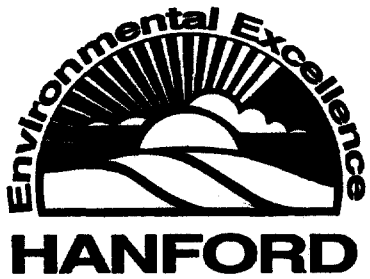
BHI-01084
Rev. 0

Preliminary Hazard Classification for the 105-D Reactor



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

Bechtel Hanford, Inc.
Richland, Washington

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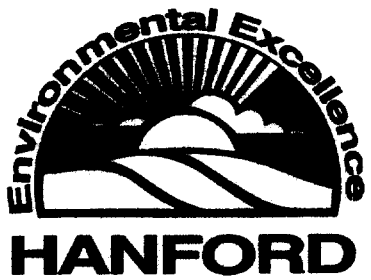

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EXECUTIVE SUMMARY

This document summarizes the inventories of radioactive and hazardous materials present within the 105-D Reactor and uses the inventory information to determine the preliminary hazard classification for the surveillance and maintenance activities of the facility.

The approach used in this document is in accordance with EDPI 4.28-01, "Hazard Classification" (BHI 1997a), and is documented in accordance with 0000X-EG-N0001, *Engineering Guide for Documenting Preliminary Hazard Classifications for Industrial, Radiological, Non-Nuclear, and Nuclear* (BHI 1997b).

The result of this effort was the preliminary hazard classification for the 105-D Building surveillance and maintenance activities. The preliminary hazard classification was determined to be Nuclear Category 3. Additional hazard and accident analysis will be documented in a separate report to define the hazard controls and final hazard classification.

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FIGURES

TABLES

1.0 INTRODUCTION

The purpose of this report is to document the preliminary hazard classification (PHC)[1] for the 105-D Reactor under the surveillance and maintenance (S&M) program. This hazard classification supports the 105-D Reactor S&M effort by summarizing the gross inventories of radioactive and hazardous chemical materials present within the four sections of 105-D Reactor and using these inventories to establish a PHC for the sections.

The hazard classification process used in the preparation of this document is defined in Bechtel Hanford, Inc. (BHI) engineering procedures and guidelines, and is consistent with the guidance provided by the U.S. Department of Energy (DOE) (Bauer 1996). The PHC process is prepared to determine the nature and extent of additional safety analysis requirements.

PHC is based upon the total inventory of hazardous substances that could be considered as a threat of release. The methodology identifies total radiological inventories within the section without regard to form, location, dispersibility, interaction with available energy source, or safety features that could prevent or mitigate a release. These gross inventories are then compared to the threshold quantities (TQs) in DOE-STD-1027-92 (DOE 1992a) to determine the PHC. Hazardous materials inventories are minimal and were found to be insignificant for this PHC.

This document consists of the following sections:

- Section 1.0 provides a general introduction.
- Section 2.0 provides a physical description of the 105-D facility.
- Section 3.0 provides a summary of the inventories of radioactive and hazardous materials within the 105-D facility.
- Section 4.0 provides the calculations (for each contributor) of the fractions of the Category 2 and Category 3 TQs (DOE 1992a).
- Section 5.0 uses the information in Section 4.0 to calculate the total section TQ fractions. These fractions are then used to establish the PHC for the 105-D facility.
- Section 6.0 cites all references used in this report.

[1]PHC is equivalent to initial screening discussed in Section 3.1.1 of DOE-STD-1027-92 (DOE 1992a).

2.0 DESCRIPTION OF THE ABOVE-GRADE FACILITY AND SECTIONS

The 105-D Reactor was one of eight water-cooled, graphite-moderated reactors constructed along the Columbia River by the U.S. Government at the Hanford Site's 100 Area to support the plutonium production effort initiated in 1942. It was constructed in 1943 to house a production nuclear reactor and directly associated equipment used in reactor operations. Initial criticality was achieved in December 1944. The 105-D Reactor was placed in final shutdown in June 1967 and has been declared surplus by the DOE. The facility is scheduled to be decontaminated and decommissioned (D&D).

The PHC presents the inventory of hazardous substances at risk at the retired 105-D Reactor. Activities performed at the facility are those related to S&M for long-term layaway. An Environmental Impact Statement (EIS) (DOE 1992b) determined that long-term S&M and later D&D is the appropriate alternative.

2.1 105-D BUILDING SECTION DESCRIPTION

Typical areas and modules for the retired Hanford Site reactors (which include the key areas of the 105-D Reactor that have significant radiological inventory) are defined in the approved hazard classification and auditable safety analysis for the 105-C Reactor interim storage project (BHI 1996). The areas are defined as

- Module 1, the general ancillary area of the reactor building
- Module 2, the area within the reactor shield walls
- The reactor block (within Module 2)
- The fuel storage area (adjacent to Modules 1 and 2).

Figure 1 provides a plan view depicting the relationships of the four areas. A more detailed description follows.

2.1.1 Module 1

Module 1 provided ancillary support areas during the former reactor operations. The prior support areas included office areas, change rooms, ventilation equipment areas, and other infrastructure support. These support areas are physically separated from reactor process areas.

The 105-C Reactor interim storage concept involves demolishing the Module 1 areas to prepare for interim safe storage. The decision to apply the 105-C interim storage concept is yet to be made. Consequently, immediate disposition of Module 1 remains in the scope of S&M.

2.1.2 Module 2

Module 2 is the area inside the shield walls, excluding the reactor block. Figure 2 provides a plan view of Module 2. The plan notes the functional areas.

Figure 1. Generic Floor Plan for 105 Reactor.

