivalent			9.6E-04

Controlling Organ:	Bone Sur
Controlling Pathway:	Inh
Controlling Radionuclide:	PU241
Total Inhalation EDE:	9.6E-04
Total Ingestion EDE:	0.0E+00

```
-----------------------------------------------------------------------------
                        GENII  Dose Calculation Program
                           (Version 1.485 3-Dec-90)

Case title:   Seismic Failure of PUREX ECMP - Offsite Proposed Bdry

Executed on:  02/05/98 at 14:08:13                                Page C.  2
-----------------------------------------------------------------------------

Acute release
Uptake/exposure period:                                              1.0
Dose commitment period:                                             50.0
Dose units:                                                      Rem


              Dose Commitment Year
                   1          2          3     ...
              ------------------------------------
Internal   : |
Intake     : |
Year:      3 |                      0.0E+00    ...
           | |                         +
           2 |            0.0E+00    0.0E+00    ...                Internal
           | |               +          +                         Effective
           1 | 2.9E-05 + 2.1E-05 + 2.1E-05 + ...  =  9.6E-04      Dose
                                                                   Equivalent
                ||         ||         ||
Internal                                                           Cumulative
Annual       2.9E-05 + 2.1E-05 + 2.1E-05 + ...  =  9.6E-04         Internal
Dose                                                               Dose
                +          +          +                 +
External
Annual       8.5E-11    0.0E+00    0.0E+00    ...     8.5E-11
Dose
                ||         ||         ||                ||
Annual                                                             Cumulative
Dose         2.9E-05 + 2.1E-05 + 2.1E-05 + ...  =  9.6E-04         Dose

                                                                   Maximum
                                                     2.9E-05       Annual
                                                                   Dose Occurred
                                                                   In Year  1
```

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Seismic Failure of PUREX ECMP - Offsite Proposed Bdry

Executed on: 02/05/98 at 14:08:13 Page C. 3

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
NA 22	3.3E-13	0.0E+00	6.3E-14	3.3E-13	3.9E-13
CO 60	1.8E-11	0.0E+00	1.4E-13	1.8E-11	1.8E-11
SR 90	1.9E-06	0.0E+00	1.2E-12	1.9E-06	1.9E-06
Y 90	8.3E-08	0.0E+00	4.3E-11	8.3E-08	8.3E-08
RU 106	3.1E-09	0.0E+00	1.0E-12	3.1E-09	3.1E-09
SB 125	4.2E-10	0.0E+00	9.6E-12	4.2E-10	4.3E-10
TE 125M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CS 134	4.7E-12	0.0E+00	1.2E-13	4.7E-12	4.8E-12
CS 137	1.9E-09	0.0E+00	2.1E-11	1.9E-09	1.9E-09
PB 212	1.3E-09	0.0E+00	5.9E-13	1.3E-09	1.3E-09
BI 212	1.7E-10	0.0E+00	7.2E-12	1.7E-10	1.7E-10
PU 242	6.5E-08	0.0E+00	1.2E-17	6.5E-08	6.5E-08
NP 238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PU 238	9.0E-05	0.0E+00	2.2E-14	9.0E-05	9.0E-05
PU 240	1.9E-04	0.0E+00	4.0E-14	1.9E-04	1.9E-04
PU 241	3.2E-04	0.0E+00	9.1E-18	3.2E-04	3.2E-04
AM 241	4.4E-05	0.0E+00	6.7E-13	4.4E-05	4.4E-05
PU 239	3.2E-04	0.0E+00	4.7E-14	3.2E-04	3.2E-04

APPENDIX D

TOTAL EFFECTIVE DOSE EQUIVALENT CALCULATIONS FOR PUREX VENTILATION SYSTEM FILTER FAILURE

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APPENDIX D

TOTAL EFFECTIVE DOSE EQUIVALENT CALCULATIONS FOR PUREX VENTILATION SYSTEM FILTER FAILURE

The following are calculations of dose (in 50 yr TEDE) for receptors located at 300 meters from the PUREX boundary, a receptor located at the current site boundary, and a receptor located at the proposed site boundary for a bounding analysis of failure of the Deep-bed and a HEPA filter at PUREX.

Assumptions

1. Air flow following the filter failure was 40,000 cfm for 24 hours.

2. The release source term is equal to the sum of the airborne contaminants (see Table 2 of WHC memo JMS-8M400-95-001) plus the material resuspended from the failure of the Deep-bed and HEPA filter as described in Section 5.1.2 and shown below, plus the additional Pu isotopes as identified in the PUREX FSAR.

3. The GENII code was used to perform the dispersion calculations.

4. The filter failure was calculated as an elevated release for receptors onsite (300 meters), offsite at the current site boundary, and at the proposed site boundary.

5. The X/Q values given in Table 3 of WHC memo JMS-8M400-95-001, dated July 27, 1995, were used for performing these calculations.

Calculations

For the filter failure the source term used was:

- 2 E-2 gm of Pu-239 [(6.2 E-2 Ci/gm)(2 E-2 gm)(1 E6 μCi/Ci) = 1.2 E3 μCi]

- 2 E-2 Ci of Cs/Sr. To establish the amount of each nuclide the ratio of each was determined from Table 2 in WHC memo JMS-8M400-95-001, dated July 27, 1995. From this table it was established that 97% of the total is Sr-90 and 3% is Cs-137. Therefore, Sr-90 is 1.9 E4 μCi and Cs-137 is 6 E2 μCi.

- Am-241 released from the filter is 25 μCi.

- The total source term is the sum of the material released due to the filter failure (listed in previous bullets) and the building airborne contaminants released over a 24-hour period (see Table 2 of WHC memo JMS-8M400-95-001).

Results

Results in 50-year TEDE for seismic failure of PUREX ventilation filters.

	REM	mSv
Onsite	4.6 E-2	4.6 E-1
Offsite (current boundary)	7.2 E-3	7.2 E-2
Offsite (proposed boundary)	7.5 E-3	7.5 E-2

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: PUREX Deep Bed Filter Failure - Onsite 300 m

Executed on: 02/05/98 at 14:07:34 Page A. 1

This is a far-field (wide-scale release, multiple site) scenario.
Release is acute
Individual dose

THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
Air

THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
Infinite plume, external
Inhalation uptake

THE FOLLOWING TIMES ARE USED:
Intake ends after (yr): 1.0
Dose calculations ends after (yr): 50.0

========= FILENAMES AND TITLES OF FILES/LIBRARIES USED =========

Input file name: \GEN2RUNS\PURXTUN1\prxdbed1.in
GENII Default Parameter Values (28-Mar-90 RAP)
Radionuclide Master Library (11/28/90 RAP)
External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R
Worst-Case Solubilities, Yearly Dose Increments (23-Jul-93 PDR)

==========

----------Release Terms----------

Release Radio-nuclide	Surface Air uCi/yr	Buried Water uCi/yr	Source uCi/m3
CO60	4.6E-01	0.0E+00	0.0E+00
SR90	3.0E+04	0.0E+00	0.0E+00
Y 90	3.0E+04	0.0E+00	0.0E+00
RU106	4.6E+01	0.0E+00	0.0E+00
SB125	1.6E+02	0.0E+00	0.0E+00
CS134	8.1E-01	0.0E+00	0.0E+00
CS137	9.4E+02	0.0E+00	0.0E+00
PB212	4.8E+01	0.0E+00	0.0E+00
BI212	5.3E+01	0.0E+00	0.0E+00
PU238	6.5E+02	0.0E+00	0.0E+00
PU239	3.3E+03	0.0E+00	0.0E+00
PU240	1.2E+03	0.0E+00	0.0E+00
PU241	1.1E+05	0.0E+00	0.0E+00
PU242	4.4E-01	0.0E+00	0.0E+00
AM241	4.4E+02	0.0E+00	0.0E+00

========== AIR TRANSPORT ==========
4.2E-05 Input E/Q value (s/m3)

