BHI-01282
Rev. 0

Hanford B Reactor Building Hazard Assessment Report

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

Submitted by: Bechtel Hanford, Inc.

BHI-01282
Rev. 0
OU: N/A
TSD: N/A
ERA: N/A

APPROVAL PAGE

Title: Hanford B Reactor Building Hazard Assessment Report

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6/28/99 — Date

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Hanford B Reactor Building Hazard Assessment Report

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Date Published

June 1999

EXECUTIVE SUMMARY

The 105-B Reactor (hereinafter referred to as B Reactor) is located in the 100 Area of the Hanford Site near Richland, Washington. The B Reactor is one of nine plutonium production reactors that were constructed in the 1940s during the Cold War Era. Construction of the B Reactor began June 7, 1943, and operation began on September 26, 1944. The B Reactor was the world's first full-scale production reactor and produced the plutonium for the first-ever man-made nuclear explosion for the Trinity Test in New Mexico on July 16, 1945. The bomb that was dropped on Nagasaki, Japan, on August 9, 1945 (credited for bringing an end to World War II with the surrender of Japan), contained plutonium that was produced at B Reactor. The reactor permanently ceased its plutonium-production operation in 1968, and the reactor building is currently a controlled-access museum.

Pursuant to Section 110 of the *National Historic Preservation Act of 1966* (NHPA), the U.S. Department of Energy, Richland Operations Office (RL) has the responsibility for the preservation of historic buildings and structures located on the Hanford Site that are eligible for the National Register of Historic Places. Based the *Programmatic Agreement Among the U.S. Department of Energy-Richland Operations Office, the Advisory Council on Historic Preservation, and the Washington State Historic Preservation Office for the Maintenance, Deactivation, Alteration, and Demolition of the Built Environment on the Hanford Site* (DOE-RL 1996), and the considerations of Section 110 of the NHPA, the B Reactor was entered into the National Register of Historic Places on April 3, 1992, by the National Park Service of the U.S. Department of the Interior.

Public tours of the facility have been conducted during recent years on a pre-planned, scheduled basis. Although public entry is permitted to several of the rooms and areas of the reactor, discussions are continuing regarding opening up additional areas in the building to public access.

The Environmental Restoration Contractor was requested by RL to provide an assessment/characterization of the B Reactor building to determine and document the hazards that are present and could pose a threat to the environment and/or to individuals touring the building. This report documents the potential hazards, determines the feasibility of mitigating the hazards, and makes recommendations regarding areas where public tour access should not be permitted.

The findings from the walk-through investigations were documented by each professional discipline. These findings are considered to be the raw hazard data used in the assessment/characterization and are included in this report as Appendices A through G. The B Reactor is managed in accordance with the Hanford Federal Facility Agreement and Consent Order and the Environmental Compliance Issue Close Out Form dated June 19, 1997. As waste is generated during surveillance and maintenance activities, it is managed in accordance with applicable environmental requirements.

The assessment concluded that where some potential hazards were noted in the existing tour route, none were of a nature to cause harm to anyone touring the facility.

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1.0 INTRODUCTION

The 105-B Reactor (hereinafter referred to as B Reactor), located in the 100 Area of the Hanford Site near Richland, Washington, is one of nine plutonium production reactors that was constructed in the 1940s and during the Cold War Era. Construction of the B Reactor began June 7, 1943, and operation began on September 26, 1944. The B Reactor was the world's first full-scale production reactor and produced the plutonium for the first-ever man-made nuclear explosion for the Trinity Test in New Mexico on July 16, 1945. The bomb dropped on Nagasaki, Japan, on August 9, 1945 (credited for bringing an end to World War II with the surrender of Japan), contained plutonium that was produced at B Reactor. The reactor permanently ceased its plutonium-production operation in 1968, and the reactor building is currently a controlled-access museum.

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Public tours of the facility have been conducted during recent years on a pre-planned, scheduled basis. Although public entry is permitted to several of the rooms and areas of the reactor, discussions are continuing regarding opening up additional areas in the building to public access.

1.1 OBJECTIVE

The Environmental Restoration Contractor (ERC) was requested by RL to provide an assessment/characterization of the B Reactor building to determine and document the hazards that are present and could pose a threat to the environment and/or to individuals touring the building. This assessment/characterization report meets the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Milestone M-93-04 commitment for the third quarter of fiscal year (FY) 1999.

NOTE: Documenting noncompliance with national codes or Federal and state laws was not the focus of this investigation.

1.2 SCOPE

The assessment included a review of previously published documents for hazard/risk identification at the B Reactor building and walk-throughs with an assessment team of professionals to confirm the current status of facility's hazards. This report will be submitted to RL and U. S. Environmental Protection Agency (EPA) and documents the hazards, determines the feasibility of mitigating the hazards, and makes recommendations on locations where public access should not be permitted. Figure 1 contains a map of the layout of the floor plan for the B Reactor building. Figure 2 contains a floor plan of the existing and additional tour routes for the reactor building.

The findings of the assessment/characterization are included as Appendices A through H of this report.

1.3 MAJOR ASSESSMENT ACTIVITIES

The first major assessment activity involved reviewing previously published documents describing past hazard/risk identification efforts at the B Reactor building. These documents included the following:

- *1994 Qualitative Risk Evaluation for the Retired Hanford Site Facilities*, BHI-00052 (BHI 1994a)
- *1994 Risk Evaluation Work Procedure for the Retired Surplus Hanford Site Facilities*, BHI-00088 (BHI 1995b)
- *Risk Management Study for the Retired Hanford Site Facilities: Qualitative Risk Evaluation for the Retired Hanford Site Facilities*, WHC-EP-0619, Volume 3 (WHC 1993)
- *Risk Management Study for the Retired Hanford Site Facilities Risk-Reduction Cost Comparison for the Retired Hanford Site Facilities*, WHC-EP-0619, Volume 4 (WHC 1994)
- *Pre-Existing Conditions Survey of Hanford Site Facilities to be Managed by Bechtel Hanford, Inc.*, BHI-00221 (BHI 1994b)
- *Surplus Reactor Auditable Safety Analysis*, BHI-01172 (BHI 1998)
- *105-B Reactor Facility Museum, Phase I Feasibility Study Report*, BHI-00076 (BHI 1995a).

Figure 1. 105-B Reactor Building Floor Plan.

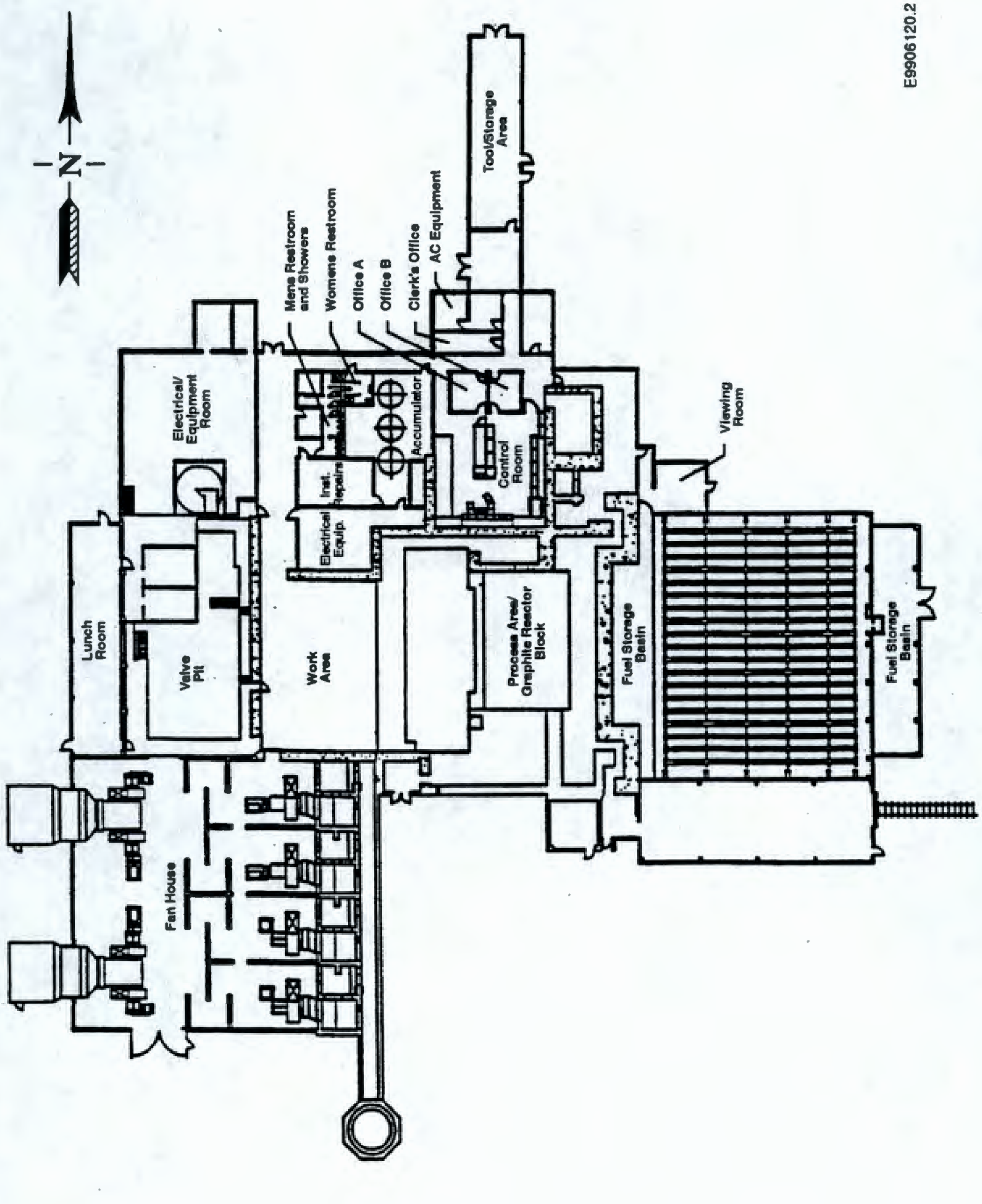

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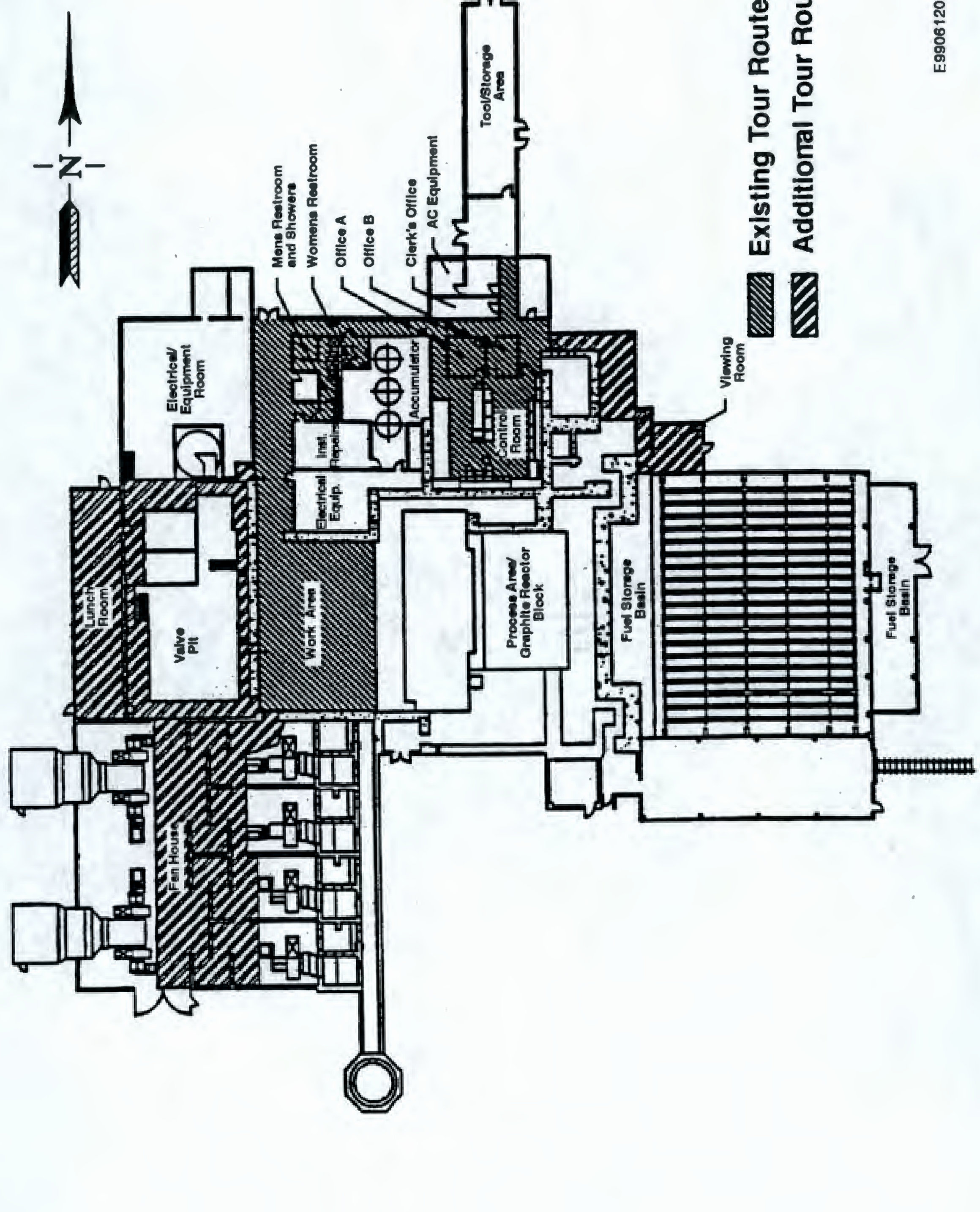
Figure 2. Existing and Additional Tour Routes for the 105-B Reactor.



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In addition to reviewing the documents listed above, the results for legacy waste identified by the Surveillance/Maintenance and Transition organization were reviewed and observed in preparation for legacy waste removal. The legacy waste is therefore not included as part of this report.

The second major assessment activity involved performing walk-throughs of the entire B Reactor facility with the assessment team to confirm the current status of hazards (i.e., the presence of radiological, industrial, environmental, electrical, structural, and hazardous materials).

Based on the existing documentation review and walk-through, the third major assessment activity was to determine the current status of the building and determine if additional information is required to complete the assessment.