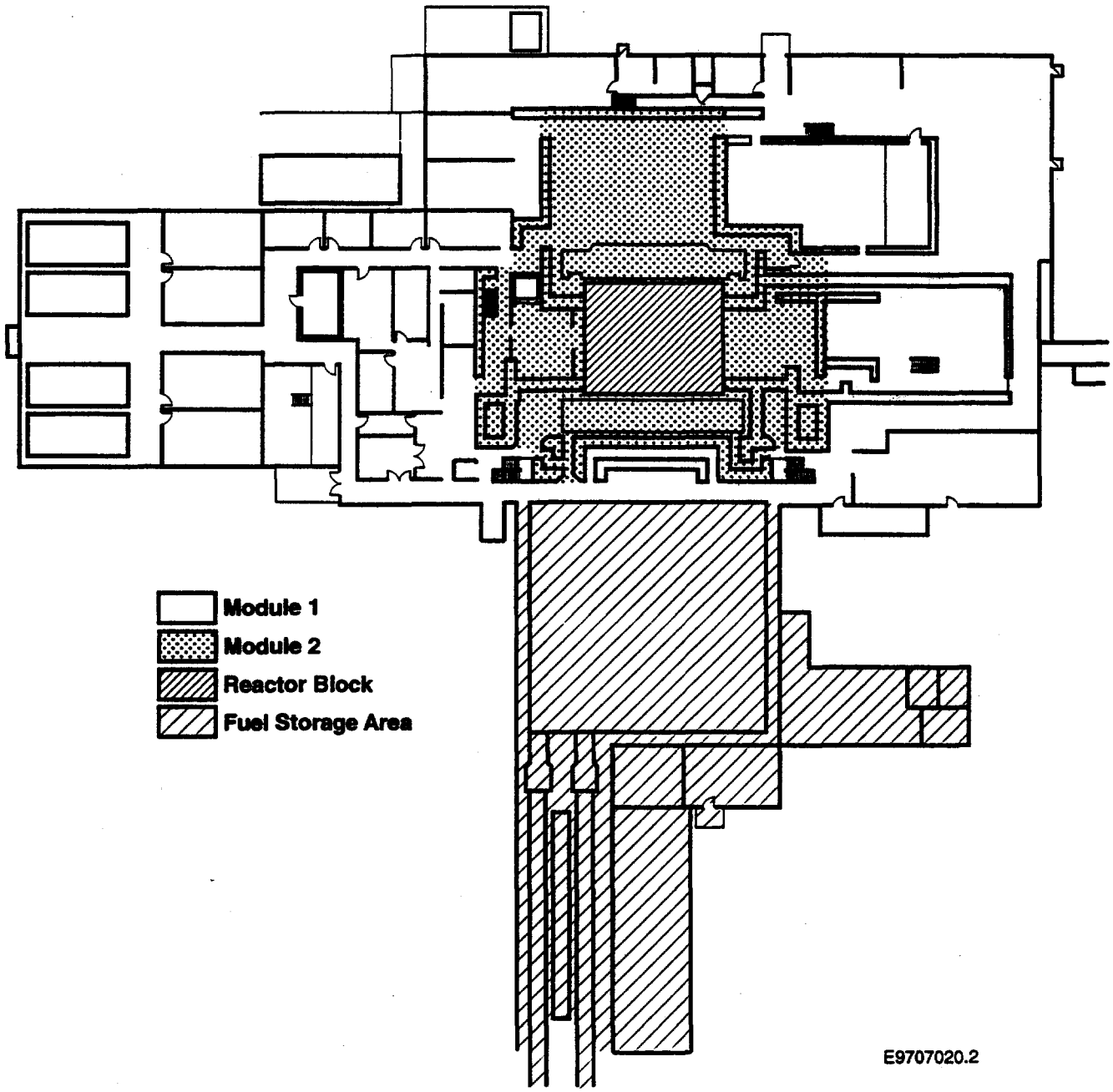
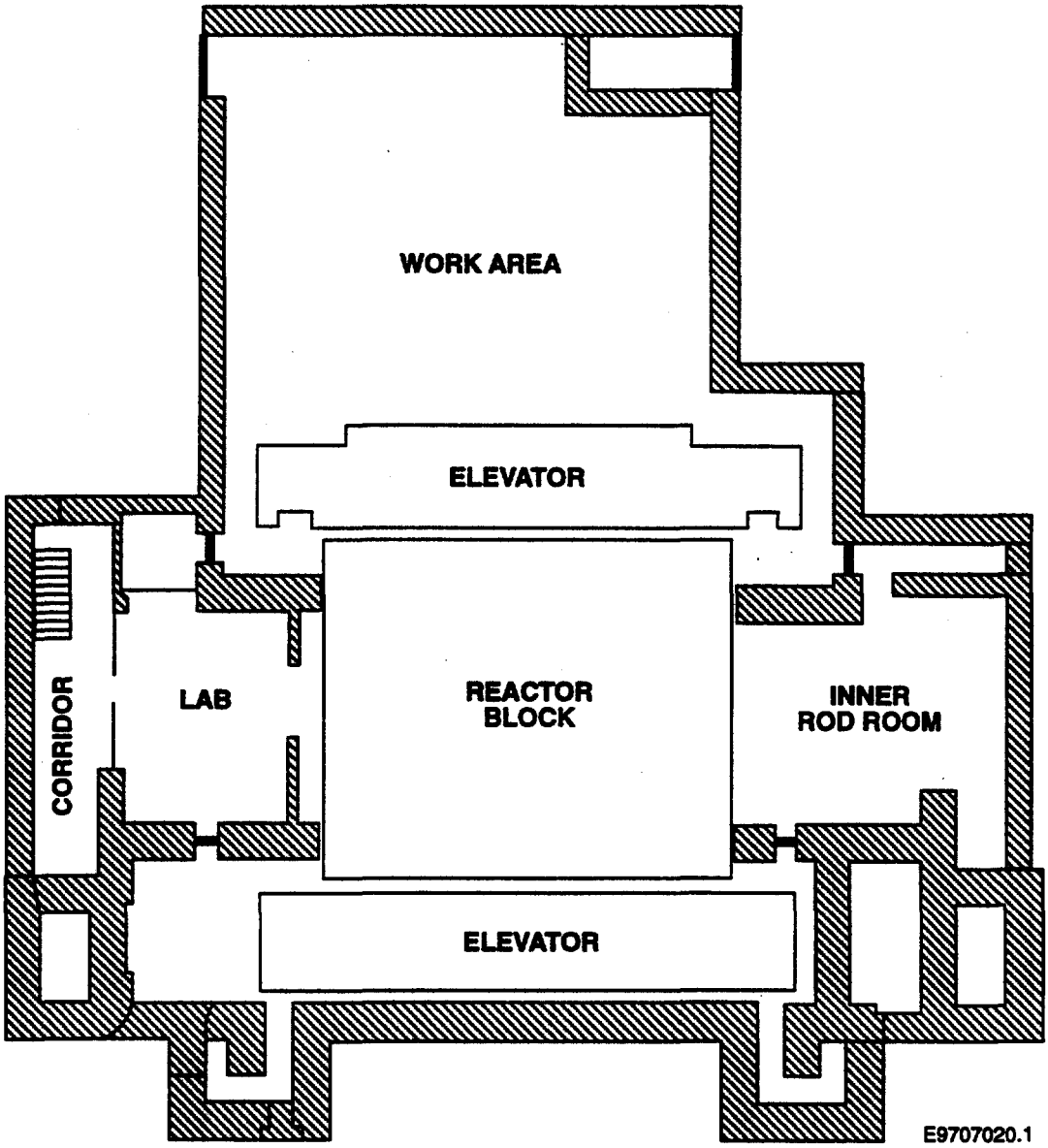