========== EXTERNAL EXPOSURE ==========
1.0E+00 Fraction of time spent in cloud

========== INHALATION ==========
Resuspension not considered

==========

Input prepared by: _____ Date: _____

Input checked by: _____ Date: _____

==========

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: PUREX Deep Bed Filter Failure - Onsite 300 m

Executed on: 02/05/98 at 14:07:36 Page C. 1

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	1.2E-02	2.5E-01	3.0E-03
Breast	1.5E-06	1.5E-01	2.3E-07
R Marrow	6.7E-02	1.2E-01	8.0E-03
Lung	5.0E-03	1.2E-01	6.0E-04
Thyroid	1.4E-06	3.0E-02	4.1E-08
Bone Sur	8.5E-01	3.0E-02	2.6E-02
Liver	1.4E-01	6.0E-02	8.7E-03
LL Int.	3.5E-05	6.0E-02	2.1E-06
UL Int.	1.4E-05	6.0E-02	8.2E-07
S Int.	3.8E-06	6.0E-02	2.3E-07
Stomach	2.5E-06	6.0E-02	1.5E-07
Internal Effective Dose Equivalent			4.6E-02
External Dose			8.3E-09
Annual Effective Dose Equivalent			4.6E-02

Controlling Organ:	Bone Sur
Controlling Pathway:	Inh
Controlling Radionuclide:	PU239
Total Inhalation EDE:	4.6E-02
Total Ingestion EDE:	0.0E+00

```
-----------------------------------------------------------------------------
                        GENII  Dose Calculation Program
                           (Version 1.485 3-Dec-90)

Case title:   PUREX Deep Bed Filter Failure - Onsite 300 m

Executed on:  02/05/98 at 14:07:36                                Page C.  2
-----------------------------------------------------------------------------

Acute release
Uptake/exposure period:                                              1.0
Dose commitment period:                                             50.0
Dose units:                                                   Rem


              Dose Commitment Year
                   1          2          3     ...
              ____________________________________
Internal    : |
Intake      : |
Year:       3 |                      0.0E+00    ...
            | |                        +
            2 |            0.0E+00   0.0E+00    ...                Internal
            | |              +         +                           Effective
            1 | 1.5E-03 + 1.1E-03 + 1.1E-03 + ...  =  4.6E-02     Dose
                                                                   Equivalent
                 ||         ||         ||
Internal                                                           Cumulative
Annual        1.5E-03 + 1.1E-03 + 1.1E-03 + ...  =  4.6E-02        Internal
Dose                                                               Dose
                 +          +          +                 +
External
Annual        8.3E-09    0.0E+00    0.0E+00    ...     8.3E-09
Dose
                 ||         ||         ||                ||
Annual                                                             Cumulative
Dose          1.5E-03 + 1.1E-03 + 1.1E-03 + ...  =  4.6E-02        Dose

                                                                   Maximum
                                                       1.5E-03     Annual
                                                                   Dose Occurred
                                                                   In Year  1
```

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: PUREX Deep Bed Filter Failure - Onsite 300 m

Executed on: 02/05/98 at 14:07:36 Page C. 3

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
CO 60	1.3E-09	0.0E+00	9.7E-12	1.3E-09	1.3E-09
SR 90	8.5E-05	0.0E+00	5.2E-11	8.5E-05	8.5E-05
Y 90	3.7E-06	0.0E+00	1.9E-09	3.7E-06	3.7E-06
RU 106	3.0E-07	0.0E+00	9.4E-11	3.0E-07	3.0E-07
SB 125	2.8E-08	0.0E+00	6.5E-10	2.8E-08	2.9E-08
TE 125M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CS 134	4.7E-10	0.0E+00	1.2E-11	4.7E-10	4.8E-10
CS 137	3.9E-07	0.0E+00	4.7E-09	3.9E-07	4.0E-07
PB 212	1.2E-07	0.0E+00	5.4E-11	1.2E-07	1.2E-07
BI 212	1.7E-08	0.0E+00	7.3E-10	1.7E-08	1.7E-08
PU 242	2.5E-06	0.0E+00	4.8E-16	2.5E-06	2.5E-06
NP 238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PU 238	3.5E-03	0.0E+00	8.8E-13	3.5E-03	3.5E-03
PU 240	7.4E-03	0.0E+00	1.6E-12	7.4E-03	7.4E-03
PU 241	1.2E-02	0.0E+00	3.6E-16	1.2E-02	1.2E-02
AM 241	2.7E-03	0.0E+00	4.1E-11	2.7E-03	2.7E-03
PU 239	2.0E-02	0.0E+00	3.0E-12	2.0E-02	2.0E-02

```
-----------------------------------------------------------------------------
                        GENII  Dose Calculation Program
                           (Version 1.485 3-Dec-90)

Case title:   PUREX Deep Bed Filter Failure - Offsite Current Bdry

Executed on:  02/05/98 at 14:07:41                                Page A.  1
-----------------------------------------------------------------------------

          This is a far-field (wide-scale release, multiple site) scenario.
          Release is acute
          Individual dose

          THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
               Air

          THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
               Infinite plume, external
               Inhalation uptake

          THE FOLLOWING TIMES ARE USED:
               Intake ends after (yr):                  1.0
               Dose calculations ends after (yr):      50.0

========== FILENAMES AND TITLES OF FILES/LIBRARIES USED ========================

Input file name: \GEN2RUNS\PURXTUN1\prxdbed2.in
GENII Default Parameter Values (28-Mar-90 RAP)
Radionuclide Master Library   (11/28/90 RAP)
External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R
Worst-Case Solubilities, Yearly Dose Increments (23-Jul-93 PDR)

=============================================================================

          -------- ----Release Terms------
          Release          Surface Buried
          Radio-   Air     Water   Source
          nuclide  uCi/yr  uCi/yr  uCi/m3
          -------- ------- ------- -------
          CO60     4.6E-01 0.0E+00 0.0E+00
          SR90     3.0E+04 0.0E+00 0.0E+00
          Y 90     3.0E+04 0.0E+00 0.0E+00
          RU106    4.6E+01 0.0E+00 0.0E+00
          SB125    1.6E+02 0.0E+00 0.0E+00
          CS134    8.1E-01 0.0E+00 0.0E+00
          CS137    9.4E+02 0.0E+00 0.0E+00
          PB212    4.8E+01 0.0E+00 0.0E+00
          BI212    5.3E+01 0.0E+00 0.0E+00
          PU238    6.5E+02 0.0E+00 0.0E+00
          PU239    3.3E+03 0.0E+00 0.0E+00
          PU240    1.2E+03 0.0E+00 0.0E+00
          PU241    1.1E+05 0.0E+00 0.0E+00
          PU242    4.4E-01 0.0E+00 0.0E+00
          AM241    4.4E+02 0.0E+00 0.0E+00

========== AIR TRANSPORT ========================================================
6.6E-06   Input E/Q value (s/m3)

========== EXTERNAL EXPOSURE ====================================================
 1.0E+00  Fraction of time spent in cloud

========== INHALATION ===========================================================
          Resuspension not considered

=============================================================================


Input prepared by: _____                    Date: _____

Input checked by:  _____                    Date: _____


=============================================================================
```

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: PUREX Deep Bed Filter Failure - Offsite Current Bdry

Executed on: 02/05/98 at 14:07:44 Page C. 1

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	1.9E-03	2.5E-01	4.7E-04
Breast	2.4E-07	1.5E-01	3.5E-08
R Marrow	1.1E-02	1.2E-01	1.3E-03
Lung	7.8E-04	1.2E-01	9.4E-05
Thyroid	2.1E-07	3.0E-02	6.4E-09
Bone Sur	1.3E-01	3.0E-02	4.0E-03
Liver	2.3E-02	6.0E-02	1.4E-03
LL Int.	5.4E-06	6.0E-02	3.2E-07
UL Int.	2.1E-06	6.0E-02	1.3E-07
S Int.	6.0E-07	6.0E-02	3.6E-08
Stomach	3.8E-07	6.0E-02	2.3E-08
Internal Effective Dose Equivalent			7.2E-03
External Dose			1.3E-09
Annual Effective Dose Equivalent			7.2E-03