Based on these activities, the results of the assessment/characterization have been documented in this report for submittal to RL and EPA.

2.0 ASSESSMENT DESCRIPTION

2.1 B REACTOR MUSEUM BACKGROUND

A new strategy was initiated by RL that moved from project to project and building to building in consideration of the development of a Historic Building Programmatic Agreement (PA). This PA (DOE-RL 1996) provides a streamlined framework that governs the management of all Manhattan Project and Cold War Era properties on the Hanford Site and guarantees historic preservation requirements are expedited while ensuring that cleanup activities are not delayed.

In 1995, the ERC completed an initial study on the feasibility of converting the B Reactor Building into a museum. The study was conducted to (1) define the activities necessary to continue using the B Reactor as a museum, (2) evaluate the technical feasibility of these activities, (3) examine the cost effectiveness of these actions vs. dismantlement, and (4) evaluate the options that would improve the B Reactor building as a museum attraction.

The Historic Museum Committee/RL will determine the scope for the inclusion, preservation, and restoration of the B Museum facilities.

2.2 ASSESSMENT DESCRIPTION

This assessment followed the basic approach described in the *1994 Risk Evaluation Work Procedure for the Retired Surplus Hanford Site Facilities* (BHI 1995b) for the facility investigation. This evaluation includes only the hazards that may affect human safety and the environment. The assessment was made by competent safety professionals that investigated the B Reactor building spaces. In this assessment, expert judgment was augmented by a professional investigation to determine the facility's current conditions. The evaluation does not include the quantification of latent cancer effects for onsite or offsite releases of hazardous materials. Effects related to hazardous material releases to the environment are estimated based on size and material considerations rather than regulatory/statutory limits.

The assessment team examined the facility according to their appropriate disciplines with the aid of hazard identification checklists developed from their review of previous B Reactor hazard/risk documents and based on past experience and observations. The process generated a list of findings that were assessed relative to their hazards, the feasibility of mitigating these hazards, and the locations where access to the public should not be permitted.

This process is divided into four major parts:

- The review of previous facility hazard identification documents and checklist development
- Facility investigation
- Finding evaluation (performed in a team meeting format)
- An assessment of results.

Hazard identification checklists were developed by each of the following professional disciplines involved in the walk-through investigation:

- Structural engineering
- Industrial safety
- Environmental specialist
- Electrical engineering
- Radiation safety
- Characterization specialist.

The findings from the walk-through investigations were documented by each professional discipline. Sufficient information is provided to readily identify the location of the hazard (i.e., room and location). The information includes specific descriptions such as identifying wall/floor/ceiling, north/south/east/west, or specific measurements. These findings are considered to be the raw hazard data used in the assessment/characterization and are included in this report as Appendices A through H. The B Reactor is managed in accordance with the Hanford Federal Facility Agreement and Consent Order and the Environmental Compliance Issue Close Out Form dated June 19, 1997. As waste is generated during surveillance and maintenance activities, it is managed in accordance with applicable environmental requirements.

This report provides a description of potential accidents associated with the hazards. These descriptions include a simple characterization of the potential harm that could result to an individual or to the environment. The discussion addresses conditions or features that affect the likelihood of the hazard resulting in an accident (e.g., absence of a personnel barrier, poor lighting, limited personnel access, a power box cover not in place, or a hallway that is the only access route in the facility). These factors provide information to determine the feasibility of mitigating the hazards and to support recommendations on the locations where public access should not be permitted.

The hazard categories were identified from the following list. If a finding could not be applied to a category in this list, a new hazard category was created.

- Falling (i.e., tripping, slipping, falling through, falling off)
- Struck by or striking
- Drowning or suffocation
- Electrical shock
- Exposure to radiation or radiological contamination
- Exposure to asbestos
- Exposure to lead
- Exposure to mercury
- Exposure to miscellaneous chemicals
- Exposure to biological hazards (i.e., disease, bites)
- Temperature extremes
- Fire
- Explosion
- Release of radioactive material
- Release of asbestos
- Release of lead
- Release of mercury
- Release of oil and/or petroleum products
- Release of miscellaneous chemicals.

3.0 ASSESSMENT PARAMETERS

Key assessment parameters include the following:

- The assessment will be for the purpose of protecting persons engaged in touring the facility, not for the purpose of worker protection or waste designation.

- This assessment does not include upgrades to the facility.

- B Reactor building legacy waste sampling performed by the SM&T organization will be completed in FY 1999 and can be reviewed in support of this effort.

4.0 HAZARD IDENTIFICATION DATA, ASSESSMENT OF FEASIBILITY TO MITIGATE, AND RECOMMENDATIONS REGARDING AREAS WHERE ACCESS SHOULD NOT BE PERMITTED

This report separates the facility and hazards into the following six zones:

- Outside area adjacent to the reactor
- Current tour route
- Proposed additional tour route
- Spaces adjacent to tour routes
- Spaces above ground floor level
- Spaces below ground floor level.

A grouping of the hazards identified for the six zones with a list of the general concerns, including the radiological assessment results/discussion and restricted tour access recommendations, are summarized in Appendix A.

4.1 OBJECTIVE

The assessment was performed for the purpose of protecting the health and safety of individuals touring the B Reactor facility. Assessments were performed on the following aspects of the facility that represent potential hazards: structural, industrial safety, environmental, electrical, radiological, and characterization.

4.2 ASSESSMENT PROCESS

The assessment process was performed as described in the *1994 Risk Evaluation Work Procedure for the Retired Surplus Hanford Site Facilities* (BHI 1995b). The assessment was performed by qualified safety professionals who considered hazards to human safety and the environment as described in Section 2.0.

4.3 ASSESSMENT SUMMARY

The walk-through assessment of B Reactor was performed on March 22 and 24 and April 27, 1999. Following the completion of the assessment, each participant prepared a report of their findings. Appendices A through G contain summaries of the findings of the walk-through in each of the assessed areas (i.e., structural, industrial safety, environmental, electrical, radiological/nuclear, and characterization, respectively). Additional information summarizing the building's hazards are provided in Table H-1 of Appendix H.

4.4 RECOMMENDATIONS

The following recommendations were made regarding the walk-through assessment of the B Reactor building. This summary addresses the hazard concerns listed in Section 2.2. For additional information, see appendices.

- Do not allow water to reach/collect on the building surface of the concrete panels for prolonged periods.
- Pre-cast concrete roof panels should be inspected each year following the end of the snow/freezing temperature season, and after any excessive build-up of snow/ice/rain on the roof.
- Wood-supported cover located above front-fact canvas drop shield: All panels should be securely attached in-place or removed completely to eliminate the potential hazard that currently exists.
- The support system for the rolled-up canvas front-face canvas drop shield should be inspected on a regular basis to ensure continued safe operations.
- Re-lamp non-tour areas for safe access.
- Remove biohazards.
- Characterize peeling paint for lead content.
- Remove all elemental lead items.
- Inventory waste containers.
- Remove and dispose of existing wastes and chemical materials within the facility.
- Remove mercury switches.
- Remove oils/liquids from deactivated equipment and clean up stained equipment leaks.
- Remove ozone depleting substances.
- Verify no mercury switches in panellit gauges or in instruments/chart recorders; check instruments/recorders for batteries.
- All items associated with the museum should be inventoried and an inventory/identification number should be placed on each item.
- A thorough review of the floor drain system is needed to assess the vulnerability of the facility. The Inactive Facilities Surveillance and Maintenance Project recently sealed off the process drain pipe system outside of the facility. The facility floor drains may have discharged to that process drain pipe system. Drains that are not plugged will collect

rainwater or could be used for liquid (water) disposal. The drains may potentially lead to the recently sealed-off process drain pipe system. If this is the case, eventually the sealed process piping will become full, thereby flooding the reactor building and museum.

4.5 CONCLUSIONS

The summary of the assessment indicates that numerous corrective safety measures are needed prior to allowing public access to additional areas of the B Reactor building for museum-related activities. In general, the corrective measures appear to be minor; however, potential hazards are apparent outside and adjacent to the reactor building, along the existing tour route, the proposed additional tour route, in spaces adjacent to the tour route, in spaces above the ground-floor level, and in spaces below the ground-floor level. Some potential hazards were observed in the existing tour route but none were of a serious nature to cause harm to anyone touring the facility.

5.0 REFERENCES

BHI, 1994a, *1994 Qualitative Risk Evaluation for the Retired Hanford Site Facilities*, BHI-00052, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1994b, *Pre-Existing Conditions Survey of Hanford Site Facilities to be Managed by Bechtel Hanford, Inc.*, BHI-00221, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995a, *105-B Reactor Facility Museum, Phase I Feasibility Study Report*, BHI-00076, Rev. 1, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995b, *1994 Risk Evaluation Work Procedure for the Retired Surplus Hanford Site Facilities*, BHI-00088, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1998, *Surplus Reactor Auditable Safety Analysis*, BHI-01172, Decisional Draft, Bechtel Hanford, Inc., Richland, Washington.

DOE-RL, 1996, *Programmatic Agreement Among the U.S. Department of Energy-Richland Operations Office, the Advisory Council on Historic Preservation, and the Washington State Historic Preservation Office for the Maintenance, Deactivation, Alteration, and Demolition of the Built Environment on the Hanford Site*, DOE/RL-96-77, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

National Historic Preservation Act of 1966 (NHPA), 16 U.S.C. 470, et seq.

WHC, 1993, *Risk Management Study for the Retired Hanford Site Facilities: Qualitative Risk Evaluation for the Retired Hanford Site Facilities*, WHC-EP-0619, Volume 3, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994, *Risk Management Study for the Retired Hanford Site Facilities: Risk Reduction Cost Comparison for the Retired Hanford Site Facilities*, WHC-EP-0619, Volume 4, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX A

105-B REACTOR ASSESSMENT FINDINGS – SPECIFIED BY AREAS OF CONCERN

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105-B REACTOR ASSESSMENT FINDINGS – SPECIFIED BY AREAS OF CONCERN

This appendix provides additional information that was summarized in Section 4.4. It separates the 105-B Reactor and its hazards into the following six zones:

- Outside area adjacent to the reactor
- Current tour route
- Proposed additional tour route
- Spaces adjacent to tour routes
- Spaces above ground floor level
- Spaces below ground floor level.

The walk-through assessment of B Reactor was performed on March 22 and 24, and April 27, 1999. Following the completion of the assessment, each participant prepared a report of their findings. This following contains a summary of these findings with respect to the six areas of potential concern. The radiological assessment results/discussion and restricted tour access recommendations are also included in this appendix. Photographs were taken during the walk-through to document findings and areas of concern; these photographs are indicated, where applicable, and appear at the end of this appendix.

Outside Area Adjacent to the Reactor

The items below represent the areas of concern for the outside area adjacent to the B Reactor Building. This area represents the immediate vicinity around the B Reactor that the public may come into contact with while touring the facility.

- Exterior stairway up south side of reactor: The wooden stairway (with concrete treads) up the south side of the reactor building has not been maintained and appears to be in poor condition. The wood has weathered, nails/bolts appear to be loose, and treads appear to have major cracks. *(Photograph 1)*

- Broken conduit with exposed electrical conductors. *(Photograph 2)*

- Covers (doors) missing from transformers.

- Peeling paint on both metal and wood surfaces may contain lead.

- Building penetrations need to be sealed to prevent animal intrusion.

- The wood roof over the tool/storage area on the north side shows signs of water damage.

- Wood covers over the stack plenum openings are weathered. *(Photograph 3)*

- Pigeons are nesting in the radiation area of the plenum.
- Transite.
- Asbestos.

Current Tour Route

The following items represent the summary findings of the inspection for the current (existing) tour route.

- Tool/storage area : The wood roof that extends outward on the north side of the reactor shows signs of water damage. The water-damaged wood will continueto deteriorate, creating an unsafe condition in the future.
- Front face area: Wireway covers are missing and wire ends are hanging out of wireway by entry to the area.
- Control room: Exposed wiring in the communications panel, main control council has an open wireway on the top left, one door is missing in the back with open wiring, and there is a fuse panel with the doors open.
- Instrument room near rod rooms: Old fluorescent fixtures.
- Men's restroom (Room 22): Temporary wiring to the fluorescent light above the sink.
- Exposure to asbestos near the front face area.
- Entrance hallway: asbestos on piping.
- Control Room: Asbestos tiles.
- Room No. 2 (IFSM&T No. 10): Asbestos floor tiles.
- Room No. 3 (IFSM&T No. 11): Asbestos floor tiles.
- Room No. 7: (IFSM&T): Asbestos pipe lagging.
- Entrance hallway: Potential mercury in floor drains.
- Process work area: Mercury in fluorescent tubes.
- Control room: Peeling paint on control panels. *(Photograph 4)*
- Entrance hallway: Potential lead-based paint.

- Process work area: Batteries in emergency lights (lead and caustics), lead in incandescent bulbs.
- Control room: Flaking paint on the control panels.
- Control room: Light ballasts, possible exposure to PCBs.
- Entrance hallway: Oil/PCBs in door closers.
- Room No. 2 (IFSM&T No. 10): Light ballast, possible exposure to PCBs.
- Room No. 3 (IFSM&T No. 11): light ballast, possible exposure to PCBs.
- Room No. 22: PCB light ballast in the men's restroom.
- Room No. 23: PCB light ballast and door closer.
- Instrument room near rod rooms: Instrument panels contain capacitors that may contain PCB oils.
- Front face: Black tar-like stains on walls from roof patching.
- Entrance hallway: Batteries in emergency lights.
- Process work area: Floor drains (heavy metals, asbestos, solvents, etc.), overhead crane (PCBs, heavy metals, and organics).
- Process work area: There is a potential for some display items to contain hazardous materials such as cadmium, lead, pressurized containers, and radioactive material.
- Process work area: Potentially pressurized gas cylinders on display. The inspection platform on the south wall should be inspected for potential hazardous materials stored on it.
- Process work area: Oil and grease in overhead crane.
- Room No. 7: Janitorial supplies on open shelves should be stored in locked cabinet/room.
- Process work area: Items on display could be picked up and carried off by visitors; items should be fastened down or a barrier setup to prevent visitors from reaching the items.
- The elevation of the floor on both sides of a required exit door shall not vary by more than 0.5 inch. At the present time, this requirement is not being met. *(Photograph 5)*

- Control room: The back side of the control panel should be barricaded to preclude visitors from coming in contact with wiring bundles.