Figure 2. Generic Floor Plan of 105 Module 2 (Inside Shield Walls) at Ground Level.



2.1.3 Reactor Block

The 105-D Building reactor block consists of a 8.5- by 11- by 11-m (28- by 36- by 36-ft) graphite moderator stack encased in a 20.3- to 25.4-cm- (8 to 10-in.) thick overlapping cast-iron thermal shielding, a 132-cm- (52-in.) thick welded biological shield consisting of alternating layers of masonite and steel on the four sides (excluding the bottom of the stack), and an unwelded, stair-step labyrinth seal shield on top. The entire block rests on a concrete foundation. The main components of the block are as follows:

- The reactor moderator stack (an assembly of graphite blocks cored to provide channels for the process tubes, control rods, and other equipment)
- The aluminum process tubes that held the uranium metal fuel elements and provided channels for cooling water
- Control rods, gun barrels, monitoring equipment, experimental test holes, etc.
- The thermal and biological shields
- A welded steel-plate box that encloses the biological shield and served to confine the gas atmosphere within the reactor.

Entry into the reactor block is excluded from current S&M activities. Figure 2 provides a plan view of the reactor block within Module 1. Figure 3 provides a three-dimensional illustration of the reactor block.

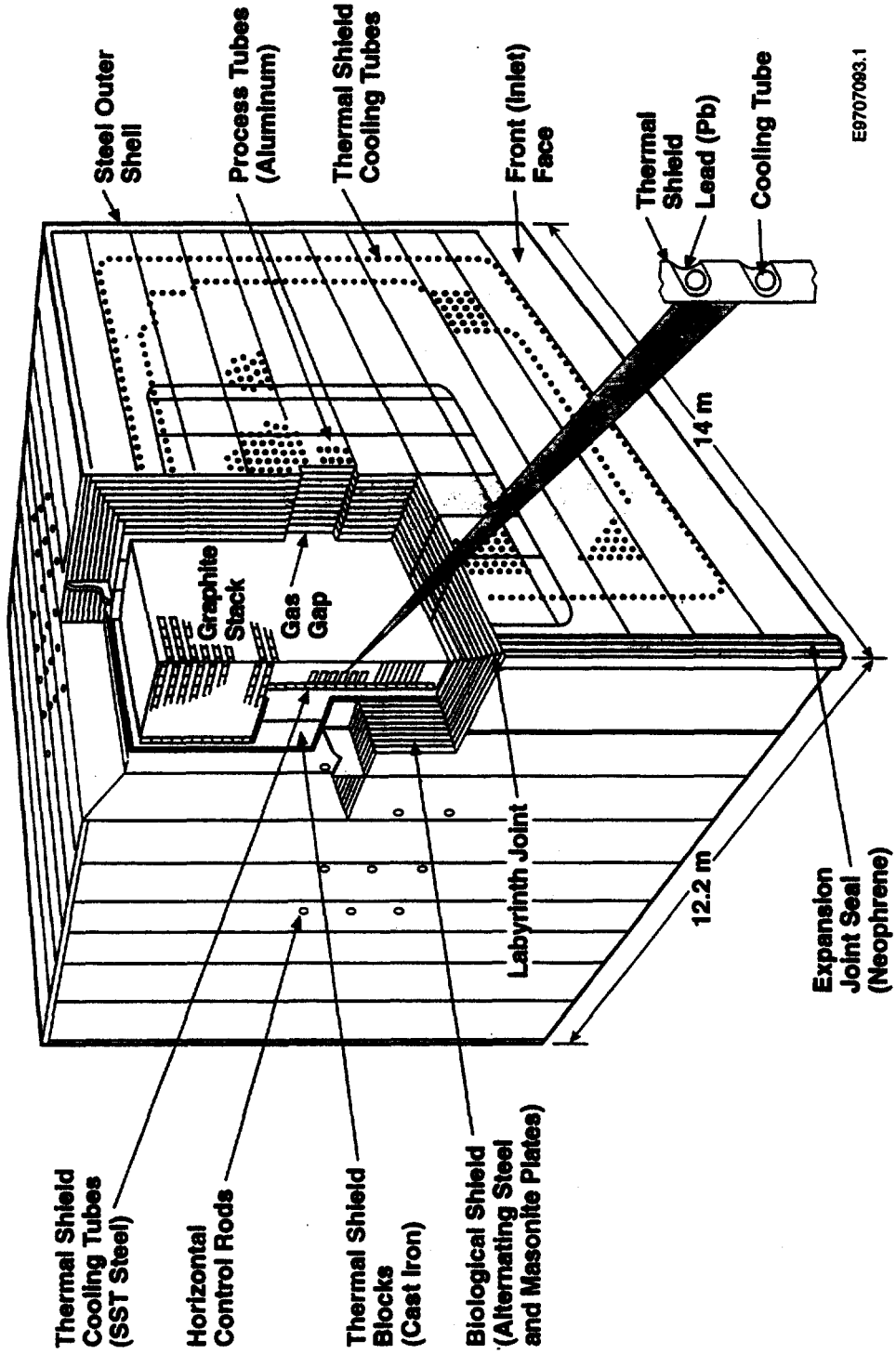
2.1.4 Fuel Storage Area

The fuel storage basin (FSB) served as an underwater collection, storage, and transfer facility for the irradiated fuel elements discharged from the reactor. The FSB complex consists of a fuel element pickup area, storage area, and transfer area. The basin has been drained and cleared of debris, and fixative has been applied to radiologically contaminated surfaces (WHC 1994a). The FSB is located within the Module 1 section. As addressed in the conclusions of the *Preliminary Hazard Classification for the 105-C Production Reactor* (BHI 1996), the transfer pits are distinctly separate in the layout of the facility from the remainder of module and were therefore considered a separate section.

2.2 105-D BUILDING SEGMENTATION

Segmentation of building structures and inventories as provided by DOE guidance (DOE 1992a) is not used in this PHC. Final hazard classification may further evaluate building segments. Decisions regarding the future use will be considered during the evaluation.

Figure 3. Generic Reactor Block Detail.



3.0 INVENTORY OF RADIOACTIVE AND HAZARDOUS MATERIALS