Controlling Organ:	Bone Sur
Controlling Pathway:	Inh
Controlling Radionuclide:	PU239
Total Inhalation EDE:	7.2E-03
Total Ingestion EDE:	0.0E+00

```
-----------------------------------------------------------------------------
                        GENII  Dose Calculation Program
                           (Version 1.485 3-Dec-90)

Case title:   PUREX Deep Bed Filter Failure - Offsite Current Bdry

Executed on:  02/05/98 at 14:07:44                                Page C.  2
-----------------------------------------------------------------------------

Acute release
Uptake/exposure period:                                              1.0
Dose commitment period:                                             50.0
Dose units:                                                   Rem

                 Dose Commitment Year
                      1          2          3     ...
                 ------------------------------------
Internal      : |
Intake        : |
Year:         3 |                        0.0E+00   ...
              . |                           +
              2 |             0.0E+00    0.0E+00   ...                 Internal
                |                +          +                          Effective
              1 | 2.4E-04 + 1.7E-04 + 1.6E-04 + ...  =  7.2E-03       Dose
                                                                       Equivalent
                  ||         ||         ||
                                                                       Cumulative
Internal                                                               Internal
Annual          2.4E-04 + 1.7E-04 + 1.6E-04 + ...  =  7.2E-03         Dose
Dose
                  +          +          +                 +
External
Annual          1.3E-09    0.0E+00    0.0E+00   ...     1.3E-09
Dose
                  ||         ||         ||                ||
                                                                       Cumulative
Annual
Dose            2.4E-04 + 1.7E-04 + 1.6E-04 + ...  =  7.2E-03         Dose

                                                                       Maximum
                                                       2.4E-04         Annual
                                                                       Dose Occurred
                                                                       In Year  1
-----------------------------------------------------------------------------
```

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: PUREX Deep Bed Filter Failure - Offsite Current Bdry

Executed on: 02/05/98 at 14:07:44 Page C. 3

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
CO 60	2.0E-10	0.0E+00	1.5E-12	2.0E-10	2.0E-10
SR 90	1.3E-05	0.0E+00	8.2E-12	1.3E-05	1.3E-05
Y 90	5.7E-07	0.0E+00	3.0E-10	5.7E-07	5.7E-07
RU 106	4.7E-08	0.0E+00	1.5E-11	4.7E-08	4.7E-08
SB 125	4.4E-09	0.0E+00	1.0E-10	4.4E-09	4.5E-09
TE 125M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CS 134	7.7E-11	0.0E+00	1.8E-12	7.7E-11	7.8E-11
CS 137	6.0E-08	0.0E+00	7.3E-10	6.0E-08	6.1E-08
PB 212	1.8E-08	0.0E+00	8.4E-12	1.8E-08	1.8E-08
BI 212	2.7E-09	0.0E+00	1.1E-10	2.7E-09	2.8E-09
PU 242	3.9E-07	0.0E+00	7.4E-17	3.9E-07	3.9E-07
NP 238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PU 238	5.5E-04	0.0E+00	1.4E-13	5.5E-04	5.5E-04
PU 240	1.1E-03	0.0E+00	2.4E-13	1.1E-03	1.1E-03
PU 241	2.0E-03	0.0E+00	5.5E-17	2.0E-03	2.0E-03
AM 241	4.3E-04	0.0E+00	6.4E-12	4.3E-04	4.3E-04
PU 239	3.1E-03	0.0E+00	4.6E-13	3.1E-03	3.1E-03

```
-----------------------------------------------------------------------------
                        GENII  Dose Calculation Program
                           (Version 1.485 3-Dec-90)

Case title:   PUREX Deep Bed Filter Failure - Offsite Proposed Bdry

Executed on:  02/05/98 at 14:07:49                                Page A.  1
-----------------------------------------------------------------------------

          This is a far-field (wide-scale release, multiple site) scenario.
          Release is acute
          Individual dose

          THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
               Air

          THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
               Infinite plume, external
               Inhalation uptake

          THE FOLLOWING TIMES ARE USED:
               Intake ends after (yr):                  1.0
               Dose calculations ends after (yr):      50.0

========== FILENAMES AND TITLES OF FILES/LIBRARIES USED ========================

Input file name: \GEN2RUNS\PURXTUN1\prxdbed3.in
GENII Default Parameter Values (28-Mar-90 RAP)
Radionuclide Master Library   (11/28/90 RAP)
External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R
Worst-Case Solubilities, Yearly Dose Increments (23-Jul-93 PDR)

=============================================================================

          -------- ----Release Terms------
          Release          Surface Buried
          Radio-   Air     Water   Source
          nuclide  uCi/yr  uCi/yr  uCi/m3
          -------- ------- ------- -------
          CO60     4.6E-01 0.0E+00 0.0E+00
          SR90     3.0E+04 0.0E+00 0.0E+00
          Y 90     3.0E+04 0.0E+00 0.0E+00
          RU106    4.6E+01 0.0E+00 0.0E+00
          SB125    1.6E+02 0.0E+00 0.0E+00
          CS134    8.1E-01 0.0E+00 0.0E+00
          CS137    9.4E+02 0.0E+00 0.0E+00
          PB212    4.8E+01 0.0E+00 0.0E+00
          BI212    5.3E+01 0.0E+00 0.0E+00
          PU238    6.5E+02 0.0E+00 0.0E+00
          PU239    3.3E+03 0.0E+00 0.0E+00
          PU240    1.2E+03 0.0E+00 0.0E+00
          PU241    1.1E+05 0.0E+00 0.0E+00
          PU242    4.4E-01 0.0E+00 0.0E+00
          AM241    4.4E+02 0.0E+00 0.0E+00

========== AIR TRANSPORT ========================================================
6.9E-06   Input E/Q value (s/m3)

========== EXTERNAL EXPOSURE ====================================================
 1.0E+00  Fraction of time spent in cloud

========== INHALATION ===========================================================
          Resuspension not considered

=============================================================================


Input prepared by: _____________________________        Date: _____________

Input checked by:  _____________________________        Date: _____________


=============================================================================
```

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: PUREX Deep Bed Filter Failure - Offsite Proposed Bdry

Executed on: 02/05/98 at 14:07:51 Page C. 1

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	2.0E-03	2.5E-01	4.9E-04
Breast	2.5E-07	1.5E-01	3.7E-08
R Marrow	1.1E-02	1.2E-01	1.3E-03
Lung	8.2E-04	1.2E-01	9.8E-05
Thyroid	2.2E-07	3.0E-02	6.7E-09
Bone Sur	1.4E-01	3.0E-02	4.2E-03
Liver	2.4E-02	6.0E-02	1.4E-03
LL Int.	5.6E-06	6.0E-02	3.4E-07
UL Int.	2.2E-06	6.0E-02	1.3E-07
S Int.	6.2E-07	6.0E-02	3.7E-08
Stomach	4.0E-07	6.0E-02	2.4E-08
Internal Effective Dose Equivalent			7.5E-03
External Dose			1.4E-09
Annual Effective Dose Equivalent			7.5E-03

Controlling Organ:	Bone Sur
Controlling Pathway:	Inh
Controlling Radionuclide:	PU239
Total Inhalation EDE:	7.5E-03
Total Ingestion EDE:	0.0E+00

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: PUREX Deep Bed Filter Failure - Offsite Proposed Bdry

Executed on: 02/05/98 at 14:07:51 Page C. 2

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

	Dose Commitment Year 1	2	3	...			
Internal Intake Year: 3			0.0E+00	...			
			+				
2		0.0E+00	0.0E+00	...			Internal Effective Dose Equivalent
		+	+				
1	2.5E-04 +	1.7E-04 +	1.7E-04 +	...	=	7.5E-03	
	||	||	||				
Internal Annual Dose	2.5E-04 +	1.7E-04 +	1.7E-04 +	...	=	7.5E-03	Cumulative Internal Dose
	+	+	+			+	
External Annual Dose	1.4E-09	0.0E+00	0.0E+00	...		1.4E-09	
	||	||	||			||	
Annual Dose	2.5E-04 +	1.7E-04 +	1.7E-04 +	...	=	7.5E-03	Cumulative Dose
						2.5E-04	Maximum Annual Dose Occurred In Year 1