- Wood-supported cover located above front-face canvas drop shield: All panels should be securely attached in place or removed completely to eliminate the potential hazard that currently exists.

- Front-face canvas drop shield: The support system for the rolled-up canvas shield should be inspected on a regular basis to ensure continued safe operations.

Proposed Additional Tour Route

The following items represent the summary group findings for the proposed additional tour route.

- Several panels in the hallway leading to the view windows overlooking the fuel storage basin have minor cracks and some spalling/discoloration. They do not appear to be stressed, but when loaded with snow/ice/rain, the panels could potentially fail. The integrity of each panel needs to be considered when assessing the overall structural adequacy of the roofing system. Because of the potential for single panel failure, access to roof areas should be restricted for all personnel.

- Electrical equipment Room No. 35: Ground bus on the floor is a tripping hazard.

- Supply fan room: Loose mechanical piping over the wireway.

- Supply fan room: Wireway cover is missing.

- Electrical/equipment room: Asbestos on piping and floor tiles.

- Room No. 5: Asbestos pipe lagging.

- Room No. 8: Pipe covering is not adequately protected.

- Basin viewing room: Asbestos pipe lagging.

- Lunch room: Possible asbestos insulation.

- Room No. 5 (electrical equipment): Mercury in fluorescent tubes.

- Lunch room: Peeling paint. *(Photograph 6)*

- Basin viewing room: Light ballast, possible PCBs.

- Lunch room: Old fluorescent fixtures, possible PCBs.
- Room No. 5 (electrical equipment): Semi-volatile organics.
- Room No. 5: Batteries for the emergency lights.
- Fan rooms: Emergency lights and batteries.
- No. 8 fan supply room: Calcium chloride or similar desiccant in moisture absorbers on air lines.
- Fan room: Oil on casings of fan motors. *(Photograph 7)*
- Fan room: Dehydrator has oil in it and is dripping on the floor.
- Room No. 5 (electrical equipment): Oil in the seismometer.
- No. 8 fan supply room: Oil in air line accumulators.
- No. 9 fan cell: Oil in moisture separator.
- Basin viewing room: Oil separators on air line.
- Fan Rooms: Oil in motors and fans, hydraulic pistons on dampers, and hydraulic fluid in Kwik Srak fork truck.
- Supply fan room: No lighting.
- Grated walkways could create a tripping hazard to individuals with heeled footwear. *(Photograph 8)*

Spaces Adjacent to Tour Route

The following items represent the summary group findings for the spaces adjacent to the tour route.

- Electric equipment room: Missing covers on the wireway and gutters. Locate energized lines and isolate, label, or put barriers in place. Exposed wiring on the "C" platform should have "DO NOT TOUCH" signs on barriers. *(Photograph 9)*
- Electrical equipment room No. 35: Incandescent light fixtures missing lamps and globes. Fluorescent lighting fixtures need repair.
- Electrical switch gear room (Room 25): Wiring hanging from the wireway and sliding access doors are not secured from opening and may contain energized circuits.

- Backside loadout bay area: 55-gallon non-transuranic rad. waste drum.
- Backside loadout bay area: Friable asbestos pipe insulation in need of encapsulation or removal.
- Backside loadout bay area: Large incandescent light bulbs with lead bottoms.
- Northeast stairwell: Pile of lead bricks under the stairwell.
- Electrical/equipment room: Peeling paint on the transformer on the north wall.
- Reactor rear face area: Seven 4-ft by 12-ft lead blankets hanging from process tube caps. Blankets are held in place by rusted chains and "S" hooks.
- Reactor decon shop: PCBs on floor and light fixture above from leaking PCB light ballast.
- Electrical/equipment room: PCB light ballasts.
- Room No. 4 (accumulator room): Asbestos on piping.
- Room No. 4 (accumulator room): Light ballast, possible PCBs.
- Room No. 4 (accumulator room): Flaking paint on the stairs.
- Room No. 4 (accumulator room): Oil in panellit test compressor and in hydraulic units located behind the accumulators (PCBs heavy metals, organics).
- Room No. 4 (accumulator room): Potential mercury/hazardous materials in floor drains.
- Room No. 4: Residual oil on air compressor casings.
- Room No. 5 (electrical equipment): Lead in incandescent bulbs.
- Room No. 5: Flaking paint on transformer.
- Room No. 5: Door closer.
- Room No. 5 (electrical equipment): Possible PCBs.
- Backside loadout bay area: Paint pails with hardened paint in them.
- Backside loadout bay area: Three 55-gallon drums numbered 100B-96-0014, 100B-97-001, and 100B-96-0013.
- Third floor (second level) (LBS system area): Shop area has spray paint containers.

- 14-ft level rear elevator area: Oil/water separator has unknown liquid in it.
- IFSM&T No. 4: Graphite, chlorofluorocarbons (CFCs) in old air conditioners, transite, and floor drains.
- Backside loadout area: Paint pails with hardened paint in them, several 55-gallon drums, contents unknown.
- Rear face, top of reactor: Bird carcasses and bird feces and air compressor unit covered with bird feces.
- Nozzle shop (12-ft level): Bat carcass and feces.
- Reactor decon shop: Bird carcasses and rat feces.
- Backside loadout area: Dead birds and bird feces.
- C-elevator platform: Control drive leaking oil.
- Basin tour area: Accumulator sight glass contains oil and water and the window is broken.
- Backside loadout area: Overhead crane gearbox is leaking oil.
- Tool/storage area: It is recommended that no tours be allowed in this area until proper repairs are made and that the current condition is monitored/inspected periodically (every six months, after heavy rains, or when there is snow build-up). *(Photograph 10)*
- Room No. 10 (IFSM&T No. 1): Light ballast.
- Room No. 24: PCB light ballast.
- Room No. 24: Flaking paint.
- Room No. 26: Asbestos pipe lagging.
- Room No. 26: Light ballast.
- Room No. 27 (IFSM&T No. 2): Light ballast.
- Room No. 28: Oil stains on the pump platform and mix-pump casing.
- Hallway to maintenance shop: Light ballast.
- Maintenance shop: Flaking paint on transformer.
- Ball 3X power supply: Openings that could allow access to rodents and insects.

Spaces Above Ground Floor Level

The following items represent the summary group findings for the spaces above ground floor level.

- Northeast stairwell (Room 3, Level 2): Ceiling tiles falling down.
- Mezzanine above reactor block: Canvas cover hanging down and ready to fall below. This is located directly above the tourist display area and is not detected from the display area.
- Back face, stairwells, reactor top: Inadequate lighting and old open wiring.
- Back face, stairwells, reactor top: Possible asbestos in the old wiring.
- Rear face, top of reactor: Mercury switch on "D compressor" control panel.
- Outer/inner rods rooms: Poor lighting, old fluorescent fixtures and tubes with cord and plug connections to receptacles in the ceiling, and old non-working incandescent fixtures.
- Northeast stairwell (Room 3, Level 2): Friable asbestos pipe insulation.
- Northeast stairwell (Level 3): Friable asbestos pipe insulation.
- Northeast stairwell (Level 4): Friable asbestos.
- Northeast stairwell (Level 2, Room 3): Light fixtures with PCB ballasts.
- Nozzle shop (Level 12): Light ballasts, possible PCBs.
- Mezzanine above reactor block: Safety rod pumps wrapped in plastic with oil drip pans under them need to have the oils drained, some pumps are leaking, 2-ton chain hoist is leaking oil, and the electric crane is leaking oil.
- Northeast stairwell (Level 3): Water cooler with ozone depleting substances (Freon).
- Mezzanine above reactor block: "Soluble oil" tank has strong organic odor. Possible heel left in tank.
- Top of reactor block: Oil stains on reactor block from oils dripping from above mezzanine.
- Rear face, top of reactor: Elevator motor leaking oil.
- Third floor (second level) (LBS system area): Chain hoist leaking oil.

- Northeast stairwell (Levels 3 and 4): Peeling paint (possible lead-based).
- Top of reactor block: Lead-based light bulbs and lead bricks.
- Third floor, second level (LBS system area): Lead bricks.
- Nozzle shop (Level 12): Lead bricks.
- Wood supported cover located above front-face canvas drop shield: There is a cover consisting of several wood-framed panels above the rolled-up canvas drop shield at the front face of the reactor block. One corner of the northern-most panel is unsupported and hanging downward.

Spaces Below Ground Floor Level

The following items represent the summary group findings for the spaces below ground floor level.

- Valve pit: Oil/grease in valves.
- Valve pit: Asbestos gaskets.
- Fuel storage basin: Accumulator site glass contains oil and water.
- Fuel storage area: Viewing area has open wiring in the ceiling coming out of a conduit, open wiring on the instrumentation, lighting is plug and cord connected (i.e., old, brittle and possibly asbestos), and portable cord run in the ceiling.
- Fuel storage/loadout areas: New lighting installed.
- Fuel storage basin: Drinking fountain with CFC refrigerant.
- Fuel storage basin: Viewing window glass is cracked.
- Fuel storage basin area: A large lead blanket is being used for shielding is located below the viewing window. Elemental lead is exposed to the atmosphere instead of encapsulated.

RADIOLOGICAL ASSESSMENT

The following information represents the findings for the radiological assessment made for the above listed categories.

There were several areas within the facility to which access to the assessment group was restricted. Consequently, no judgment as to the appropriateness of public tours within those areas can be made here. Given the potential for localized areas of moderate exposure rates that, almost certainly, were not captured during this broad survey, it is recommended that more detailed surveys be conducted, with one objective being the generation of a definitive survey map or table providing the maximum measured dose rates of each potential tour area, an assessment of the removable contamination for each tour area, the estimated stay times, and all assumptions made regarding the exposure conditions of the tour groups, as well as estimated maximum potential doses. No inferences should be drawn from the data presented here with respect to the radiological conditions in those areas not reviewed by the assessment group.

This assessment took only a very limited number of samples for removable contamination the area of the reactor block. Since many of the contaminants which may be present facility-wide, could be present in a removable form, and may evade detection by the type of portable instrumentation used in this preliminary survey, it is recommended that sampling for removable contamination be increased substantially in future studies with the duel objectives of characterizing the identity and relative abundance of the various contaminants, as well as providing a basis for assessing the potential for internal uptake of radionuclides.

Radiological Results/Discussion

Title 10 Code of Federal Regulations (CFR), Part 835, promulgates specific radiological dose limits for both radiological workers and selected members of the public. Specifically, 10 CFR 835.208 establishes *limits for members of the public entering controlled areas* as 100 mrem/year (1.0 millisievert/yr). If we take the highest dose rate encountered during this tour, we can calculate the maximum stay-time for the tour-accessible areas as:

Given the maximum dose rate = 400 Trem/hr = 0.4 mrem/hr (found at the fuel storage bay entrance with the door open).

Therefore, maximum stay time = (100 mrem/yr)/(0.4 mrem/hr) = 250 hrs.

A higher dose rate (higher than 400 Trem/hr) was detected on the second floor of the inner rod room. This highly localized dose rate (150 mrem/hr) would only be relevant to a member of the tour group who positioned himself/herself directly against the wall separating the inner rod room and reactor block area, at the point of penetration by the number two rod drive. An individual in such an unlikely position would have to remain there for 40 hrs in order to reach the annual limit for a member of the public entering a controlled area of 100 mrem.

This is clearly longer than any member of the public would occupy this area of the reactor, or would even be within the reactor building, during a complete tour.

One future activity that should be considered with respect to maintaining the tour group's dose as low as readily achievable is the control of radon. Radon is one of the daughter products in the uranium decay series (and, as a colorless, odorless gas) and is responsible for a substantial fraction of collective public dose in residences, as well as from the mining and processing of uranium ore. The dose from radon gas, which can easily collect within any relatively airtight building, can be reduced significantly for the tour groups by simply opening several doors of the facility and running exhaust fans for several hours, prior to the tour group's entry. The exact time required, and the optimal methods used to reduce the radon levels to acceptable concentrations for the tour groups, may need to be evaluated each day of use and will behave as a function of a number of variables, including: radon levels, degree of building "leakiness", temperature, outdoor wind speed, etc. The optimization of the radon control techniques(s) should be monitored and evaluated by radiological engineering.

General Concerns

Following the inspection, several general concerns were presented by the team of qualified personnel. These concerns are presented below:

- Reactor ventilation duct: Vent duct has a hole in it that was patched with duct tape, but the tape fell loose.
- Poor lighting outside of tour area.
- Building penetrations need to be sealed to prevent animal intrusion.
- Chemicals remain within and around the facility.
- Waste materials and containers remain within and around the facility.
- Room No. 7: Janitorial supplies on open shelves should be in locked cabinet/room.
- Process work area: Items on display could be picked up and carried off by visitors; items should be fastened down or a barrier set up to prevent visitors from reaching the items.
- Supply fan room: No lighting.
- Poor lighting throughout the facility, some of the lighting fixtures may contain PCBs.
- Numerous covers were missing from wireways, busways, conduit bodies, control panels, and instrument panels. The missing covers create the potential for biological hazards.
- Fuel storage basin: Viewing window glass is cracked.
- Stairs, handrails, and guardrails around the facility are old and in some cases, deteriorated.
- Travel distance to an emergency exit exceeds the allowable travel distance (150 ft) for public access) in all areas of the facility, excepting the current designated tour route.

- Grated walkways could create a tripping hazard to individuals with heeled footwear.

- The elevation of the floor on both sides of a required exit door shall not vary by more than 0.5 in. At the present time this requirement is not being meet.

Restricted Tour Access

- Control room: The back side of the control panel should be barricaded to preclude visitors from coming in contact with wiring bundles.

- The radiological assessment revealed that non-tour areas within the facility were to remain as restricted access areas for the public.