The source documentation that identifies the radioactive and hazardous chemical inventories of the 105-D Reactor is *Radionuclide Inventory and Source Terms for the Surplus Production Reactors at Hanford* (UNC 1987), *Radioactive Air Emissions Notice of Construction for the 105-C Reactor Safe Storage Enclosure* (DOE-RL 1996), and *105-C Building Characterization Survey Data Report* (DOE-RL 1994). The inventory found in UNC (1987) is the data that served as the basis used in the EIS for the facility disposition decision.

The radionuclide inventories calculated for the reactor block in UNC (1987) were based on previous analysis and physical measurements of the 105-DR reactor block, and then adjusted using the operating history and fluence differences of 105-D. The radionuclide inventories calculated for the FSB in UNC (1987) were based on an estimated total sludge mass of 50,000 kg multiplied by measured nuclide concentrations. Where numerical data contained in this report were estimated, the estimates were conservative.

The radionuclide inventories presented in this hazard evaluation for the Module 1 and Module 2 sections were assumed to be equivalent to the radionuclide inventories presented for the 105-C Reactor Building Module 1 and Module 2 segments in BHI (1996). Both the 105-C and 105-D reactor buildings have similar dimensions and generally had similar process functions. Also, each operated for approximately the same amount of time (the 105-D Reactor operated only 26% longer than the 105-C Reactor). This 26% difference is negligible since all assumptions are still conservative.

3.1 RADIOLOGICAL INVENTORIES

Radionuclide inventories can be found in all four sections of the facility, but inventories that exceeded the reportable quantity (RQ) and TQ values were only found in the reactor block and storage basin sections (see Tables 7 and 8). A criticality screening evaluation (BHI 1997c) has been performed and concluded that there is no potential for accidental criticality. Table 1 shows a summary of radionuclide inventories present in each of the sections defined in Section 2.1.

3.2 NONRADIOLOGICAL HAZARDOUS MATERIAL INVENTORIES

The 105-D Building has been deactivated, and all bulk chemical inventories have been removed from the facility for recycling or disposal. Several types of hazardous materials remain in the facility, consisting of asbestos (in the form of transite siding and insulation), mercury, lead, and polychlorinated biphenyls (PCBs) (contained in light fixtures). Of these hazardous chemical constituents, asbestos and lead are in the greatest quantities and are found throughout the facility. The BHI safety and health program provides the appropriate level of controls for lead and asbestos abatement.

Table 1. Inventory of Radionuclides Present in Each Section to be Decay Corrected.