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: PUREX Deep Bed Filter Failure - Offsite Proposed Bdry

Executed on: 02/05/98 at 14:07:51 Page C. 3

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Radio-nuclide	Inhalation Effective Dose Equivalent	Ingestion Effective Dose Equivalent	External Dose	Internal Effective Dose Equivalent	Annual Effective Dose Equivalent
CO 60	2.0E-10	0.0E+00	1.6E-12	2.0E-10	2.0E-10
SR 90	1.4E-05	0.0E+00	8.6E-12	1.4E-05	1.4E-05
Y 90	5.9E-07	0.0E+00	3.1E-10	5.9E-07	5.9E-07
RU 106	4.7E-08	0.0E+00	1.5E-11	4.7E-08	4.7E-08
SB 125	4.6E-09	0.0E+00	1.1E-10	4.6E-09	4.7E-09
TE 125M	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CS 134	7.7E-11	0.0E+00	2.0E-12	7.7E-11	7.9E-11
CS 137	6.3E-08	0.0E+00	7.6E-10	6.3E-08	6.4E-08
PB 212	2.0E-08	0.0E+00	8.4E-12	2.0E-08	2.0E-08
BI 212	2.7E-09	0.0E+00	1.2E-10	2.7E-09	2.8E-09
PU 242	4.0E-07	0.0E+00	7.7E-17	4.0E-07	4.0E-07
NP 238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PU 238	5.9E-04	0.0E+00	1.4E-13	5.9E-04	5.9E-04
PU 240	1.2E-03	0.0E+00	2.5E-13	1.2E-03	1.2E-03
PU 241	2.0E-03	0.0E+00	5.8E-17	2.0E-03	2.0E-03
AM 241	4.4E-04	0.0E+00	6.6E-12	4.4E-04	4.4E-04
PU 239	3.3E-03	0.0E+00	4.8E-13	3.3E-03	3.3E-03

APPENDIX E

PUREX HAZARD ANALYSIS SUMMARY DATA

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APPENDIX E

PUREX HAZARD ANALYSIS SUMMARY DATA

Bldg: 202-A **Location:** A-Cell
Access: No Access
Descript: Used for Metal dissolution, 35' x 14' x 42'6"
Instrument Engineering Diagram List H-2-63201 thru 63205
Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.
In-cell fiberglass filter.
The silver reactor used in the metal dissolution process contains the majority of the hazardous material remaining in the cell.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris, dried sludge, etc.)
Ag -250 lb (670 g-mol), in Silver Reactor full charge
Silver salts: 1-129,1-131, Chloride, Fluoride
Mercury - In Dissolver thermowells

Tank	Volume	Heel	Endpoint	Comment
TK-A3	4745	20	WHC Sample Analysis 2 < pH < 12.5 Cd < l pprn Cr < 5 pprn	
TK-A34	2085	17		Radioactively Contaminated Water

Bldg: 202-A **Location:** AMU
Access: Routine
Descript: Aqueous Make-up Area. Houses bulk of chemical makeup tanks in four floors and mezzanine in 202-A Annex. Over 30 chemical streams.

Some equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained within the PUREX building and evaporate.

Utilities: HVAC - 202-A Building Ventilation
Surveillance Lighting

Material: Some residual solid contamination in piping and/or tanks.
Tanks and Headers emptied and/or flushed,
Heels to RCRA sample
Lines Blanked.
Loose Supplies removed.
Quarterly surveillance - external interface

Tank	Volume	Heel	Endpoint	Comment
TK-104	3037	425.9	WI-iC Sample Analysis 2 < pH < 12.5	Sodium Nitrate Makeup NaNO3
TK-110	750	0	WHC Sample Analysis 2 < pH < 12.5	Miscellaneous Overflow tank
TK-112	300	0	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm	CdNO3 Overflow tank
TK-113	180	5	WHC Sample Analysis 2 < pH < 12.5	Miscellaneous Collection Tank
TK-150	631	0	WHC Sample Analysis 2 < pH < 12.5	HN03 3BX makeup
TK-151	655	0	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm	Cd(NO3)2
TK-152	642	0	WHC Sample Analysis 2 < pH < 12.5	NaNO3
TK-153	647	391b*	WHC Sample Analysis 2 < pH < 12.5	NaOH
TK-155	406	0	WHC Sample Analysis 2 < pH < 12.5	HN03 3BX Feed
TK-156	405	0	Meet RCRA Sample Requirements	HN03 3AS Feed Part A Permit
TK-223	4849	0	H20	Demineralized Makeup Water Head Tank

Bldg: 202-A **Location:** B-Cell
Access: No Access
Descript: Used for Metal Dissolution, 35' x 14' x 42'6"
Instrument Engineering Diagram List H-2-63206 thru 63210
Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.
In-cell fiberglass filter
The silver reactor used in the metal dissolution process contains the majority of the hazardous material remaining in the cell.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris, dried sludge, etc.)
Ag - 250 lb (670 g-mol), In Silver Reactor full charge
Silver salts: 1-1 29, 1-131, Chloride, Fluoride
Mercury - In Dissolver thermowells

Tank	Volume	Heel	Endpoint	Comment
TK-B3	5087	20	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-B3-4	2030	17		Radioactively Contaminated Water

Bldg: 202-A **Location:** Blower Room
Access: Routine
Descript: Located east of AMU

Process blower room - blowers for ventilation system 1 &2
Service blower room - blowers for ventilation system 3

Utilities: Surveillance lighting
HVAC - 202-A Building Ventilation

Material:

Bldg: 202-A **Location:** C-Cell
Access: No Access
Descript: Used for Metal Dissolution, 35' x 14' x 42'6"
Instrument Engineering Diagram List H-2-63211 thru 63215
Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell 1 sump and evaporate.
In-cell fiberglass filter
The silver reactor used in the metal dissolution process contains the majority of the hazardous material remaining in the cell.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris, dried sludge, etc.)
Ag ~250 lb (670 g-mol), in Silver Reactor full charge
Silver salts: 1-129, 1-131, Chloride, Fluoride
Mercury - In Dissolver thermowells

Tank	Volume	Heel	Endpoint	Comment
TK-C3	5055	20	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-C3-4	2095	17		Radioactively Contaminated Water

Bldg: 202-A **Location:** Canyon Lobby
Access: Routine
Descript: Remove and dispose SGSAS
Remove and dispose stored and loose equipment and supplies

Utilities: Surveillance lighting
HVAC - 202-A Building Ventilation

Material:

Bldg: 202-A **Location:** Change Rooms
Access: Routine
Descript: Used to Change out of SWPs

Utilities: HVAC - 202-A Building Ventilation
Surveillance lighting.
Sewers Grouted.

Material:

Bldg: 202-A **Location:** Compressor Room
Access: Routine
Descript: Located in West Annex next to the process blower room. Houses compressor and dryers to produce instrument, process, and fresh breathing air.
Process and instrument Air systems abandoned- Oils drained.

Utilities: HVAC - 202-A Building Ventilation
Surveillance lighting.

Material:

Bldg: 202-A **Location:** Control Room - Central/Power
Access: Routine
Descript: The Central and Power Control Rooms are located in the West Annex.

The Central room (63' x 26') contains graphic panels for some batch processes and the continuous portions of -the process.

The Power control room (46' x 12') is located in the process blower room and contains the controls for the building ventilation system, lab ventilation systems, compressor equipment and instrumentation for the utility services.

Building ventilation reduced by a factor of 3. Reduced air turnovers will require air monitoring prior to entry.