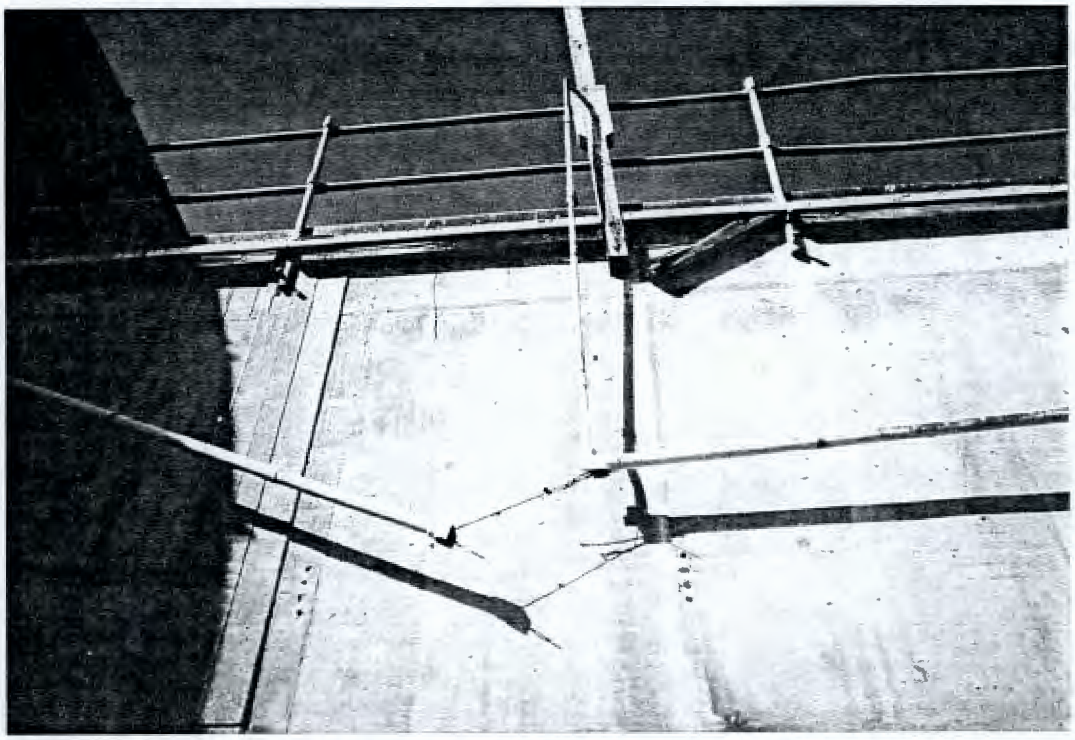
- Tool/storage area: It is recommended that no tours be allowed in this area until proper repairs are made and that the current condition is monitored/inspected periodically (every six months, after heavy rains, or when there is snow build-up).

- Exterior stairway up south side of reactor: It is recommended that the stairway be blocked and posted as dangerous at all access points. The stairway should not be used by anyone prior to a complete structural evaluation and completion of any necessary repairs.

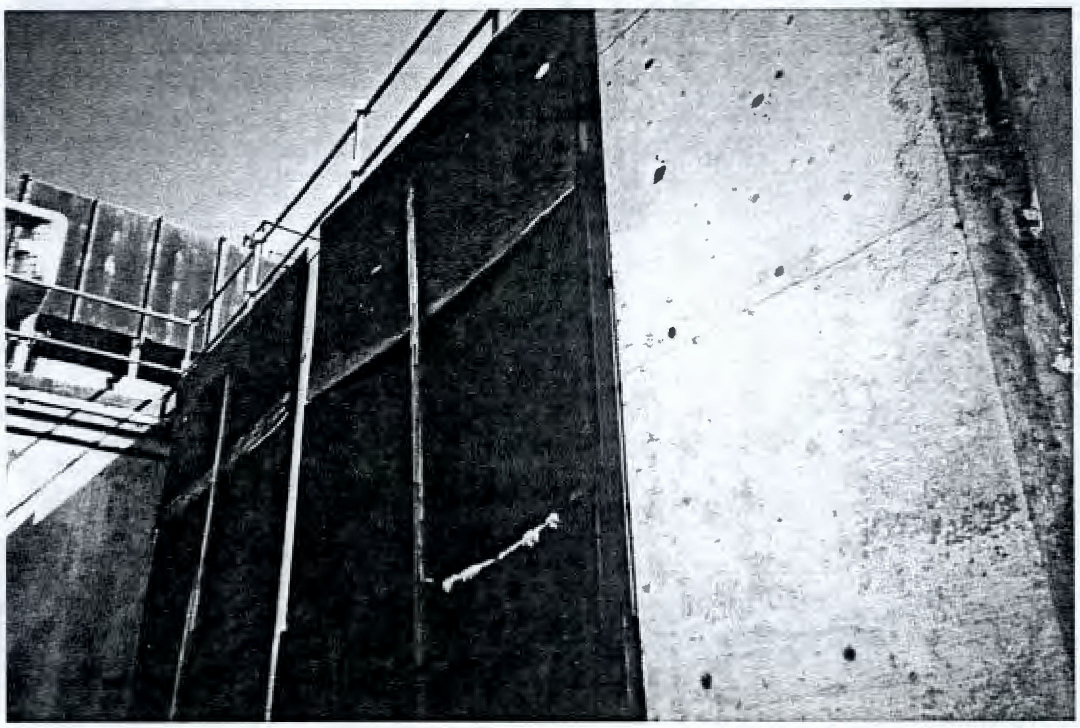
Photograph 1. Wood Stairway on South Side of the Reactor Building.

E9906122.1

Photograph 2. Broken Conduit with Exposed Electrical Conductors.

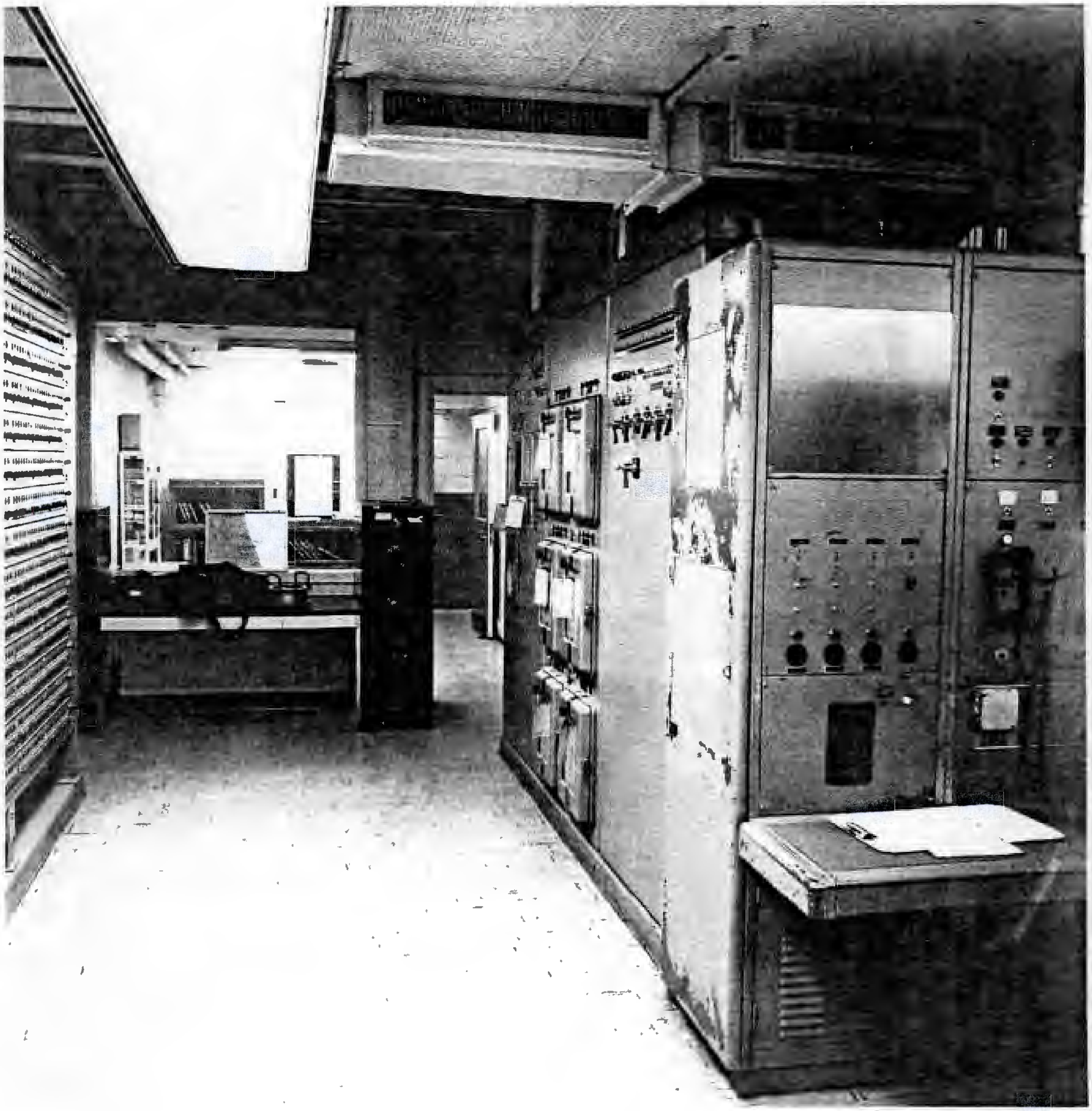


Photograph 3. Wood Covers Over the Stack Plenum Openings.



E9906122.2

Photograph 4. Peeling Paint in Control Room.



E9906122.3

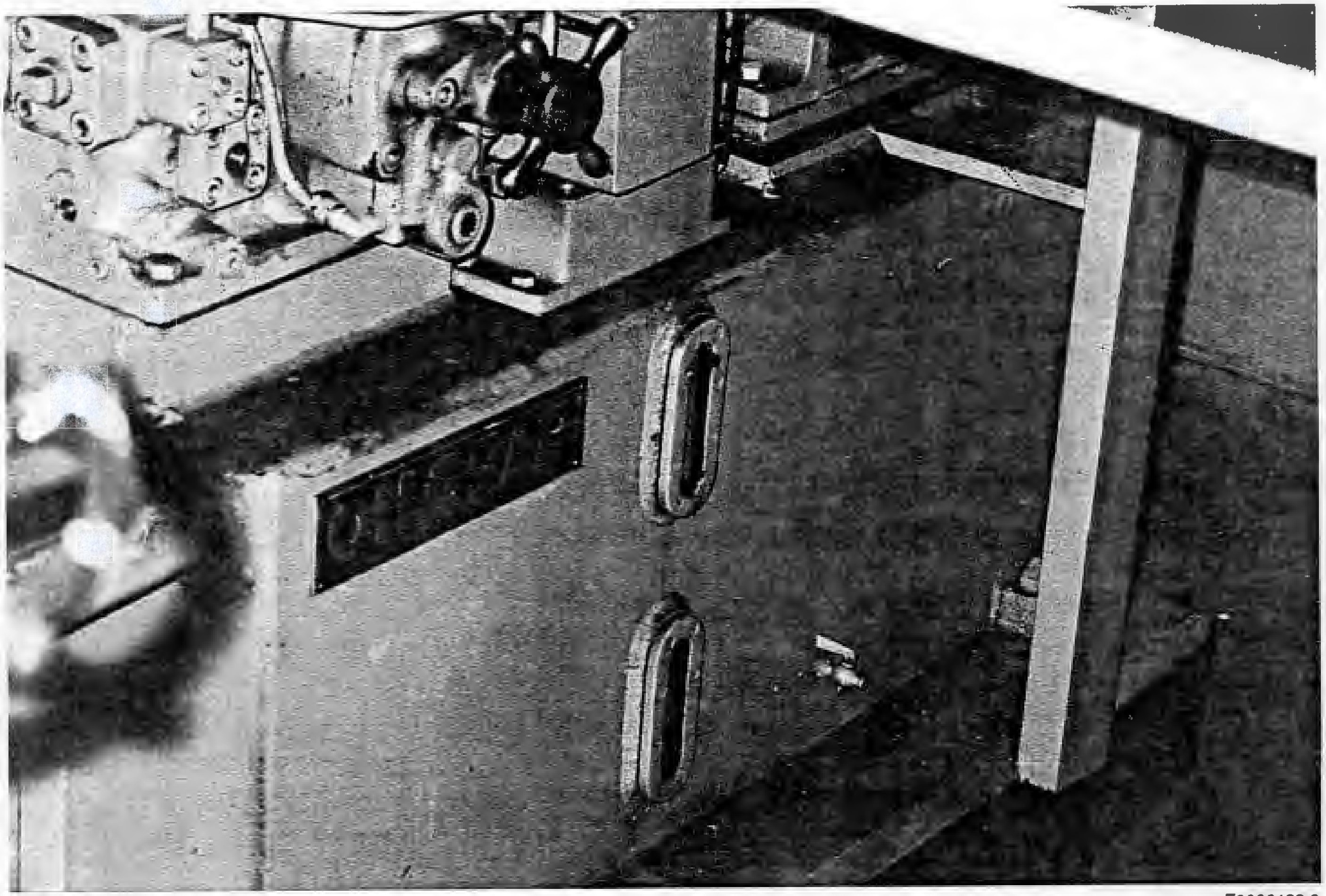
Photograph 5. Tripping Hazard Through Doorway.

E9906122.4

Photograph 6. Peeling Paint in the Lunch Room.