Isotopes	Reactor (Module 2) (Ci) (1985)	Module 2 (Excluding Reactor) (Ci) (1996)	Fuel Storage Basin (Module 1) (Ci) (1985)	Module 1 (Excluding Fuel Storage Basin and Water) (Ci) (1996)
H-3	7.70e+03	-	-	-
C-14	4.30e+03	-	-	-
Cl-36	3.40e+01	-	-	-
Ca-41	1.52e+02	-	-	-
Ni-59	9.10e+00	-	2.00e-03	-
Co-60	7.85e+03	7.02e-06	5.00e-02	2.89e-05
Ni-63	1.10e+03	-	2.70e-01	-
Sr-90	1.02e+01	8.50e-05	6.00e-02	4.42e-02
Zr-93	-	-	-	-
Mo-93	4.00e-02	-	-	-
Nb-94	3.20e-01	-	-	-
Tc-99	2.00e-03	-	-	-
Ag-108m	3.00e-02	-	-	-
Cs-137	3.00e+01	3.63e-04	1.20e-01	1.53e-03
Eu-152	4.17e+01	4.10e-05	2.00e+00	1.68e-04
Eu-154	2.12e+01	1.03e-05	7.00e-03	4.25e-05
U-238	-	-	-	-
Pu-238	-	-	-	-
Pu-239	1.00e+00	-	2.40e-02	-
Am-241	3.00e-01	-	8.00e-03	-

Lighting that contained PCBs has generally been replaced with light fixtures that do not contain PCBs. The old lighting remains, however, and the PCBs contained therein do not present a hazardous material concern. The mercury contained in switches and instruments within the building is not readily dispersable and would not be significantly impacted by S&M activities (BHI 1995, Appendix C).

Solvents, grease, oils (i.e., hydraulic, fuel) and aerosol containers have been found throughout the building. The majority of these items have been removed for proper disposal, although the potential exists for personnel performing S&M activities to find containers containing residual

chemical constituents. In such instances, personnel are expected to deal with chemical constituents according to their work plans (WHC 1994b).

The Environmental Restoration Contractor has in place two hazardous materials control and removal programs (commonly referred to as "abatement plans") to expedite removal of noncontaminated lead and asbestos from facilities managed by BHI and its subcontractors. These programs reduce or eliminate exposure potential to onsite and offsite personnel by removing and/or isolating accessible and noncontaminated asbestos and lead contained in the surplus facilities. Therefore, noncontaminated asbestos and lead are not factored by BHI into the hazardous chemical inventories of the facilities during the hazard classification process.

Asbestos exposure risk has been rated as negligible (WHC 1994a). Piping, electrical wire insulation, and ventilation components are insulated with asbestos-containing materials, and transite is used as wall covering. The majority of asbestos has been removed. Friable asbestos has been noted on the roof of the basin and possibly under the ventilation units on the south side of the building (WHC 1994b).

Lead exposure risk has been rated as minor (WHC 1994a). Lead was used as shielding in the forms of lead shot, lead brick, lead sheet, and cast-lead forms. The amount of lead an individual may absorb depends on the length of exposure, the level of surface oxidation, how easily the surface of the lead can be disturbed, and whether the lead oxide is disturbed by activities such as cutting, grinding, and burning. Most work associated with lead cleanup does not require disruption of the surface. In addition, the majority of the lead in the 105-D Building is located in radiation zones and in the transfer area of the storage basin where S&M activities would not frequently be carried out.

4.0 HAZARD CLASSIFICATION EVALUATIONS

The radionuclides stated in UNC (1987) and DOE-RL (1996) were decay corrected to a January 31, 1997, date to more closely coincide with the current timeline of the S&M project. The supporting calculations can be found in the *Preliminary Hazard Classification for 105-D Reactor* (BHI 1997d).

Tables 2 through 5 present the comparison of the sections of the 105-D Building with the TQs (individual and sum of the fractions) presented in DOE (1992a).

Table 2. Threshold Quantity Comparison for the Reactor Block Section. (page 1 of 2)

Isotopes	Inventory as of 1985 (Ci)	Inventory as of 1997 (Ci)	Category 3 Threshold (Ci)	Category 3 Fraction	Category 2 Threshold (Ci)	Category 2 Fraction
H-3	7.70e+03	3.95e+03	1.00e+03	3.95e+00	3.00e+05	1.32e-02
C-14	4.30e+03	4.29e+03	4.20e+02	1.02e+01	1.40e+06	3.06e-03
Cl-36	3.40e+01	3.40e+01	3.40e+02	1.00e-01	1.40e+03	2.43e-02
Ca-41	1.52e+02	1.52e+02	1.60e+03	9.50e-02	4.30e+05	3.53e-04
Ni-59	9.10e+00	9.10e+00	1.10e+04	8.27e-04	4.30e+05	2.12e-05
Co-60	7.85e+03	1.63e+03	2.80e+02	5.82e+00	1.90e+05	8.58e-03
Ni-63	1.10e+03	1.01e+03	5.40e+03	1.87e-01	4.50e+06	2.24e-04
Sr-90	1.02e+01	7.66e+00	1.60e+01	4.79e-01	2.20e+04	3.48e-04
Y-90	[a]	7.65e+00	1.40e+03	5.46e-03	4.30e+05	1.78e-05
Mo-93	4.00e-02	3.99e-02	2.00e+03	2.00e-05	4.30e+05	9.28e-08
Nb-93m	[a]	1.72e-02	2.00e+03	8.60e-06	4.30e+05	4.00e-08
Nb-94	3.20e-01	3.20e-01	2.00e+02	1.60e-03	8.60e+04	3.72e-06
Tc-99	2.00e-03	2.00e-03	1.70e+03	1.18e-06	3.80e+06	5.26e-10
Ag-108m	3.00e-02	2.81e-02	2.00e+02	1.41e-04	4.30e+05	6.53e-08
Ag-108	[a]	2.61e-03	[b]	[b]	4.30e+05	6.07e-09
Cs-137	3.00e+01	2.28e+01	6.00e+01	3.80e-01	8.90e+04	2.56e-04
Ba-137m	[a]	2.16e+01	[b]	[b]	4.30e+05	5.02e-05
Eu-152	4.17e+01	2.23e+01	2.00e+02	1.12e-01	1.30e+05	1.72e-04
Gd-152	[a]	6.50e-13	1.00e-01	6.50e-12	5.50e+01	1.18e-14
Eu-154	2.12e+01	8.04e+00	2.00e+02	4.02e-02	1.10e+05	7.31e-05
Am-241	3.00e-01	2.94e-01	5.20e-01	5.65e-01	5.50e+01	5.35e-03
Pb-209	[a]	1.06e-14	6.20e+05	1.71e-20	4.30e+05	2.47e-20
Tl-209	[a]	2.29e-16	[b]	[b]	4.30e+05	5.33e-22
Bi-213	[a]	1.06e-14	3.20e+03	3.31e-18	4.30e+05	2.47e-20
Po-213	[a]	1.04e-14	[b]	[b]	5.50e+01	1.89e-16
At-217	[a]	1.06e-14	[b]	[b]	5.50e+01	1.93e-16
Fr-221	[a]	1.06e-14	[b]	[b]	5.50e+01	1.93e-16
Ac-225	[a]	1.06e-14	3.20e+01	3.31e-16	2.90e+03	3.66e-18
Ra-225	[a]	1.07e-14	7.20e+01	1.49e-16	3.80e+03	2.82e-18