Utilities: HVAC - 202-A Building Ventilation
Surveillance lighting.

Material: Radon

Bldg: 202-A **Location:** Control Room - Head End
Access: Routine
Descript: The Head End Control Room is located in the East Annex. 42' (long) x 28' (wide). Contains the graphic panels for the batch-type fuel decladding and dissolution processes and for acid concentration.

Utilities: HVAC - 202-A Building Ventilation
Surveillance lighting

Material:

Bldg: 202-A **Location:** Crane Gallery
Access: Special
Descript: Extends full length of building and includes East and West Crane Maintenance Platforms. Floor is 39'6" above canyon roof. Provides shield to operator in or entering crane cab. Provides work area and hoists for repairing canyon cranes.

Loose equipment will be removed and disposed.

Utilities: Plug-in receptacles with nightlight for spotlights to surveil roof.
Surveillance Lighting in craneway.
HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris, dirt, particulates).

Bldg: 202-A **Location:** D-Cell
Access: No Access
Descript: Used for Metal Solution Storage, 65' x 14' x 42'6"
Instrument Engineering Diagram List H-2-63216 thru 63219

Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris, dried sludge, etc.)

Tank	Volume	Heel	Endpoint	Comment
TK-D1	5228	11	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 pprn	
TK-D2	5262	27	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 pprn	Jet heel.
TK-D3	7736	74	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-D4	7736	74	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-D5	5244	44	Meet RCRA Sample Requirements	Part A Permit

Bldg: 202-A **Location:** E-Cell
Access: No Access
Descript: Used for Feed Preparation and cladding Waste Treatment, 71' x 14' x 42'6"
Instrument Engineering Diagram List H-2-63220 thru 63226

Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris, dried sludge, etc.)

Tank	Volume	Heel	Endpoint	Comment
TK-E1	1871	11	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 pprn	
TK-E3	5234	45	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-E3-2	2152	6.3		Radioactively Contaminated Water
TK-E5	5250	22	Meet RCRA Sample Requirements	Part A Permit
TK-E6	5234	21	Meet RCRA Sample Requirements	Part A Permit
G-E2	180	1.3	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
G-E4	125	1.1	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	

Bldg: 202-A **Location:** F-Cell
Access: No Access
Descript: Used for Waste Treatment and Process Ventilation, beginning to partition between TK-FI2/TK-FI3: 151' x 14' x 42'6", Partion to End: 65' x 14' x 42'6".
Instrument Engineering Diagram List H-2-63227 thru 63243

Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.

In-cell filter: Large; major holdup potential.

Filter contained in housing.
Similar filters buried outside plant.

Utilities: HVAC - 202-A Building Ventilation

Material: Open metal box with solids from E-cell (contaminated concrete debris - contains chromium) Surface contamination (dust/debris, etc.)

Tank	Volume	Heel	Endpoint	Comment
TK-F1		50**		Radioactively Contaminated Water ** Assumed heel
TK-F3	5274	45	Meet RCRA Sample Requirements	Part A Permit
TK-F4	5176	19*		Spare Tank
T-F5	299	0	Meet RCRA Sample Requirements	Acid Absorber Part A Permit
E-F6-1	2167	4*	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	Concentrator
TK-F7	3815	15	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-F8	5228	23	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-F10	5241	45	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	

E-F11-1	2590	15	Meet RCRA Sample Requirements	Concentrator Part A Permit
TK-F12	5259	46	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-F13	5258	15	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-F15	5130	2.3	Meet RCRA Sample Requirements	Part A Permit
TK-F16	5249	57	Meet RCRA Sample Requirements	Part A Permit
TK-F 8	5230	56	Meet RCRA Sample Requirements	Part A Permit
TK-F26	3641	1.5	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	

Bldg: 202-A **Location:** G-Cell
Access: No Access
Descript: Used for Solvent Treatment System 1, 109' x 14' x 42'6"
Instrument Engineering Diagram List H-2-63244 thru 63251

Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.

2 centrifuges (probably small capacity) (used to separate solids) contain lubricating oils, hydraulic fluids. Hydrogen generation << LFL.

Floor contamination << contamination in A, B, C, F cells.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris, dried sludge, etc.). Oils in equipment.

Tank	Volume	Heel	Endpoint	Comment
TK-G1	4930	43	Meet RCRA Sample Requirements	Part A Permit
T-G2	2179	5	Meet RCRA Sample Requirements	Part A Permit
TK-G2	1866	22	Meet RCRA Sample Requirements	Part A Permit

TK-G5	14636	55	Meet RCRA Sample Requirements	Part A Permit
TK-G6	464	3.6	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-G7	15000	92	Meet RCRA Sample Requirements	Part A Permit
TK-G8	5252	55	Meet RCRA Sample Requirements	Part A Permit

Bldg: 202-A **Location:** H-Cell
Access: No Access
Descript: Used for Solvent Treatment Systeml, from beginning to partition betweenTK-J5 andTK-J6: 117' x 14' x 42'6"
Instrument Engineering Diagram List H-2-63252 thru 63256

Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris. dried sludge, etc.). Oils in equipment.

Tank	Volume	Heel	Endpoint	Comment
TK-H1	5176	45	Meet RCRA Sample Requirements	Part A Permit
T-H2	1850	50**	Meet RCRA Sample Requirements	Part A Permit ** Assumed heel
E-H4-1	2678	113	Meet RCRA Sample Requirements	Concentrator Part A Permit

Bldg: 202-A **Location:** Hot Shop
Access: No Access
Descript: Used for maintenance of canyon equipment by semi-remote methods.
30' x 20'. Accessible by crane through metal ventilation covers. Contains a monorail and jib crane, decontamination sink and hood, and a shielded vessel TK-M2 for deconning pumps, agitators, etc.

Loose equipment removed and disposed of.

Fixed/permanent equipment/tanks will remain in place, with the liquids flushed, and emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris, dried sludge, etc.). Oils in equipment.

Tank	Volume	Heel	Endpoint	Comment
TK-M2	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 ppm			

Bldg: 202-A **Location:** J-Cell
Access: No Access
Descript: Used as Partion System and for Neptunium Recovery, from partition between TK-J5 and TK-J6 to partition between TK-K5/TK-K6: 1 1 1' x 14' x 42'6"
Instrument Engineering Diagram List H-2-63257 thru 63268

Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris, dried sludge, etc.). Oils in equipment.

Tank	Volume	Heel	Endpoint	Comment
TK-J 1	5264	45	Meet RCRA Sample Requirements	Part A Permit
TK-J2	1336	8	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-J3	5260	19	Meet RCRA Sample Requirements	Part A Permit
T-J4	131	1	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	

TK-J5	368	1	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
T-J6	1600	5	Meet RCRA Sample Requirements	Part A Permit
T-J7	1778	5	Meet RCRA Sample Requirements	Part A Permit
E-J8-1	2678	113*	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	Concentrator
TK-J21	307	1	Meet RCRA Sample Requirements	Part A Permit
T-J22	150	6	Meet RCRA Sample Requirements	Part A Permit 6 gallon heel based on Static Pressure
T-J23	103.7	3.3	Meet RCRA Sample Requirements	Part A Permit 3.3 gallon heel based on Static Pressure

Bldg: 202-A **Location:** K-Cell
Access: No Access
Descript: Used for Uranium Decontamination and Concentration System, from partition between TK-K5 and TK-K6 to partition between TK-LI/TK-L2: 26' 1 1" x 14' x 42'6" Instrument Engineering Diagram List H-2-63269 thru 63274

Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris, dried sludge, etc.). Oils in equipment.

Tank	Volume	Heel	Endpoint	Comment
TK-K1	5238	45	Meet RCRA Sample Requirements	Part A Permit
T-K2	1372	2	Meet RCRA Sample Requirements	Part A Permit
T-K3	1719	5	Meet RCRA Sample Requirements	Part A Permit
E-K4-1	3739	9	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	Concentrator

TK-K5	5243	22	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
TK-K6	5176	22	Meet RCRA Sample Requirements	Part A Permit

Bldg: 202-A **Location:** L-Cell
Access: No Access
Descript: Used for Plutonium Decontamination and Concentration System, from partition between TK-LI/TK-L2 to the end of L: 33'1" x 14' x 42'6"
Instrument Engineering Diagram List H-2-63275 thru 63280

Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell 1sump and evaporate.