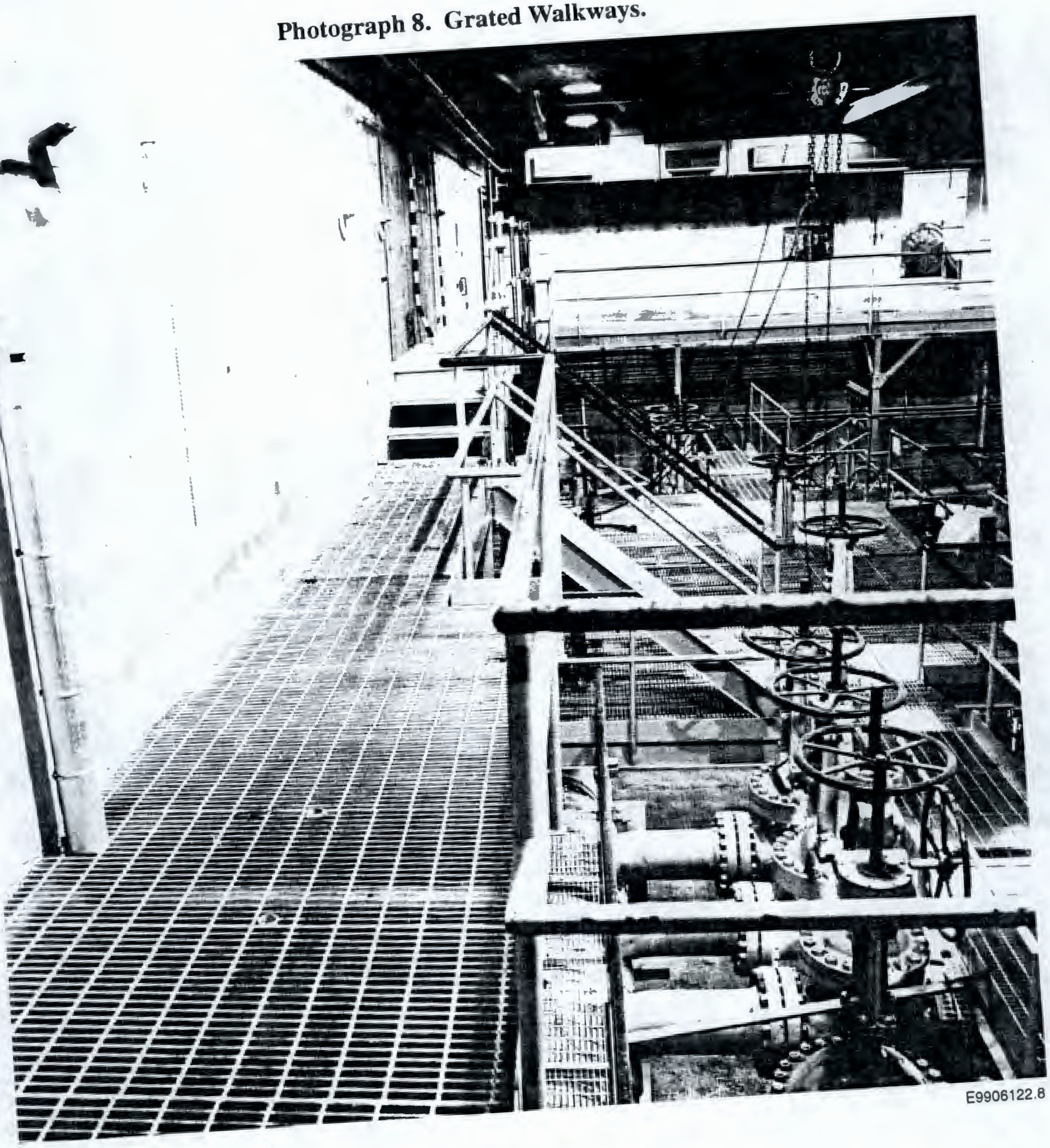
E9906122.5

Photograph 7. Leaking Oil on Equipment.

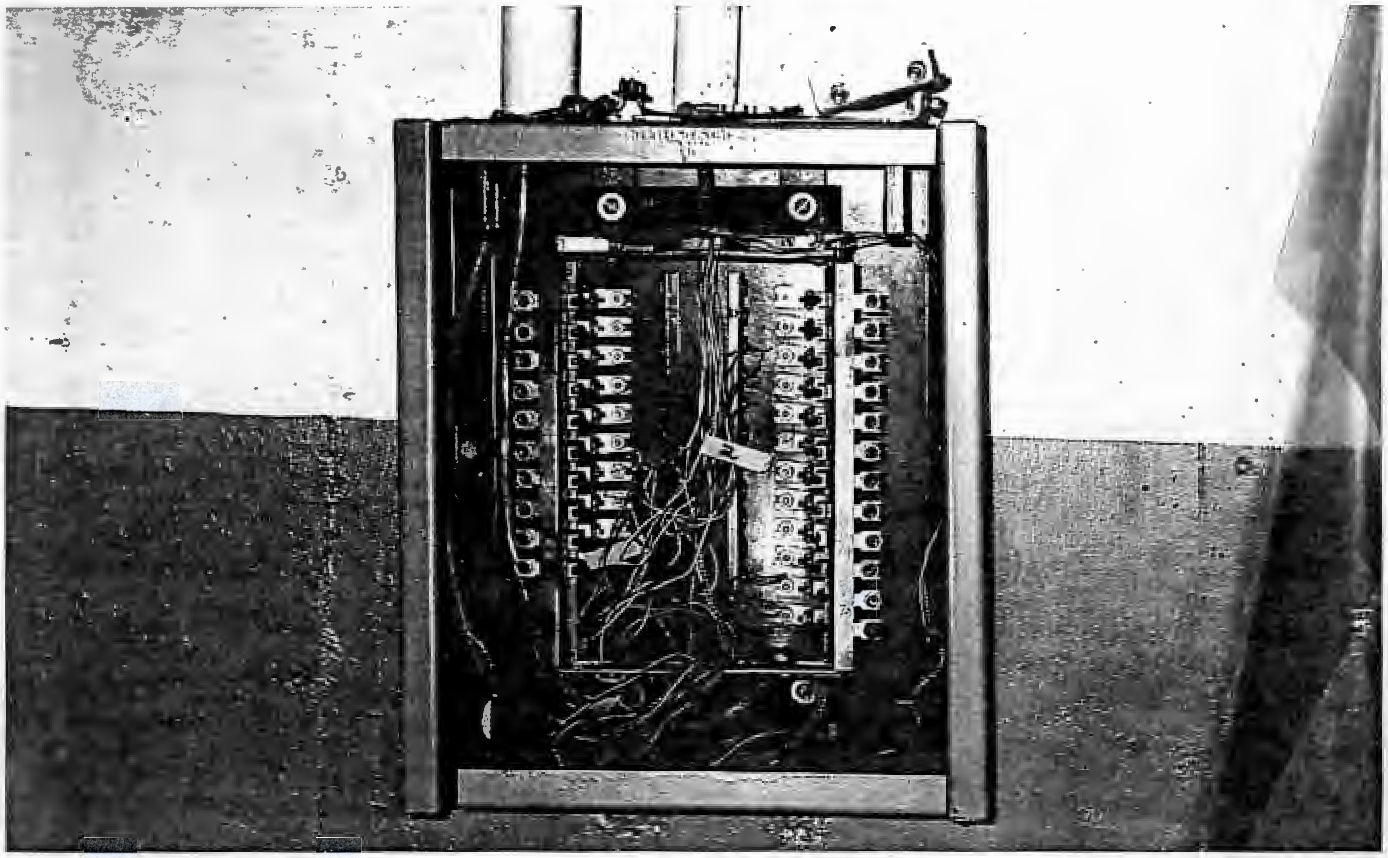


E9906122.6

Photograph 8. Grated Walkways.



Photograph 9. Missing Electrical Covers.



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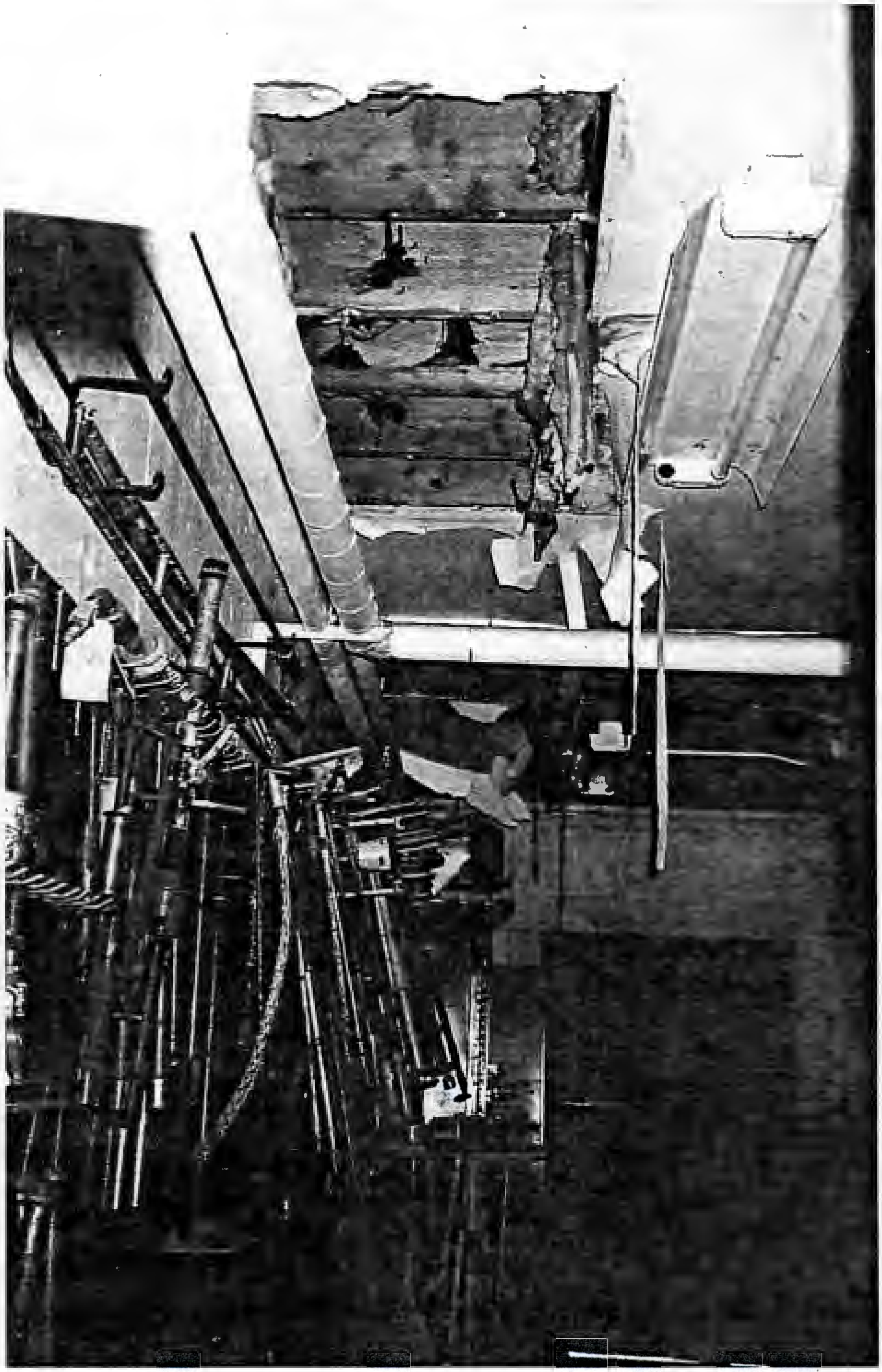
Photograph 10. Conditions in the Tool Storage Room.



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APPENDIX B

STRUCTURAL ASSESSMENT

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TO: Paul W. Griffin X9-08

DATE: May 4, 1999

COPIES: M. A. Mihalic X9-08
Document and Info Services H0-09

FROM: Richard S Day
D&D Projects
X9-08, 373-7564

SUBJECT: 105-B REACTOR HAZARD ASSESSMENT
Reference: IOM Dated April 14, 1999, same subject

STRUCTURAL ASSESSMENT

A walk down of the assessable portions of the facility was performed on March 22nd, 24th, and again on April 27th, 1999. The purpose of the walk downs were to assess from visible conditions encountered the potential structural hazards present in the 105-B Reactor Building that could pose a threat to persons touring the facility. This documents the structural hazards that were observed and provides recommendations. The information is provided to support a TPA milestone commitment for the second quarter of FY '99 (M-93-04). An initial report (reference) was submitted on April 14, 1999. This transmittal supercedes the April report and includes additional information obtained by the April 27th, 1999 walk down. The April walk down was performed in the Reactor Rod Rooms that were not accessible during the March assessment.

The conditions identified are generic in nature and could be found throughout the building at most levels and rooms covered directly by an exterior roof (both rad and non-rad areas). The current tour route and the proposed expanded routes have many of the same structural conditions. The primary structural related hazard is the condition of the roof supporting system, in particular the pre-cast concrete panels and any wood-formed roofs or overhead covers.

For the most part, considering the age and service conditions of the facility, the concrete roof panels appear from beneath to be in very good condition. With a few noted exceptions, the concrete panels show no signs of load-related cracking, spalling, water seepage, stains, or corroding reinforcement. However, the panel's underside can only provide an indication, not the total picture, and can sometimes be misleading. The structural integrity for this type of pre-cast concrete roof panel can only be assured by examining both the top and bottom surfaces of each and every panel (this assumes the panels were constructed in accordance with the design requirements).

The roofing system is predominantly composed of three basis elements: the roof coating system or built-up section (comprised of elements such as foam, tar paper, gravel, insulation, etc) that prevents water from entering the facility; the pre-cast concrete roof panels that directly support the roof loads; and the steel framing system that transfers the roof loads to the main structure.

Roof Built-up Section:

The built-up roof section does not provide any structural function; however, it is essential in protecting the pre-cast panels from weather related damage. If water is allowed to reach/collect on the surface of the concrete panels for prolonged periods, it can result in extensive damage to the panels. Water collecting on the surface of the concrete panels can greatly accelerate deterioration through the freeze-thaw cycle causing larger and deeper cracking of the concrete, exposing the reinforcing steel and initiating corrosion.

The built-up roof section was not part of this evaluation and would require inspection by qualified roofing materials experts to determine its current condition and assess the potential for prior damages.

Pre-cast Concrete Roof Panels:

As stated above the pre-cast concrete roof panels in most cases appear to be in very good condition when viewed from below. There are several panels in the hallway leading to the view windows overlooking the fuel storage basin that have minor cracks and some spalling/discoloration. Under current conditions they do not appear to be distressed, but when loaded with snow/ice/rain they could potentially fail.

The concrete panels work independently of each other and provide the initial load-resisting element. If any panel losses it structural capacity it can/will fail as there is no mechanism to transfer its load to adjacent panels. Therefore the integrity of each and every panel needs to be considered when assessing the overall structural adequacy of the roofing system. Due to the potential for single panel failure, access to the roof areas should be restricted for all personnel. Prior to allowing any personnel access to a roof area, a detailed plan should be developed/reviewed/approved by a competent structural engineer.

It is recommended that the pre-cast concrete roof panels be inspected each year following the end of the snow/freezing temperature season, and after any excessive build-up (15 psf) of snow/ice/rain on the roof (during which time no one should be allowed in the facility).

Steel Framing System:

The steel framing system supports the independent concrete panels and transfers the roof loads to the main structural system for the facility. The observed framing appeared to be in very good condition with no signs of corrosion or loose/missing bolts/nuts. The steel roof framing systems should not pose any hazard to tour groups under normal conditions. However, during periods when there is an excessive build-up (15 psf) of snow/ice/rain on the roof no one should be allowed inside the facility. After such an event the roof system should be inspected prior to reopening the facility.

Other Items of Note:

Wooden Roof over Tool/Storage Area

The wooden roof over the Tool/Storage Area that extends outward on the north side of the reactor shows signs of water damage. The water-damaged wood could continue to deteriorate creating an unsafe condition in the near future.