Table 2. Threshold Quantity Comparison for the Reactor Block Section. (page 2 of 2)

Isotopes	Inventory as of 1985 (Ci)	Inventory as of 1997 (Ci)	Category 3 Threshold (Ci)	Category 3 Fraction	Category 2 Threshold (Ci)	Category 2 Fraction
Ra-225	[a]	1.07e-14	7.20e+01	1.49e-16	3.80e+03	2.82e-18
Th-229	[a]	1.09e-14	9.40e-02	1.16e-13	5.50e+01	1.98e-16
Pa-233	[a]	1.14e-06	4.60e+03	2.48e-10	4.30e+05	2.65e-12
U-233	[a]	2.92e-11	4.20e+00	6.95e-12	2.20e+02	1.33e-13
Np-237	[a]	1.15e-06	4.20e-01	2.74e-06	5.80e+01	1.98e-08
Pu-239	1.00e+00	1.00e+00	5.20e-01	1.92e+00	5.60e+01	1.79e-02
U-235	[a]	1.17e-08	4.20e+00	2.79e-09	2.40e+02	4.88e-11
Th-231	[a]	1.17e-08	1.20e+04	9.75e-13	4.30e+05	2.72e-14
Pa-231	[a]	1.46e-12	2.00e-01	7.30e-12	5.50e+01	2.65e-14
Ac-227	[a]	1.70e-13	4.20e-02	4.05e-12	4.30e+00	3.95e-14
Fr-223	[a]	2.34e-15	8.20e+03	2.85e-19	4.30e+05	5.44e-21
Ra-223	[a]	1.65e-13	6.20e+01	2.66e-15	3.80e+03	4.34e-17
Rn-219	[a]	1.65e-13	[b]	[b]	5.50e+01	3.00e-15
Po-215	[a]	1.65e-13	[b]	[b]	5.50e+01	3.00e-15
Pb-211	[a]	1.65e-13	6.20e+03	2.66e-17	4.30e+05	3.84e-19
Bi-211	[a]	1.65e-13	[b]	[b]	5.50e+01	3.00e-15
Tl-207	[a]	1.64e-13	[b]	[b]	4.30e+05	3.81e-19
Po-211	[a]	4.50e-16	[b]	[b]	5.50e+01	8.18e-18
Th-227	[a]	1.64e-13	3.20e+01	5.13e-15	5.50e+01	2.98e-15
			Sum of Fractions	2.39e+01	Sum of Fractions	7.38e-02

[a] These elements are the resultant daughter products of the 1985 inventory.
[b] No Category 3 threshold values were given by DOE-STD-1027-92 (DOE 1992a) or EH-31. This isotope was excluded from the threshold value calculation.

Table 3. Threshold Quantity and Reportable Quantity Comparison for the Fuel Storage Basin. (page 1 of 2)