Criticality - not possible: Pu is contained in sludge, which is wax-like, preventing migration/movement of PU into a critical mass.

Utilities: HVAC - 202-A Building Ventilation

Material: Pu - 3-4 Kg (mostly on floor [99%] "dry sludge" with nitric/nitrate salts, organic TBP, phosphate; chemically stable)
HN03 - trace
TBP - trace

Tank	Volume	Heel	Endpoint	Comment
T-L1	126	10	VVHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	
T-L2	118	0	Meet RCRA Sample Requirements	Part A Permit
TK-L3	488 L	8.2 L	Meet RCRA Sample Requirements	Part A Permit
T-L4	138.5 L	0.5 L	Meet RCRA Sample Requirements	Part A Permit
T-L5	114 L	0.5 L	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	

Bldg: 202-A **Location:** Laboratory
Access: No Access
Descript: Located in western end of East Annex. 114'(long) x 34' high

Loose equipment removed.
Hoods sealed
Liquid sources blanked
Substantial contamination sources and vent exhaust ducts foamed/filled
Drains blanked or grouted

Access only to center corridor. Corridor tied to HVAC, which exhausts to environment. No HVAC in labs. Breathe through natural building processes through lab ventilation. No forced ventilation.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination fixed in place.

Bldg: 202-A **Location:** M-Cell/Pool Cell
Access: No Access
Descript: Used for Equipment decontamination and storage, Plutonium Nitrate Storage.
The cell is 'L' shaped, the main portion is 34'6" x 14', and the extended base is 20' x 16'6". Pool cell 12' x 14' x 35'.
Instrument Engineering Diagram List H-2-63281

M-Cell equipment/tanks will remain in place, with the liquids flushed, and emptied or with only a minimum heel remaining including vessel TK-M1 used for cleanup of pumps, agitators, etc., removal equipment storage racks, and 4 PuNO3 storage tanks (TK-M3, M4, M5, M6) which will be emptied.
If a leak occurs, the liquid will be contained by the cell/sump and evaporate.

Pool Cell equipment will be removed and disposed.

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris, dried sludge, etc.).

Tank	Volume	Heel	Endpoint	Comment
TK-M1	4105	14	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	

Bldg: 202-A **Location:** N-Cell/PR Room
Access: Routine
Descript: N Cell has two stories and is used to house the process, transfer, maintenance, primary canning, secondary canning, control and storage areas necessary to convert plutonium nitrate to plutonium dioxide and prepare the product for storage.

Product Removal Room, separated from N-Cell by a 6-foot-wide pipe chase. Used for Product Removal. Storage gallery level 41'2" x 19'6". Contains 3 areas for isolating equipment from the main working area. One area contains a vacuum/rework tank (TK-L1-1) enclosed in a glovebox. A second isolates the plutonium sampler tank (TK-L9) in a glovebox. The third area formerly enclosed a tank that was removed. Additionally, the cell contains a load-out facility.

Cell equipment/tanks will remain in place with the liquids emptied.
Sump leak detectors removed.
Liquid sources blanked.

Glovebox equipment disassembled and removed. Glovebox ports to be shrink-wrapped. -12 gloveboxes contain Pu in metal and oxide form (<450 g Pu max in 1 glovebox or it is in a form precluding criticality) .
Gloveboxes in negative pressure.

Utilities: HVAC - 202-A Building Ventilation Surveillance lighting.

Material: Pu - 1-2 Kg - inside gloveboxes surface contamination (dust/debris, etc.)

Bldg: 202-A **Location:** P&O Gallery
Access: Routine
Descript: Piping and Operating gallery. Contains nonradioactive piping headers, MCCs, other related equipment.

Extends full length of building, 20' wide by 20'3" high.

Equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the PUREX Building and evaporate.
Lines blanked.
Loose supplies removed.

Seal pots in P&O (2 gallons) contain water/dilute chemicals. Dead legs in pipes (possible small amount of clean inventory; small amounts of reagents).

Possibility for residual spots of contamination behind control panels and other normally inaccessible places.

Utilities: HVAC - 202-A Building Ventilation
Surveillance lighting
All floor drains plugged

Material:

Tank	Volume	Heel	Endpoint	Comment
TK-A3A	3285	11		Dissolver Drown Tank - H20
TK-133A	3291	12		Dissolver Drown Tank - H20
TK-C3A	3265	11		Dissolver Drown Tank - H20

Bldg: 202-A **Location:** Q-Cell
Access: Routine
Descript: Neptunium Purification Unit. Storage gallery level. Includes a control room, a load-out room, an AMU level, a maintenance room with shielded hood, and a shielded hot cell (vault).

Glovebox equipment in place (sealed ports/fixed contamination).
Room equipment removed as appropriate.
Contains tanks that were flushed for readiness tests. Any leak will be contained by the cell/sump and evaporate.
Rooms are low-level contamination under paint; mostly on floor.
Gloveboxes will be sealed. (~1 gram Neptunium remaining)

Utilities: HVAC - 202-A Building Ventilation
Surveillance lighting.

Material: Low-level surface contamination with some floor dust/debris. Protactinium primary daughter product.

Tank	Volume	Heel	Endpoint	Comment
TK-Q5	2105 L	0.2 L	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 ppm	
TK-Q8	180 L	3.4 L	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 ppm	

Bldg: 202-A **Location:** Railroad Tunnels
Access: No Access
Descript: Used to receive railcars from N and K Basins

22' (wide) x 145' (long)

Tunnel Doors closed.
Water Filled doors empty.

Not included in scope.

Bldg: 202-A **Location:** Sample Gallery
Access: No Access
Descript: Extends full length of bldg. 19'6" wide 10'3" high. Located under the P&O gallery.

Liquid sources isolated.
Samplers sealed.
Floor drains plugged
Supplies removed.

Ventilated to canyon

Utilities: HVAC - 202-A Building Ventilation

Material: Surface contamination (dust/debris).
Some high-level contamination inside hoods (fission products, west end Pu).
Seal loops -may contain acids

Bldg: 202-A **Location:** Slug Storage Basin
Access: No Access
Descript: Fuel Storage Basin

20' (wide) x 30' (long) x 27' (deep)
Located on the East side of the RR Tunnel. Canyon level.
Fuel removed and basin emptied.
Low levels of fission products.
Pump out water and put fixative in bottom (over sludge/sand) if required.
No cover - doesn't exhaust to canyon cell.

Utilities: Water blanked.
Overflow and Jet-out line capped/plugged.

Material: Low-level contamination (sand) in basin (may be fixed).

Bldg: 202-A **Location:** Storage Gallery/PIV Room
Access: Routine
Descript: Used for storage of dry chemicals, spare instruments, and miscellaneous supplies.
PIV room housed frequency sets for supplying electric power to the pulse generators and PAX telephone central exchanges system.
Located under the Sample gallery. Adjacent to Q Cell.
Pulser oil drained/removed.
Stored supplies removed. Storage structures dismantled and removed.
40 ft below grade level.
Quarterly surveillance.
If covers/fixatives fail -> worker exposure; no release to environment.

Utilities: HVAC - 202-A Building Ventilation Surveillance lighting.

Material: Surface contamination (dust/debris)
Two known leaking expansion joints (B & F), maybe a few other spots (fixed contamination). Hot spots.

Bldg: 202-A **Location:** White Room
Access: Routine
Descript: Separated by door from P&O gallery with open top.
Is an artifact of a contamination event.

Room equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the PUREX Building and evaporate.