It is recommended that no tours are allowed in this area until proper repairs are made and that the current condition is monitored/inspected periodically (every six months, after heavy rains, or when there is snow build-up).

Exterior Stairway up South Side of Reactor

The wooden stairway (with concrete treads) up the south side of the reactor building has not been maintained and appears to be in poor condition. The wood has weathered, nails/bolts appear to be loose, and treads appear to have serious cracks.

It is recommended that the stairway be blocked and posted as dangerous at all access points. The stairway should not be used by anyone prior to a complete structural evaluation and completion of any necessary repairs.

Wood-Supported Cover Located above Front-Face Canvas Drop Shield

There is a cover consisting of several wood-framed panels above the rolled-up canvas drop shield at the front face of the reactor block. One corner of the northern-most panel is unsupported and hanging downward. It appears that it could become totally disengaged and fall all the way to grade level. The panels are above the area that is behind the current exhibits in front of the reactor face. However, if one of the panels fell it could strike something on its way down and be deflected into the exhibit area, or knock something else into the exhibit area.

It is recommended that all of the panels be securely attached in-place or removed completely to eliminate the potential hazard that currently exists.

Front-Face Canvas Drop Shield

The rolled-up canvas shield appears to be adequately supported and the cable system used to lower/unravel the canvas appears to be in good condition. However, because of the shield's height above the floor, its weight, and close proximity to the display area by the front face, it is recommended that the support system be examined on a regular basis (annually) to ensure its continued safe condition.

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APPENDIX C

INDUSTRIAL SAFETY ASSESSMENT

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Job No. 22192
Written Response Required: NO
Due Date: N/A
Actionee: N/A
Closes CCN: N/A
OU: N/A
TSD: N/A
ERA: N/A
Subject Code: 5600

Environmental Restoration Contractor **ERC Team**

Interoffice Memorandum

TO: Distribution

COPIES: None

DATE: April 5, 1999

FROM: D. G. Parthree
373-6964/X0-34

SUBJECT: **105-B REACTOR HAZARD ASSESSMENT**

Industrial Safety and Fire Protection

A walk-through of the facility was performed on March 22nd and 23rd, 1999 with the assessment team. The purpose of the walk-through was to assess and document hazards present in the 105-B Reactor that could pose a threat to persons touring the facility. High radiation areas were not entered during this portion of the assessment. This IOM is in support of a single, collective report that will document the observations by the assessment team.

Plans to expand the tour route will require completion of some of the hazards identified below:

Outside Areas Adjacent to the Facility:

- Broken conduit with exposed electrical conductors.
- Covers (doors) missing from transformers.
- Peeling paint on both metal and wood surfaces may contain lead.
- Building penetrations need to be sealed to prevent animal intrusion.

Current Tour Route:

- Access corridors - asbestos pipe insulation, at floor level, is not protected from inadvertent damage (cloth covered).
- Unsealed floor drains in the access corridors and front race area need to be sealed. Radioactive contamination is confirmed in the front face floor drains.
- Panel "G," adjacent to the front entrance is used to control the lighting for the current tour route. The switches are not protected by a panel door cover and can be inadvertently actuated by persons not assigned to the facility and facility lighting could be deactivated with people in the facility.

Control Room:

- The East Side area in back of the control panel should be barricaded to preclude visitors from coming in contact or handling the wiring bundles, some of which have asbestos-containing jacketing.
- Paint flaking off the control panels should be stabilized, as well as, being tested for lead content.
- PCB containing light ballast in the control room.

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Bechtel Hanford, Inc. – CH2M Hill Hanford, Inc. – Thermo Hanford, Inc.

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Distribution
Page 2

Room 8 (door 8):
- Asbestos containing pipe covering (at floor level) is not adequately protected from damage (cloth covered).

Room 22 Men's Restroom:
- Temporary wiring supplies the fluorescent light mounted above the sink. This restroom is in-service and open to the public during tours.

Room 25 - Electrical Switchgear Room:
- Electrical wireway not covered.
- De-terminated wiring hanging from the wireway and readily accessible from the floor.
- Residual oil in the cup bases of the seismic sensors are mounted 36 to 42 inches above the floor.
- Sliding access doors to the wood control panels are not secured from opening. May contain energized circuits.

Balance of Facility:

Fan Room:
- Oil on the casing of the fan motor.
- Oil leaking from the dehydrator.

Backside Loadout Area:
- Paint pails with hardened pain in them.
- Several 55 gallon drums on the mezzanine. Contents unknown.
- Several 55 gallon drums in a large box with no identification on the drums or box.
- The overhead crane gearbox is leaking oil.
- Biohazards- Dead birds and bird feces.

Fuel Storage Basin:
- Accumulator sight glass contains oil and water.
- The viewing window glass is cracked.
- A large lead blanket is lying just below the viewing window.

Northeast Stairwell:
- Lead bricks stored underneath the stairwell.

Northeast Stairwell - Level 2 (Room 3):
- Ceiling tile falling down.
- Light fixtures with PCB containing ballast.

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Northeast Stairwell - Levels 3 and 4:

- Peeling paint needs stabilized and tested for lead.
- Friable asbestos pipe insulation.

Top of Reactor Block and Rear Face:

- Air compressor covered with bird feces.
- Elevator motor leaking oil.
- "D" compressor control panel contains a mercury switch.
- Large amount of elemental lead brick.
- Biohazards- Bird carcasses and bird feces.

Mezzanine Above the Reactor:

- Safety rod pumps are leaking oil.
- Two ton hoist leaking oil.
- Electric crane gearbox leaking oil.
- Canvas draft curtain hanging down. This is located above the front face display area and the supporting frame and anchorage needs evaluation.

Nozzle Shop - 12 Level:

- Numerous lead brick.
- Lighting with PCB containing ballast.

Reactor Decon Shop:

- Light ballast leaking PCBs on the floor.

General Observations Applicable to the Facility as a Whole:

- Stairs, handrails, and guardrails around the facility stairs and sub-grade structures are old and in some cases, deteriorated. Wooden stair handrail are the most suspect and should not be relied upon to provide a safe structural access.
- Openings in electrical and instrumentation cabinets may contain energized circuits/stabs and must be avoided until covered or removed.
- Poor general lighting outside the tour area.
- Elemental lead in the form of bricks, shot, and blankets throughout the facility.
- Animal/bird feces found in most areas of the facility.
- Flaking paint is prevalent on both the inside and exterior of the facility and potentially contains lead.
- The travel distance to an "emergency" exit exceeds the allowable travel distance (150 feet for public access) in all areas of the facility, excepting the current designated tour route. If the valve pit area and lunchroom (Room 38) were added to the tour route, the lunchroom exterior door would have to be re-activated to meet the travel distance to an exit.
- The "industrial" type guardrails-upper and mid-rail-would require modification to preclude the passing of a four inch sphere between the rails for general public access. This modified guard is required to a minimum of 34 inches from the floor.

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- The opening (pattern) in the grated walkways could create a tripping hazard for visitors wearing "high heel" or other "heeled" casual footwear.
- The slight difference between the grated walkways and the concrete floor deck or platforms would require "highlighting" to define a potential trip (stumbling) hazard.
- Emergency lighting is required in designated exit stairs, corridors and passageways to an exit if the area is open to public access.
- At least two means of egress is required from any mezzanine, story, level or portion thereof. There is not two means of egress available from all upper or sub-grade elevations.
- The elevation of the floor on both sides of a required exit door shall not vary by more than 1/2 inch. This requirement is not met at the current designated exit from the facility.

This report is based on the requirements for facility tours by persons not assigned to the facility; i.e., the general public, and is not intended to be applied to Surveillance and Maintenance (S&M) activities.

DGP:clr

Distribution:
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APPENDIX D

ENVIRONMENTAL ASSESSMENT

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Environmental Restoration Contractor **ERC Team**

Interoffice Memorandum

Job No. 22192
Written Response Required: NO
Due Date: N/A
Actionee: N/A
Closes CCN: N/A
OU: N/A
TSD: N/A
ERA: N/A
Subject Code: 3030

TO: Distribution

COPIES: See Below
Document and Info Services H0-09

DATE: April 29, 1999

FROM: J. P. Zoric
BHI Regulatory Support
X5-53 373-4315

SUBJECT: **105-B REACTOR HAZARD ASSESSMENT**
Reference: IOM Dated March 29, 1999, Same Subject. (CCN 066838)

EVIRONMENTAL ASSESSMENT

A Walk down of the facility was performed on March 22nd 24th, and April 27th, 1999. The purpose of the walk down was to assess/characterize hazards present in the 105-B Reactor Building that could pose a threat to persons touring the facility. This IOM documents the hazards that were observed and recommendations to correct them. The information is provided to support a TPA milestone commitment for second quarter of FY99. (M-93-04) An initial report (reference) was submitted on March 29, 1999. This transmittal supercedes the March report and includes additional information obtained by an April 27th walk down. The April walk down was performed in the Reactor Rod Rooms that were not accessible during the March assessment.

The hazards identified are generic throughout the building at most levels and rooms (both rad and non-rad areas.) The current tour route was found to have the least amount of hazards during the assessment. Plans to expand the tour route will require completion of some of the corrective actions identified below.

Outside of the Facility

- Wooden (plywood) covers over stack plenum openings are weathered. Pigeons are nesting in the radiation area of the plenum.
- Broken conduit with exposed electrical lines exist.
- Peeling paint on outside metal and wood surfaces (possible lead based)
- Waste box numbered 100B-96-0003

Current Tour Route

- Front Face Area – Hazards Identified – Asbestos, PCB light ballasts, black tar like stains on walls from roof patching,
- Lunchroom – Peeling paint (possible lead based)
- Room 28 pump platform – Oil stains on platform and mix-pump casing
- Room 4 (door 4) – Air compressors have residual oil on casings.
- Control Room – PCB light ballasts, peeling paint on control panels (possible lead based)
- Basin Tour Area – Accumulator sight glass contains oil and water, viewing window is broken

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Distribution
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Fan Room
- Oil on casings of fan motors
- Dehydrator has oil in it and is dripping on the floor

Backside Loadout Bay Area
- 55 gallon "Non-Tru" rad waste drum
- Paint pails with hardened paint in them
- Large incandescent light bulbs with lead bottoms
- Three 55 gallon drums numbered 100B-96-0014, 100B-97-001 and 100B-96-0013
- Friable asbestos pipe insulation in need of encapsulation or removal
- Seven 55 gallon drums on a mezzanine with no markings
- Several 55 gallon drums in a large box with no markings
- A 5 gallon pail of paint
- 30 Ton overhead crane leaking oil onto the floor
- Biohazards identified – dead birds and bird feces
- One 4x4x8 Rad Waste Box numbered 100B-96-001
- One lead cask

Fuel Storage Basin Area
- A water fountain remains in the area with Ozone Depleting Substances (ODS) ((Freon))
- A large lead blanket being used for shielding is located just below the viewing window. Elemental Lead is exposed to the atmosphere instead of encapsulated.

N. E. Stairwell
- Pile of lead bricks located underneath the stairwell

N. E. Stairwell – Room 3, Level 2
- Friable asbestos pipe insulation
- Ceiling tiles falling down
- Light fixtures with PCB ballasts

N. E. Stairwell – Level 3
- Friable asbestos pipe insulation
- Water cooler with ODS

N. E. Stairwell – Level 4
- Friable asbestos
- Peeling paint (possible lead based)

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Distribution
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Rear Face, Top of Reactor
- Biohazards – bird carcasses and bird feces
- Air compressor unit covered with bird feces
- Mercury switch on "D Compressor" control panel
- Elevator motor leaking oil

Mezzanine above Reactor Block
- Safety rod pumps wrapped in plastic with oil drip pans under them need to have the oils drained. Some pumps are leaking
- 2-Ton chain hoist leaking oil
- Electric crane leaking oil
- "Soluble oil" tank has strong organic odor. Possible heel left in tank.
- Canvas cover hanging down and ready to fall below. This is located directly above the tourist display area and is not detected from the display area.

Top of Reactor Block
- Lead base light bulbs
- Large amount of lead bricks
- Oil stains on reactor block from oils dripping from above mezzanine

C-Elevator Platform
- Control drive leaking oil

3rd Floor, Second level (LBS System Area)
- Lead bricks
- Chain hoist leaking oil
- Shop area has lead bricks
- Shop area has spray paint containers

Nozzle Shop –12 ft Level
- Lead bricks
- Biohazards – bat carcass, feces
- PCB light ballasts

Reactor Ventilation Duct
- Vent duct has hole in it that was patched with duct tape but duct tape fell loose.

Reactor Decon Shop
- Biohazards – bird carcasses, rat feces
- PCBs on floor and light fixture above from leaking PCB light ballast

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Distribution
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Reactor Rear Face Area

- ~ Seven 4'x 12' lead blankets hanging from process tube caps. Blankets are held in place by rusted chains and "S" hooks

14' Level Rear Elevator Area

- Oil/Water separator has unknown liquid in it.

Reactor Rod Rooms

- Waste oil in open containers (coffee cans.)
- Tar like substance hanging from ceiling and mezzanine (roof sealer.)
- Residual oils present inside and on the surface of hydraulic pumps and plumbing.
- Oil stains on the concrete floor.
- Lead wool stored in cabinet.
- Oily rags observed in trash can.
- Lead bricks throughout.
- Lead based light bulbs on the zero foot levels.
- Box of borax.
- Fluorescent light tubes in upper levels.
- Suspect PCB ballasts in light fixtures.
- Peeling paint.
- Lead shot.
- Biohazards observed (rat and pigeon droppings.)
- Friable asbestos insulation.

General Observations

- Poor lighting outside of tour area
- Building penetrations need sealed to prevent animal intrusion
- Peeling paint inside and outside of facility may contain lead
- Elemental lead bricks, blankets, shot within the facility
- Friable asbestos inside and outside the facility
- Deactivated equipment within the facility still has oils/liquids remaining that are leaking within the facility
- ODS systems are still in place
- Chemicals remain within the facility
- Waste materials and containers remain within and around the facility. A review of the Hanford Site database for waste container tracking revealed that there are ten controlled waste containers assigned to the 105B Reactor. Those containers are; 100B-96-0003, 100B-96-0004, 100B-96-0005, 100B-96-0007, 100B-96-0011, 100B-96-0013, 100B-97-0001, 100B-96-0014, 100B-96-0012 and 100B-96-0008. However, during the assessment, not all of these containers were located. Some containers observed are not controlled by BHI Field Support Waste Management. (Unmarked or markings that are not characteristic to Field Support Waste Management container tracking system.)