Isotopes	Inventory as of 1985 (Ci)	Inventory as of 1997 (Ci)	Category 3 Threshold (Ci)	Category 3 Fraction	Category 2 Threshold (Ci)	Category 2 Fraction	Reportable Quantity (Ci)	Reportable Quantity Fraction
Ni-59	2.00e-03	2.00e-03	1.00e+04	2.00e-07	4.30e+05	4.65e-09	1.00e+02	2.00e-05
Co-60	5.00e-02	1.04e-02	2.80e+02	3.71e-05	1.90e+05	5.47e-08	1.00e+01	1.04e-03
Ni-63	2.70e-01	2.49e-01	5.40e+03	4.61e-05	4.50e+06	5.53e-08	1.00e+02	2.49e-03
Sr-90	6.00e-02	4.50e-02	1.60e+01	2.81e-03	2.20e+04	2.05e-06	1.00e-01	4.50e-01
Y-90	[a]	4.50e-02	1.40e+03	3.21e-05	4.30e+05	1.05e-07	1.00e+01	4.50e-03
Cs-137	1.20e-01	9.13e-02	6.00e+01	1.52e-03	8.90e+04	1.03e-06	1.00e+00	9.13e-02
Ba-137m	[a]	8.64e-02	[b]	[b]	4.30e+05	2.01e-07	[b]	[b]
Eu-152	2.00e+00	1.07e+00	2.00e+02	5.35e-03	1.30e+05	8.23e-06	1.00e+01	1.07e-01
Gd-152	[a]	3.13e-14	1.00e-01	3.13e-13	5.50e+01	5.69e-16	1.00e-03	3.13e-11
Eu-154	7.00e-03	2.65e-03	2.00e+02	1.33e-05	1.10e+05	2.41e-08	1.00e+01	2.65e-04
Pu-239	2.40e-02	2.40e-02	5.20e-01	4.62e-02	5.60e+01	4.29e-04	1.00e-02	2.40e+00
U-235	[a]	2.81e-10	4.20e+00	6.69e-11	2.40e+02	1.17e-12	1.00e-01	2.81e-09
Th-231	[a]	2.81e-10	1.20e+04	2.34e-14	4.30e+05	6.53e-16	1.00e+02	2.81e-12
Pa-231	[a]	3.54e-14	2.00e-01	1.77e-13	5.50e+01	6.44e-16	1.00e-02	3.54e-12
Ac-227	[a]	4.07e-15	4.20e-02	9.69e-14	4.30e+00	9.47e-16	1.00e-03	4.07e-12
Fr-223	[a]	5.62e-17	8.20e+03	6.85e-21	4.30e+05	1.31e-22	1.00e+02	5.62e-19
Ra-223	[a]	3.96e-15	6.20e+01	6.39e-17	3.80e+03	1.04e-18	1.00e+00	3.96e-15
Rn-219	[a]	3.96e-15	[b]	[b]	5.50e+01	7.20e-17	[b]	[b]
Po-215	[a]	3.96e-15	[b]	[b]	5.50e+01	7.20e-17	[b]	[b]
Pb-211	[a]	3.96e-15	6.20e+03	6.39e-19	4.30e+05	9.21e-21	1.00e+02	3.96e-17
Bi-211	[a]	3.96e-15	[b]	[b]	5.50e+01	7.20e-17	[b]	[b]
Tl-207	[a]	3.95e-15	[b]	[b]	4.30e+05	9.19e-21	[b]	[b]
Po-211	[a]	1.08e-17	[b]	[b]	5.50e+01	1.96e-19	[b]	[b]
Th-227	[a]	3.95e-15	3.20e+01	1.23e-16	5.50e+01	7.18e-17	1.00e+00	3.95e-15
Am-241	8.00e-03	7.85e-03	5.20e-01	1.51e-02	5.50e+01	1.43e-04	1.00e-02	7.85e-01
Np-237	[a]	3.05e-08	4.20e-01	7.26e-08	5.80e+01	5.26e-10	1.00e-02	3.05e-06
Pa-233	[a]	3.03e-08	4.60e+03	6.59e-12	4.30e+05	7.05e-14	1.00e+02	3.03e-10
U-233	[a]	7.80e-13	4.20e+00	1.86e-13	2.20e+02	3.55e-15	1.00e-01	7.80e-12
Th-229	[a]	2.90e-16	9.40e-02	3.09e-15	5.50e+01	5.27e-18	1.00e-03	2.90e-13
Ra-225	[a]	2.86e-16	7.20e+01	3.97e-18	3.80e+03	7.53e-20	1.00e+00	2.86e-16

Table 3. Threshold Quantity and Reportable Quantity Comparison for the Fuel Storage Basin. (page 2 of 2)

Isotopes	Inventory as of 1985 (Ci)	Inventory as of 1997 (Ci)	Category 3 Threshold (Ci)	Category 3 Fraction	Category 2 Threshold (Ci)	Category 2 Fraction	Reportable Quantity (Ci)	Reportable Quantity Fraction
Ac-225	[a]	2.83e-16	3.20e+01	8.84e-18	2.90e+03	9.76e-20	1.00e+00	2.83e-16
Fr-221	[a]	2.83e-16	[b]	[b]	5.50e+01	5.15e-18	[b]	[b]
At-217	[a]	2.83e-16	[b]	[b]	5.50e+01	5.15e-18	[b]	[b]
Bi-213	[a]	2.83e-16	3.20e+03	8.84e-20	4.30e+05	6.58e-22	1.00e+02	2.83e-18
Tl-209	[a]	6.11e-18	[b]	[b]	4.30e+05	1.42e-23	[b]	[b]
Pb-209	[a]	2.83e-16	4.30e+05	6.58e-22	4.30e+05	6.58e-22	1.00e+03	2.83e-19
Po-213	[a]	2.77e-16	[b]	[b]	5.50e+01	5.04e-18	[b]	[b]
			Sum of Fractions	7.11e-02	Sum of Fractions	5.83e-04	Sum of Fractions	3.84e+00

[a]These elements are the resultant daughter products of the 1985 inventory.
[b]No Category 3 threshold values were given by DOE-STD-1027-92 (DOE 1992a) or EH-31. This isotope was excluded from the threshold value calculation.

Table 4. Threshold Quantity and Reportable Quantity Comparison for Module 1.