Utilities: HVAC - 202-A Building Ventilation Surveillance lighting
All floor drains plugged

Material: Fixed surface contamination - Pu

Tank	Volume	Heel	Endpoint	Comment
TK-L9A	21.75	0.8	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	Pu Cell Add tank - PR Control Room
TK-N38	49 L	2.8 L	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	White Run

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Bldg: 202-A **Location:** UNH Storage
Access: No Access
Descript: Uranium Storage and Handling
Provided UNH storage and shipping and Pump House
Located east of the badge house
Tanks and headers flushed and/or emptied.
Lines blanked.
Loose supplies removed and disposed.
External tanks. Diked - reduce level of dike contamination to a CA. Dike surrounding tanks will contain any leak. Liquid will then evaporate (solar evaporation) from diked areas.
May fix some dike areas (sump) with fixative coating

HSRCM, Table **2-2** defines CA level

Utilities:

Material: Low-level contamination (fixed).

Tank	Volume	Heel	Endpoint	Comment
TK-P1	106384	459*	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 ppm	Radioactively Contaminated Water Stainless Steel
TK-P2	106617	308*	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 ppm	Recovered UNH Storage
TK-P3	106452	371	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 ppm	Recovered UNH Storage
TK-P4	106452	303*	Meet RCRA Sample Requirements	Recovered UNH Storage Part A Permit
TK-P5	3840	109	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 ppm	Waste Storage
TK-P6	14090	109	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 ppm	Waste Storage
TK-P13	7000	55	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 ppm	Recovered Acid Receiver
TK-PI4	7000	55	WHC Sample Analysis 2 < pH < 12.5 Cr< 5 ppm	Recovered Acid Receiver
TK-P15	13438	303	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 ppm	Recovered Acid Receiver

Bldg: 202-A **Location:** U-Cell
Access: No Access
Descript: Recovered acid and laboratory waste storage vault. 76' x 20' x 35'

Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.

Floor level liquid level monitoring (probe) connected and monitored on a quarterly basis due to 204-A sticking out and cover blocks potentially leaking.
Floor at - -20'grade.

Utilities: HVAC - 202-A Building Ventilation Leak detection

Material: Surface contamination (dust/debris, dried sludge, etc.)

Tank	Volume	Heel	Endpoint	Comment
TK-U1	14546	55	WHC Sample Analysis 2 < pH < 12.5	
TK-U2	14790	67	WHC Sample Analysis 2 < pH < 12.5	
TK-U3	8222	15	Meet RCRA Sample Requirements	Part A Permit
TK-U4	8238	15	Meet RCRA Sample Requirements	Part A Permit

Bldg: 202-A **Location:** Fractionator
Access: No Access
Descript: Put windows in door for viewing: (Blast door) type protection. Seal/cap ventilation duct to U-Cell, isolate inlet/exhaust vents to atmosphere.
Could be RA (High Dose Rate Acid spill/overflow).
Residual contamination in piping and concrete.

Room equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the building/sump and evaporate.

Animal intrusion concerns.
Review impact of vehicle traffic

Utilities:

Material: Friable Asbestos, floor ground level.

Tank	Volume	Heel	Endpoint	Comment
TK-U5	9005	0	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 pprn	
T-LI6	1773	136	WHC Sample Analysis 2 < pH < 12.5 Cr < 5 pprn	Acid Fractionator
E-U6-2	1750		136 2 < pH < 12.5 Cr < 5 pprn	WHC Sample Analysis
TK-U8	1057		308 2 < pH < 12.5 Cr < 5 ppm	WHC Sample Analysis

Bldg: 211-A **Location:** Bulk Liquid Chemical Storage
Access: No Access
Descript: Bulk Liquid Chemical Storage Area

Tanks and headers flushed and/or emptied.
Lines blanked.
Loose supplies removed and disposed.

External tanks. Diked - reduce level of dike contamination to a CA. Dike surrounding tanks will contain any leak. Liquid will then evaporate (solar evaporation) from diked areas.

Wrecking ball theory applies (except to TK-40 and TK-41).

Diesel - non-dangerous RCRA (regulated) TK-40/41.
Non-Reportable quantities.

Utilities:

Material: TK-40/41 LSA internal contamination TBD

Tank	Volume	Heel	Endpoint	Comment
TK-1 1	106474	9571b*	WHC Sample Analysis 2 < pH < 12.5 Ammonium Nitrate < 10 wt.%	NH4F-NH4NO3
TK-12	106474	49501b*	WFIC Sample Analysis 2 < pH < 12.5	57% HN03 Heel 4950 lbs
TK-20	30250	12801b*	WHC Sample Analysis 2 < pH < 12.5	50% NaOH Heel 1280 lbs
TK-21	30800	661 lb*	WHC Sample Analysis 2 < pH < 12.5	45% KOH
TK-30	50,000	208*		Contained Demineralized Water
TK-31		9*	WHC Sample Analysis 2 < pH < 12.5	Underground Catch tank 1" = 9 gal.
TK-32	110	3*	WHC Sample Analysis 2 < pH < 12.5	H2SO4 1" = 3 gal.
TK-33	110	3*	WHC Sample Analysis 2 < pH < 12.5	NaOH 1" = 3 gal.
TK-34			WHC Sample Analysis 2 < pH < 12.5	Neutralizer
TK-40	65345	11851b	Meet RCRA Sample Requirements	Part A Permit Hydrocarbon diluent (NPH) Heel 1185 lbs <10% TBP in Heel

TK-41	31075	5851b* TBP < 10 wt.%	WHC Sample Analysis	TBP (C4H9)3PO4 -1 50 gallons Internally contaminated (LSA), diesel flush. (RMA)?
TK-42	7,850	22441b*	WHC Sample Analysis Ammonium Nitrate Nonahydrate < 10 wt.%	Al(NO3)3*9H20 Heel 2244 lbs
TK-50	8,400	7501b*	WHC Sample Analysis 2 < pH < 12.5	93% H2SO4
T-AX1			Remove Resin and Rinse	Anion Inside Pump House.
T-AX2			Remove Resin and Rinse	Anion Inside Pump House.
T-AX3			Remove Resin and Rinse	Anion Inside Pump House.
TK-AX4	186.5	5*	WHC Sample Analysis 2 < pH < 12.5	50% NaOH 3'2" dia x 38 " H wf 1 " = 4.91 gal Assumed Cylindricai Vol = Pi(D A 2)H/4 = 186.5 gal Inside Pump House.
T-CX1			Remove Resin and Rinse	Cation Inside Pump House.
T-CX2			Remove Resin and Rinse	Cation Inside Pump House.
T-CX3			Remove Resin and Rinse	Cation Inside Pump House.
TK-CX4	450	12*	WHC Sample Analysis 2 < pH < 12.5	H2SO4 4'1 1" dia x 38" H wf 1" = 11.83 gal Assumed Cylindrical Vol = Pi(DA2)H/4 = 450 gal Inside Pump House,

Bldg: 212-A **Location:**
Access: No Access
Descript: Process liquid waste load-out: Liquid waste load-out station

Utilities:

Material: Surface contamination (<5 mren-dhr RA outside)

Bldg: 213-A **Location:**
Access: No Access
Descript: Liquid waste load-in.
Temporary storage/contaminated dry waste.

Utilities:

Material: Surface contamination (<5 mrem/hr RA outside)

Bldg: 214-A/B/C/D **Location:**
Access: No Access
Descript: PUREX warehouses
A - Dangerous Waste Storage
B/C/D - Consumable Material Storage

Utilities:

Material: Potential hazardous contamination << low-levels.

Bldg: 215 **Location:**
Access: No Access
Descript: Sodium hydroxide Tank Farm instrument house.

Utilities:

Material: Potential contamination

Bldg: 216-A **Location:**
Access: No Access
Descript: Spud cellar sample pit: valve control facility.

Utilities:

Material: Surface contamination (fixed)

Bldg: 216-A-42 **Location:**
Access: No Access
Descript: Effluent diversion basin. Open to environment.