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- PCBs remain within the facility
- Biohazards are present throughout the facility
- Mercury containing equipment remain within the facility
- Floor drains are not plugged.
- Possible presence of mercury in all rooms/drains (process knowledge.)

Recommendations

- A thorough inventory of waste containers and application of control numbers for all waste containers is needed. Clarification and updating of the waste tracking system in needed. Remove and dispose of existing wastes and excess chemical materials within the facility.
- Re-lamp non-tour areas for safe access.
- Seal building penetrations to mitigate animal intrusion
- Removed biohazards (animal carcasses, feces, etc.)
- Characterize peeling paint for lead content. If paint is proven to be lead based, remove or encapsulate to prevent exposure to personnel and the public.
- Remove all elemental lead items. Where lead is needed for shielding purposes, use encapsulated lead blankets or items.
- Mercury switches observed during the inspection needs to be removed and recycled.
- Encapsulate or removed friable asbestos.
- Remove oils/liquids from deactivated equipment (including door closures) and clean up stained equipment from leaks.
- Remove ODS materials for recycle (e.g., from deactivated water fountains and any other refrigerant containing equipment.
- A thorough review of the floor drain system is needed to assess the vulnerability of the facility. IFS&M project recently sealed off the process drainpipe system outside of the facility. The facility floor drains may have discharged to that process drainpipe system. Drains that are not plugged will collect rainwater or could be used for liquid (water) disposal. There is a potential that the drains may go to the recently sealed off process drain pipe system. Eventually, the sealed process piping will become full, thereby flooding the reactor building and museum.

JPZ:jpz

Cc: W. J. Adam H9-01
R. M. Bone X0-17
R. S. Day X9-08
D. W. Eckert X7-75
D. B. Encke T6-05
P. W. Griffin X9-08
C. J. Kemp S3-20

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R. J. Landon H0-02
J. W. Lawson X5-54
M. A. Mihalic X9-08
D. G. Parthree X0-34
B. D. Schilperoort T2-05
R. G. Shuck T7-05
R. T. Swenson H0-13
R. H. Wyer H0-09
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APPENDIX E

ELECTRICAL ASSESSMENT

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105-B HAZARD ASSESSMENTS

The walk down that I made with the assessment team consisted primarily of looking for electrical safety problems. The items are broken out by the areas as best they can be identified and as generalizations.

Specific Areas:

1) Electric equipment room: Missing covers on the wireway and gutters. There need to be locking means on the cabinets that contain power. Locate where there is still energized lines and isolate, label, or put barriers in place. Exposed wiring on the "C" platform should have signs, "DO NOT TOUCH," or barriers.

2) Electrical equipment room No. 35: Incandescent light fixtures missing lamps and globes (i.e., open sockets and or exposed lamps). Wireways and busways are missing covers. Ground bus on the floor is a tripping hazard. Old fluorescent lighting fixtures (PCBs) and lamps need repair.

3) Ball 3X power supply has openings. This is unsafe for any number of reasons (i.e., biohazard snakes, spiders, mice, feces, sharp edges, asbestos insulation on wiring, etc.).

4) Lunch room: Lighting old fluorescent fixtures (PCBs) and cord and plug connections; most likely rotten insulation and possibly asbestos insulation.

5) Supply fan room: There is loose mechanical piping over the wireway. Wireway is missing covers. No lighting.

6) Front face area: Wireway covers are missing. Wire ends are hanging out of wireway by entry to the area. This area is well lit with halogen light fixtures.

7) Control room: The communications panel has a gap in the back with visible exposed wiring. There is power in this panel. The main control council has open wireway on the top left. One door is missing in back with open wiring within reach. There is a fuse panel with the doors open. Lighting is old fluorescent but is in working condition.

8) Fuel storage area: In the viewing area there is open wiring in the ceiling coming out of a conduit. There is open wiring on the instrumentation. Lighting is plug and cord connected (i.e., old, brittle and possibly asbestos). There is portable cord run in the ceiling.

9) Fuel storage/load out areas: Since this area will probably never be in a tour route it should be cleaned up and new lighting installed so area can be viewed via remote video cameras.

10) Back face, stair wells, reactor top: Similar to 9) above. No lighting, or poor lighting. There is a lot of old open wiring. This old wiring probably contains asbestos on the individual conductors with an outer jacket that is brittle.

11) Outer/inner rods rooms: Very poor lighting conditions. Stairway leading to these rooms are old fluorescent fixtures and tubes that are cord and plug connect to receptacles in the ceiling. Inside the room are old non-working incandescent fixtures.

12) Instrument room near rod rooms: These rooms also contained old fluorescent fixtures as in 11) above. There were several old instrument panels that still contained capacitors, which may contain PCB oils. The vacuum tubes in these panels probably do not contain mercury.

General Comments on Electrical Safety

1) There were numerous places where the covers were missing from wireways, busways, conduit bodies, control panels, and instrument panels. These places are ideal for insect, snake, and rodent entry points and they are exposed sharp edges. Some of these on the wireways and busways could be covered with clear plastic material to give a visible look into what was inside. In the control room, the communication panel needs to be moved to close an opening in the rear or a metal cover should be installed to keep small hands out of the panel. The other control panels could have clear covers installed for viewing purposes. The possibility exists that there could be energized wiring inside some of these panels. Some of the wireways and conduits have the wiring hanging out or cut off just outside the raceway. This wire usually has sharp edges and could cause puncture wounds. The wires need to be put back into the raceway or cut off and capped or covered.

2) The lighting was generally poor throughout the facility. The fluorescent fixtures more than likely had old ballasts that contained PCBs. The wiring to the fixture was cord and plug, which is likely asbestos internally in the fixture and the cord. The old tubes are an environmental hazard because they contain mercury and phosphors.

3) Many of the old incandescent fixtures were missing globes and bulbs. Some of the bulbs were broken and some were just missing. Due to their physical size and lighting inefficiency, it would be interesting to leave these fixtures in place and add lighting around them with modern fixtures and lamps.

APPENDIX F

RADIOLOGICAL/NUCLEAR ASSESSMENT

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TO: P. W. Griffin X9-08

DATE: May 7, 1999

COPIES: W. C. Borden H9-01
Document and Info Services H0-09

FROM: W. J. Adam
CH2MHill Hanford, Inc., IPA - Safety and Health
H9-01/2-9311

SUBJECT: 105-B REACTOR HAZARDS ASSESSMENT - PRELIMINARY RADIOLOGICAL RESULTS.

The attached tables and diagrams are being provided to document the results of a risk assessment walk down and radiological surveys of the 105-B Reactor facility conducted on March 22nd, 24th, April 22nd and May 4th. The objective of this walk down was to characterize some of the radiological hazards and potential exposure levels to persons touring the facility.

The walk down consisted of an assessment of selected radiologically controlled and nonradiologically controlled areas using count rate, dose rate and removable contamination assays to assess potential radiological hazards in those areas that will be, or may be, considered for public tour areas. These results should not be considered as representative of the entire facility.

There were several areas within the facility to which access to the tour group was restricted. Consequently, no judgement as to the appropriateness of public tours within those areas can be made here. Given the potential for localized areas of moderate exposure rates that, almost certainly, were not captured during this broad survey, it is recommended that more detailed surveys be conducted, with one objective being the generation of a definitive survey map or table providing the maximum measured dose rates of each potential tour area, the estimated stay times, and all assumptions made regarding the exposure conditions of the tour groups, as well as estimated potential doses.

This assessment took only a very limited number of samples for removable contamination in the area of the reactor block. Since many of the contaminants which may be present facility-wide, could be present in a removable form, and may evade detection by the type of portable instrumentation used in this preliminary survey, it is recommended that sampling for removable contamination be increased substantially in future studies with the duel objectives of characterizing the identity and relative abundance of the various contaminants, as well as providing a basis for assessing the potential for internal uptake of radionuclides.

Results/Discussion

Title 10 Code of Federal Regulations (10 CFR), Part 835, promulgates specific radiological dose limits for both radiological workers and selected members of the public. Specifically, 10 CFR 835 § 835.208 establishes *Limits for members of the public entering controlled areas* as: 100

mrem/year (1.0 millisievert/yr). If we take the highest dose rate encountered during this tour, we can calculate the maximum stay-time for the tour-accessible areas as:

Given: max dose rate = 400 μrem/hour = 0.4 mrem/hr (found at the fuel storage bay entrance with the door open)

Therefore, maximum stay time = (100 mrem/yr)/(0.4 mrem/hr) = 250 hours.

A higher dose rate was detected on the second floor of the inner rod room. This highly localized dose rate (150 mrem/hr) would only be relevant to a member of the tour group who positioned himself/herself directly against the wall separating the inner rod room and reactor block area, at the point of penetration by the number two rod drive. An individual in such an unlikely position would have to remain there for 40 hours in order to reach the annual limit for a member of the public entering a controlled area of 100 mrem.

This is clearly longer than any member of the public would occupy this area of the reactor, or even be within the reactor building, during a complete tour.

One word regarding the attached data is needed here: there are two facility maps attached: one map provides the approximate locations where removable contamination samples and count rate measurements were made, the second map provides the approximate locations of the dose rate measurements. The two maps are required to clearly document the results of the two-tiered approach to collecting the data: the count rate surveys were conducted first, primarily to locate those areas where, based upon the count rate results, more detailed dose rate measurements would be warranted.

One future activity that should be considered with respect to maintaining the tour group's dose As Low As Readily Achievable is the control of radon. Radon is one of the daughter products in the uranium decay series and, as a colorless, odorless gas, is responsible for a substantial fraction of collective public dose in residences, as well as from the mining and processing of uranium ore. The dose from radon gas, which can easily collect within any relatively airtight building, can be reduced significantly for the tour groups by simply opening several doors of the facility and running exhaust fans for several hours. The exact time required, and the optimal methods used to reduce the radon levels to acceptable concentrations for the tour groups may need to be evaluated each day of use and will behave as a function of a number of variables, including: initial radon levels, degree of building "leakiness", temperature, outdoor wind speed, and others. The optimization of the radon control technique(s) should be monitored and evaluated by radiological engineering.

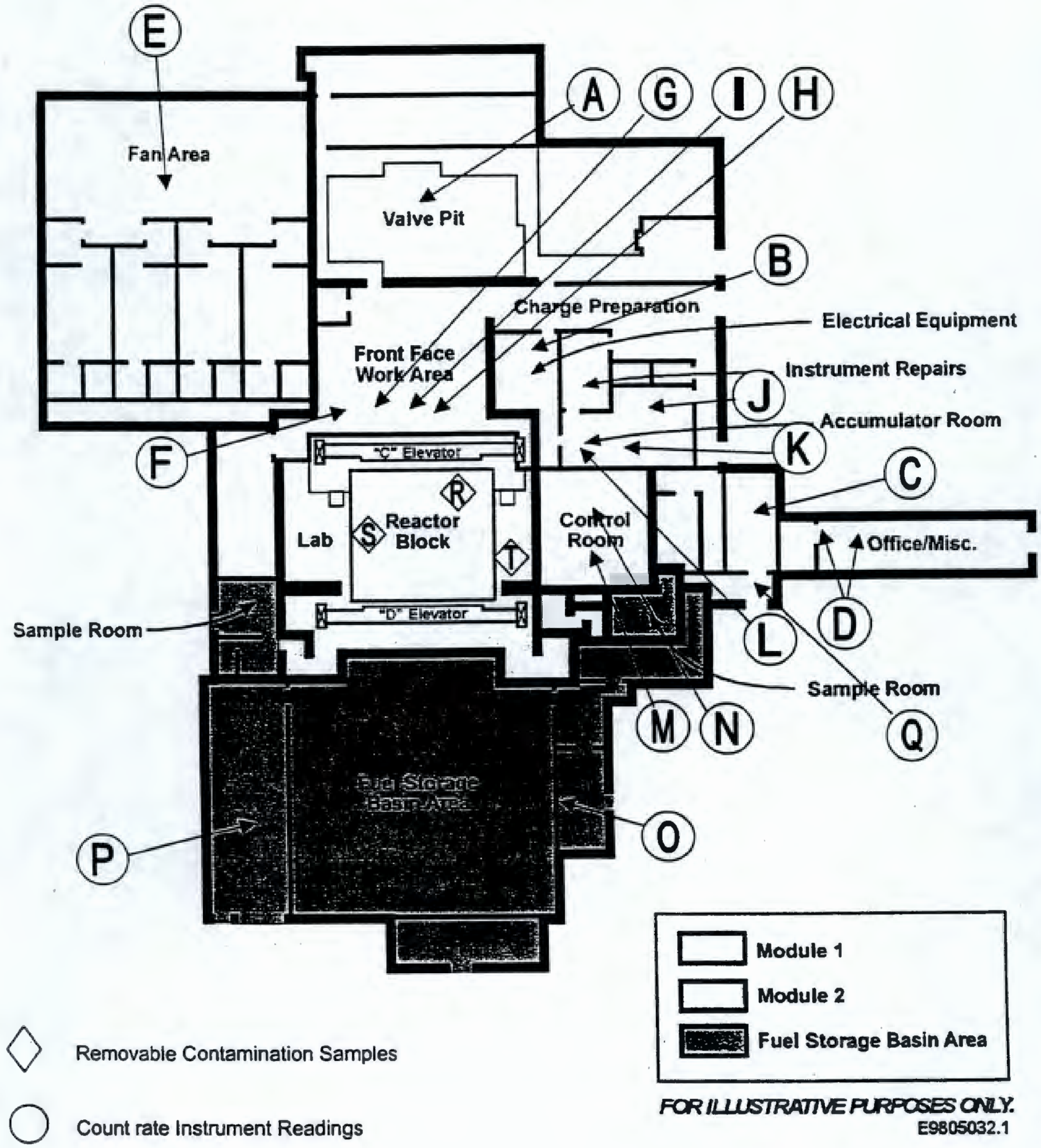
WJA:wja

105-B Survey Results and Map Locators from 105-B Reactor facility tour.