Isotopes	Inventory as of 1996 (Ci)	Inventory as of 1997 (Ci)	Category 3 Threshold (Ci)	Category 3 Fraction	Category 2 Threshold (Ci)	Category 2 Fraction	Reportable Quantity (Ci)	Reportable Quantity Fraction
Co-60	2.89e-05	2.78e-05	2.80e+02	9.93e-08	1.90e+05	1.46e-10	1.00e+01	2.78e-06
Sr-90	4.42e-02	4.39e-02	1.60e+01	2.74e-03	2.20e+04	2.00e-06	1.00e-01	4.39e-01
Y-90	[a]	4.39e-02	1.40e+03	3.14e-05	4.30e+05	1.02e-07	1.00e+01	4.39e-03
Cs-137	1.53e-03	1.52e-03	6.00e+01	2.53e-05	8.90e+04	1.71e-08	1.00e+00	1.52e-03
Ba-137m	[a]	1.44e-03	[b]	[b]	4.30e+05	3.35e-09	[b]	[b]
Eu-152	1.68e-04	1.65e-04	2.00e+02	8.25e-07	1.30e+05	1.27e-09	1.00e+01	1.65e-05
Gd-152	[a]	8.76e-20	1.00e-01	8.76e-19	5.50e+01	1.59e-21	1.00e-03	8.76e-17
Eu-154	4.25e-05	4.15e-05	2.00e+02	2.08e-07	1.10e+05	3.77e-10	1.00e+01	4.15e-06
			Sum of Fractions	2.80e-03	Sum of Fractions	2.12e-06	Sum of Fractions	4.45e-01

[a]These elements are the resultant daughter products of the 1985 inventory.
[b]No Category 2 or Category 3 threshold values were given by DOE-STD-1027-92 (DOE 1992a) or EH-31. This isotope was excluded from the threshold value calculation.

Table 5. Threshold Quantity and Reportable Quantity Comparison for Module 2.

Isotopes	Inventory as of 1996 (Ci)	Inventory as of 1997 (Ci)	Category 3 Threshold (Ci)	Category 3 Fraction	Category 2 Threshold (Ci)	Category 2 Fraction	Reportable Quantity (Ci)	Reportable Quantity Fraction
Co-60	7.02e-06	6.75e-06	2.80e+02	2.41e-08	1.90e+05	3.55e-11	1.00e+01	6.75e-07
Sr-90	8.50e-05	8.44e-05	1.60e+01	5.28e-06	2.20e+04	3.84e-09	1.00e-01	8.44e-04
Y-90	[a]	8.44e-05	1.40e+03	6.03e-08	4.30e+05	1.96e-10	1.00e+01	8.44e-06
Cs-137	3.63e-04	3.61e-04	6.00e+01	6.02e-06	8.90e+04	4.06e-09	1.00e+00	3.61e-04
Ba-137m	[a]	3.41e-04	[b]	[b]	4.30e+05	7.93e-10	[b]	[b]
Eu-152	4.10e-05	4.04e-05	2.00e+02	2.02e-07	1.30e+05	3.11e-10	1.00e+01	4.04e-06
Gd-152	[a]	2.14e-20	1.00e-01	2.14e-19	5.50e+01	3.89e-22	1.00e-03	2.14e-17
Eu-154	1.03e-05	1.01e-05	2.00e+02	5.05e-08	1.10e+05	9.18e-11	1.00e+01	1.01e-06
			Sum of Fractions	1.16e-05	Sum of Fractions	9.32e-09	Sum of Fractions	1.22e-03

[a]These elements are the resultant daughter products of the 1985 inventory.
[b]No Category 2 or Category 3 threshold values were given by DOE-STD-1027-92 (DOE 1992a) or EH-31. This isotope was excluded from the threshold value calculation.

5.0 RESULTS

The results of the hazard classification evaluation are presented in Table 6. As can be seen in Tables 7 and 8, the integration of all four of the sections calculated would result in a hazard classification of Nuclear Category 3. The reactor block section and FSB exceed Category 3 inventory threshold quantities, with contributions to total inventory by the Module 1 and Module 2 sections being negligible.

Exposure to nonradioactive hazardous materials in the facility was found to be minor, and release of nonradioactive hazardous materials from the facility was found to be negligible (WHC 1994a). The PHC of the 105-D Building is Nuclear Category 3.

Table 6. Sum of Fractions for Reportable Quantities and Threshold Quantities for 105-D Building Sections.

Section	Sum of Fractions for Radiological	Sum of Fractions for Nuclear Category 3	Sum of Fractions for Nuclear Category 2
Reactor block[a]	> 1	2.39e+01 > 1	7.38e-02 < 1
Module 1	4.45e-01 < 1	2.80e-03 < 1	2.12e-06 < 1
Module 2	1.22e-03 < 1	1.16e-05 < 1	9.32e-09 < 1
Fuel Storage Basin	3.84e+00 > 1	7.11e-02 > 1	5.83e-04 < 1

[a]When the reactor block section exceeds the threshold quantity levels for Nuclear Category 3, the section is automatically greater than the reportable quantity levels for a hazard classification of radiological.

Table 7. Integration of Building Sections for Purposes of Hazard Classification (Nuclear Category 2).

Sections	Sum of Fractions for Nuclear Category 2
Reactor Block	7.38e-02 < 1
Module 1	2.12e-06 < 1
Module 2	9.32e-09 < 1
Fuel Storage Basin	5.83e-04 < 1
Total	7.44e-02 < 1

Table 8. Integration of Building Sections for Purposes of Hazard Classification (Nuclear Category 3).

Sections	Sum of Fractions for Nuclear Category 3
Reactor Block	2.39e+01 > 1
Module 1	2.80e-03 < 1
Module 2	1.16e-05 < 1
Fuel Storage Basin	7.11e-02 < 1
Total	2.40e+01 > 1

Additional analysis is needed to document the appropriate hazard controls and final hazard classification because the inventory exceeds the Category 3 thresholds (DOE 1992a). The form of documentation will be a graded hazard and safety analysis that uses the guidance found in DOE standards DOE-STD-1027-92 (DOE 1992a), DOE-STD-3009-94 (DOE 1994a), DOE-EM-STD-5502-94 (DOE 1994b), and applicable DOE instructions and memorandums.

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