Utilities:

Material: Surface contamination (<5 mrerrVhr)

Bldg: 252-A **Location:**
Access: No Access
Descript: Electrical switching station 13.8 kV

Utilities:

Material: None identified.

Bldg: 2701-AB **Location:** Badge House
Access No Access
Descript: Penetrations sealed
Outside walkbys performed during surveillance

Utilities:

Material: None identified.

Bldg: 2701-AC **Location:** Guard Shack
Access: No Access
Descript: Patrol Guard Shack on northwest corner 202-A Roof.

Utilities:

Material: None identified.

Bldg: 2709-A **Location:**
Access: No Access

Descript: Railroad cut change house (outside).

Utilities:

Material: None identified.

Bldg: 271-AB **Location:**
Access: Routine
Descript: PUREX Maintenance Facility.
Annex attached to 202-A facility, contains offices and maintenance shop.

Utilities: Surveillance Lighting

Material: None identified.

Bldg: 2711-A **Location:**
Access: No Access
Descript: Air Compressor Building; equipment for dry air to gloveboxes.

Utilities:

Material: None identified.

Bldg: 2712-A **Location:**
Access: No Access
Descript: Pumphouse; air sampling pumps.

Utilities:

Material: None identified.

Bldg: 2714-A **Location:**
Access: No Access
Descript: Chemical warehouse: north of 202-A, storage for dry and liquid containerized chemicals.

Utilities:

Material: Potential hazardous material residues.

Bldg: 2714-U **Location:**
Access: No Access
Descript: Warehouse at 20OW Area and T-Hopper Storage Pad.

Utilities:

Material: Surface contamination (fixed)
Exterior designated as Radiological Buffer Area

Bldg: 202-A **Location:** R-Cell
Access: No Access
Descript: R-Cell - Solvent Recovery and Storage Vault
Provided decontamination of organic solvent from the final uranium cycle and storage of the recovered solvent. Cell is 65' x 23'.

Cell equipment in place.

Contamination similar to G-cell, but "cleaner'.

Cell equipment/tanks will remain in place, with the liquids flushed, and be emptied or have only a minimum heel remaining. If a leak occurs, the liquid will be contained by the cell/sump and evaporate.

Utilities: HVAC

Material: Surface contamination (dust/debris, dried sludge, etc.). Oils in equipment.

Tank	Volume	Heel	Endpoint	Comment
TK-R1	4787	34	Meet RCRA Sample Requirements	Part A Permit
T-R2	2188	1	Meet RCRA Sample Requirements	Part A Permit
TK-R2	1782	5	Meet RCRA Sample Requirements	Part A Permit
TK-R5	9250	0	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm TBP < 10 wt.%	
TK-R6	429	3	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm TBP < 10 wt.%	
TK-R7	9292	0	Meet RCRA Sample Requirements	Part A Permit
TK-R8	5126	50	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm TBP < 10 wt.%	

Bldg: 281-A **Location:**
Access: No Access
Descript: Backup generator facility; emergency power.

Utilities:

Material: Potential hazardous material residues.

Bldg: 292-AA **Location:**
Access: No Access
Descript: Product removal exhaust sampling and monitoring.

Utilities:

Material: Low-level contamination potential

Bldg: 293-A **Location:**
Access: No Access
Descript: Backup facility Lines Blanked. Loose supplies and equipment removed and disposed.

Utilities:

Material: Surface contamination (interior)
Hazardous Material: Asbestos in basement
Exterior meets criteria for contamination area.

Tank	Volume	Heel	Endpoint	Comment
TK-XC	4939	45		Radioactively Contaminated Water
TK-XD	2345	45		Radioactively Contaminated Water

Bldg: 294-A **Location:**
Access: No Access
Descript: Off-gas dissolver monitoring shack.

Buildings Locked/sealed.
294-A - instrument shack to monitor D06.
Filters in concrete outside cells. Volatile isotopes.

Utilities:

Material: Surface contamination (fixed)

Bldg: 295 **Location:** PDD
Access: No Access
Descript: Process Discharge Distillate Facilities
Includes:
295-A Liquid Effluent Ammonia Scrubber Distillate
295-AA Liquid Effluent Steam Condensate Distillate
295-AB Process Discharge Distillate Monitoring Shack
295-AC Liquid Effluent Chemical Sewer Low
295-AD Liquid ffluent Cooling Water Low
295-AE New PDD Monitoring Shack

Utilities:

Material: Surface contamination (fixed)

Bldg: 296-A **Location:** Stacks
Access: No Access
Descript:

Utilities: Isolated/capped

Material: Surface contamination (fixed)

Bldg: 302-A **Location:**
Access: No Access
Descript: Catch tank for 302 Diversion Boxes and underground piping.

South of PUREX

Utilities:

Material:

Tank	Volume	Heel	Endpoint	Comment
TK-302-A	8444	22*	WHC Sample Analysis 2 < pH < 12.5 Cd < 1 ppm Cr < 5 ppm	Underground Waste Collection Buried in gravel -20' 1"= 22 gal.

Bldg: Mobile Office **Location:**
Access: No Access
Descript: Trailers Inside fence in southwest corner.

Includes MO-112, MO-325, MO-332, MO-540, MO-993.

Utilities:

Material:

Bldg: P008 **Location:**
Access: No Access
Descript: Maintenance Hazardous Material A Shed; hazardous material conex.

Utilities:

Material:

Bldg: P009 **Location:**
Access: No Access
Descript: Maintenance Hazardous Material B Shed; hazardous material conex.

Utilities:

Material:

Bldg: P010 **Location:**
Access: No Access
Descript: Maintenance Hazardous Material C Shed; hazardous material conex.

Utilities:

Material:

Bldg: Ventilation Sys **Location:** Active
Access:
Descript: Active Portions of 202-A Ventilation System

291 -A Fans
291-AI Main Stack
291-AE Fourth Filter Building
292-AB Stack Monitoring Building
Deep Bed Filter #2
TK-216-A-2 Deep Bed Filter Catch Tank
TK-V1 1 Main Stack Condensate Catch Tank
TK-VI2 Main Stack Condensate Catch Tank
291 -AK Air Tunnel

Utilities: Electric Power

Material: 291 -A Fans: surface contamination

291-AI: Low-level
291-AE: Low-level
292-AB: None identified
Deep Bed Filter #2: 100-200 g Pu; 250,000 E-06 Ci Am; 20-200 Ci Cs/Sr
TK-216-A-2: Condensate from Deep Bed Filter
TK-V11/V12: Very low level condensate from stack
291-AK: Surface contamination

Tank	Volume	Heel	Endpoint	Comment
Tk-216-A-2	5000		NA - Active Tank	
Tk-V11-1	3344	580	NA - Active Tank	
Tk-V1 1-2	3344	580	NA - Active Tank	

Bldg: Ventilation Sys **Location:** Inactive
Access:
Descript: Deactivated portions of 202-A Ventilation System (isolated/capped).

291 -A Steam Turbine
291-AB Monitoring Shack
291-AC Monitoring Shack
291 -AD Ammonia Off-Gas Monitoring Shack
291-AG Monitoring Shack 291-AH Monitoring Shack
291-AJ Monitoring Shack
Deep Bed Filter #1
Deep Bed Filter #3

Inactive Exhaust Stacks
296-A-10 - RR Tunnel #2 Ventilation
296-A-9 - RR Tunnel #1 (not in service)
296-A-1 - Emergency PR Room Exhaust
296-A-2 - West Sample Hoods 2
96-A-3 - East Sample Hoods
296-A-6 - Sample Gallery/U-Cell
296-A-7 - West Sample Gallery, PR Corridor, N&R Cell Exhaust
296-A-8 - White Room Exhaust
296-A-14 - -293-A Off-gas
296-A-5A - Labs Hood
296-A-5B - Labs Hood

Utilities:

Material: Shacks/Steam Turbine: surface contamination
Deep Bed Filter #1: 100-200 g Pu; 250,000 E-06 Ci Am; 20-200 Ci Cs/Sr
Deep Bed Filter #3: removed

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