Count Rate and Removable Contamination Results Locator

105-B Reactor Building

Plan View at Ground Level



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FACILITY: 105-B Reactor	**DATE:** March 22, 1999	**H.P.TECHNOLOGIST:** K. D. Larson 3-1662
SURVEY INSTRUMENTS: Eberline E-600, S/N 1381 **CALIBRATION DUE:** 10-01-99	**PROBE:** N/A **CALIBRATION DUE:** N/A	**BACKGROUND (BKG):** 142 cpm
AREA SURVEYED	**MAP LOCATOR** [1]	**MEASUREMENT (includes background) (CPM)** [2]
105-B REACTOR BUILDING - COUNT RATE MEASUREMENTS - USE COUNT RATE RESULTS LOCATOR		
Valve pit - ambient level	Ⓐ	164
Switchgear Room 35	Ⓑ	BKG
Portable HEPA equipment	Ⓒ	BKG
Decon showers/locker room	Ⓓ	BKG
Fan room - ambient	Ⓔ	200
Pump "contaminated area" and fork lift	NL	250
Front face - ambient	Ⓕ	500 - 550
Front face - floor	Ⓖ	750 - 900
Front face - display (max reading)	Ⓗ	450
Display table - boron balls	Ⓘ	BKG
Buffer area - accumulator tanks	Ⓙ	350 - 450
105-B REACTOR BUILDING - COUNT RATE MEASUREMENTS - USE COUNT RATE RESULTS LOCATOR		
Unlabeled door between Accumulator room and outer	NL	400 - 500

[1] NL = not located on map
[2] CPM = counts per minute

FACILITY: 105-B Reactor	**DATE:** March 22, 1999	**H.P.TECHNOLOGIST:** K. D. Larson 3-1662
SURVEY INSTRUMENTS: Eberline E-600, S/N 1381 **CALIBRATION DUE:** 10-01-99	**PROBE:** N/A **CALIBRATION DUE:** N/A	**BACKGROUND (BKG):** 142 cpm
AREA SURVEYED	**MAP LOCATOR** [1]	**MEASUREMENT (includes background) (CPM)** [2]
rod room, at base of door, posted as contamination area/radiation area		
Accumulator room - water softener equipment	L	< 250
Control room - ambient	M	200
Control room - center	N	204
Transfer bay viewing windows	O	2600
Transfer bay entry	P	4000
Room 27 - ambient	Q	180 - 250
Room 4 - spacers on floor	NL	BKG
Room 4 - graphite forms	NL	BKG
Room 4 - air conditioner, wall unit	NL	BKG
Tool crib valve bonnets	NL	1300

FACILITY: 105-B Reactor	**DATE:** March 22, 1999	**H.P.TECHNOLOGIST:** K. D. Larson 3-1662
SURVEY INSTRUMENTS: Ludlum 2929, S/N 95571 **CALIBRATION DUE:** 10-01-99	**PROBE:** N/A **CALIBRATION DUE:** N/A	**BACKGROUND (BKG):** 41 cpm β/γ 0.2 cpm α
AREA SURVEYED	**MAP LOCATOR**	**MEASUREMENT** **(CPM/100 cm^2)**
105-B REACTOR BUILDING - REMOVABLE CONTAMINATION - USE COUNT RATE RESULTS LOCATOR		
Tool crib bonnets (Smear 1)	NL	1300 β/γ < 20 α
Level 3 - decontamination shop - chemical decon baskets (smear 2)	NL	BKG β/γ BKG α
Top of reactor block - No. 33 3X ball hopper - outer surface (smear 3)	Ⓡ	BKG β/γ BKG α
Top of reactor block - shelves within green portable tool cabinet (smear 4)	Ⓢ	BKG β/γ BKG α
3X ball storage canisters (?) - surface inside of connecting pipe fittings (smear 5)	Ⓣ	BKG β/γ BKG α

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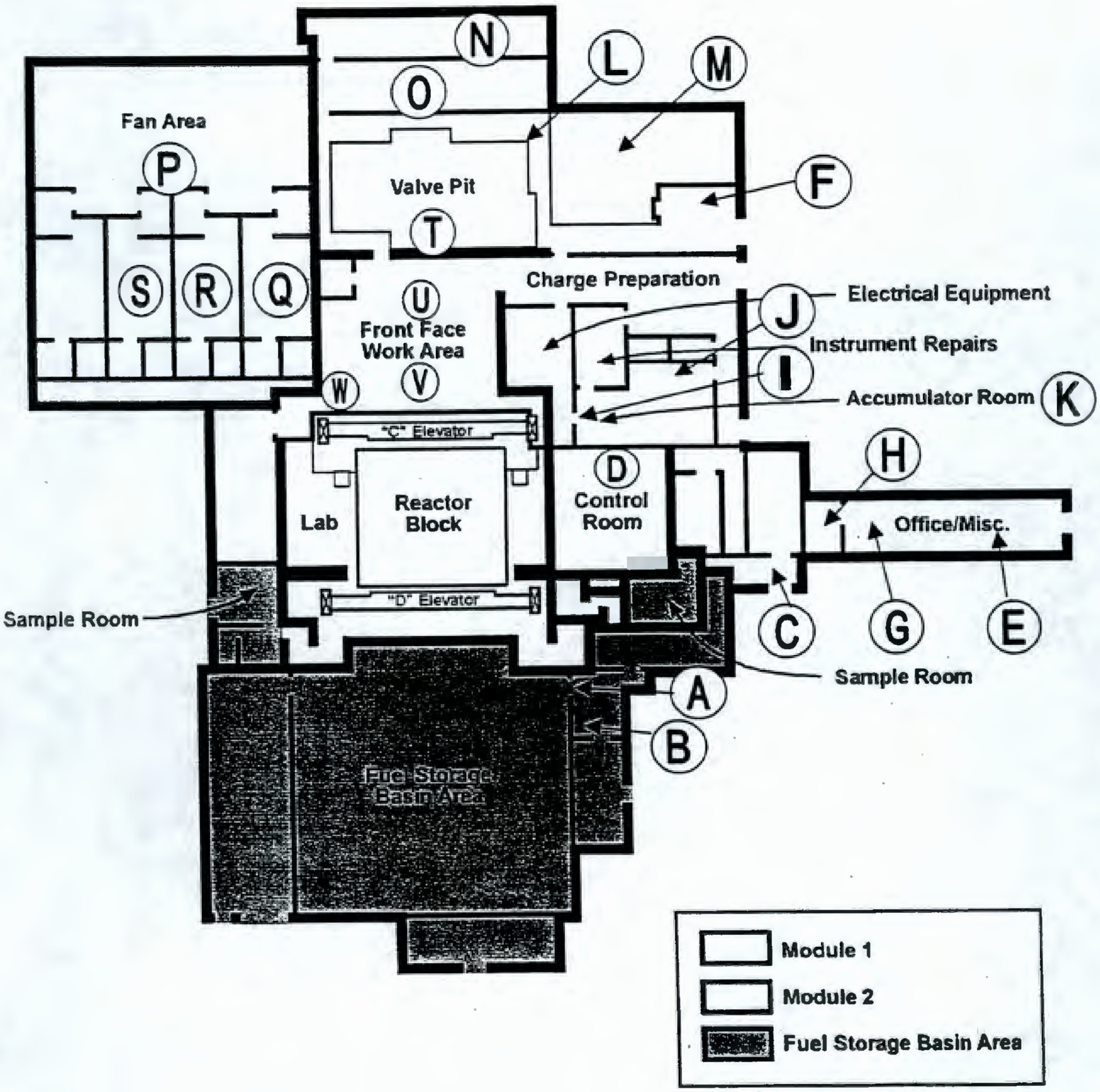
Dose Rate Results Locator

105-B Reactor Building

Plan View at Ground Level



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FACILITY: 105-B Reactor	**DATE:** March 22, 1999	**H.P.TECHNOLOGIST:** K. D. Larson 3-1662
SURVEY INSTRUMENTS: Bicron MicroRem **CALIBRATION DUE:** 10-09-99	**PROBE:** N/A **CALIBRATION DUE:** N/A	**BACKGROUND (BKG):** 2-3 μ rem/hr
AREA SURVEYED	**MAP LOCATOR**	**MEASUREMENT** (μ rem/hr)
105-B REACTOR BUILDING - DOSE RATE MEASUREMENTS - USE DOSE RATE RESULTS LOCATOR		
Fuel storage bay entrance boundary - door open	Ⓐ	400
Room 38 fuel storage bay observation window - contact	Ⓑ	200
Step-off pad		7
Room No. 7 - ambient	Ⓒ	7
Control room - ambient	Ⓓ	4 to 5
Offices - ambient	Ⓔ	4 to 5
Maintenance shop - ambient	Ⓕ	5
Room 27	Ⓖ	8
Room 10	Ⓗ	6 - 7
Outer rod room door (from accumulator room) - at base	Ⓘ	5
Ion exchange equipment above on catwalk above accumulators	Ⓙ	< 4
105-B REACTOR BUILDING - DOSE RATE MEASUREMENTS - USE DOSE RATE RESULTS LOCATOR		
First level accumulator room	Ⓚ	< 5

FACILITY: 105-B Reactor	**DATE:** March 22, 1999	**H.P.TECHNOLOGIST:** K. D. Larson 3-1662
SURVEY INSTRUMENTS: Bicron MicroRem **CALIBRATION DUE:** 10-09-99	**PROBE:** N/A **CALIBRATION DUE:** N/A	**BACKGROUND (BKG):** 2-3 μ rem/hr
AREA SURVEYED	**MAP LOCATOR**	**MEASUREMENT** (μ rem/hr)
Electrical breaker room (Room 5)	L	5 to 6
Electrical equip. room (Room 31)	M	6 - 7
Portable HEPA equipment	NL	5
-11-ft-level feed tank	NL	5
Lunch room	N	5 - 7
Flow laboratory basement	O	5 to 7
Plenum room	P	5 to 7
Fan room, fan No. 1	Q	10
Fan room, fan No. 2	R	8 - 10
Fan room, fan No. 3	S	8
Valve pit ambient	T	5
Front face (behind plexiglass shield) 5-ft to 10-ft above floor	U	20 - 25
Front face (between Rx front face and plexishield	V	55
Right front face	W	4

FACILITY: 105-B Reactor	**DATES:** April 22, and May 4, 1999	**H.P.TECHNOLOGIST:** R. Doug Elliot 3-7969
SURVEY INSTRUMENTS: Eberline RO-20 **CALIBRATION DUE:** 05-19-99	**PROBE:** N/A **CALIBRATION DUE:** N/A	**BACKGROUND (BKG):** <0.5 mrem/hr
AREA SURVEYED	**MAP LOCATOR**	**MEASUREMENT** (mrem/hr)
Valve pit/accumulator area	N/A	< 0.5
Valve pit/accumulator area - floor drain	N/A	< 0.5
Valve pit/accumulator area - brick floor	N/A	< 0.5
INNER/OUTER ROD ROOMS For purposes of this survey, the rod drives will be numbered 1, 2, or 3 corresponding to the drive order, counting from left to right, as you face the reactor block. The following results were formally documented on ERC Radiological Survey Record No. IFSM-99-0766.		
Inner rod room, first floor, rod drive 1, at wall interface nearest to reactor block	N/A	30
Inner rod room, first floor, rod drive 2, at wall interface nearest to reactor block	N/A	20
Inner rod room, first floor, rod drive 3, at wall interface nearest to reactor block	N/A	1.5
Inner rod room, first floor, rod drive 1, at wall interface nearest to reactor block	N/A	removable contamination $\simeq$ 6400 cpm β/γ
Inner rod room, second floor, rod drive 1, at wall interface nearest to reactor block	N/A	45
Inner rod room, second floor, rod drive 2, at wall interface	N/A	150

FACILITY: 105-B Reactor	**DATES:** April 22, and May 4, 1999	**H.P.TECHNOLOGIST:** R. Doug Elliot 3-7969
SURVEY INSTRUMENTS: Eberline RO-20 **CALIBRATION DUE:** 05-19-99	**PROBE:** N/A **CALIBRATION DUE:** N/A	**BACKGROUND (BKG):** <0.5 mrem/hr
AREA SURVEYED	**MAP LOCATOR**	**MEASUREMENT** (mrem/hr)
nearest to reactor block		
Inner rod room, second floor, rod drive 3, at wall interface nearest to reactor block	N/A	1.5
Inner rod room, second floor, two to six feet from wall nearest to reactor block	N/A	5 - 12
Inner rod room, second floor, greater than six feet from wall nearest to reactor block	N/A	< 0.5
Inner rod room, second floor, at wall interface nearest to reactor block	N/A	removable contamination $\simeq$ 1000 cpm β/γ
Outer rod room - all areas	N/A	<0.5, no removable contamination

APPENDIX G

CHARACTERIZATION ASSESSMENT

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CHEMICAL HAZARDS ASSESSMENT FOR THE 105-B REACTOR MUSEUM

A walk-down of the 105-B Reactor was performed on March 22 and 23, 1999, to identify potential hazards to the general public and the environment if all areas of the facility were made accessible to the general public.

The following section will address the potential "generic" chemical hazards distributed throughout the facility.

- Asbestos: Lagging on pipes, floor tiles, wire insulation, gaskets and transite.
- PCBs: Light ballasts, certain oils and greases, insulation in high voltage wires.
- Lead: Lead bricks, blankets and shot, lead based paint, solder, light bulb bases, lead/acid batteries, lead pipes, and lead joints in cast iron piping.
- Oils and greases: Motors, fans, compressors, hydraulic actuators, large valves, elevators, safety rod motors, electric winches and cranes, oilers and oiler separators in air lines, and door closure units.
- Mercury: Manometers, thermometers, instruments, switches, drains, and traps.
- Batteries: Emergency lighting, equipment, and instruments.
- Lights: Fluorescent bulbs, mercury and sodium vapor bulbs, incandescent bulbs (lead bases).
- Paint: Lead-based paint, heavy metals (Cd, Cr) in pigments.
- Bio-hazards: Dead animals, droppings, spiders, wasps and bees, and snakes.

Specific areas where potential chemical hazards were identified are:

- Electrical/equipment room (area the assessment team used as a lunch room): Asbestos on piping, asbestos floor tiles, PCB light ballasts, paint (including peeling paint on the transformer on the north wall of the room).
- Entrance hallway: Asbestos on piping, transite panels, batteries in emergency lights, oil/PCBs in door closers, potential lead-based paint, potential mercury in floor drains.
- Room No. 7: Janitorial supplies on open shelves should be stored in locked cabinet/room.

- Room No. 22 (men's restroom): PCB light ballast.
- Room No. 23 (instrument repairs): PCB light ballast, door closer (PCBs).
- Room No. 24: Light ballast (PCBs), flaking paint(lead).
- Room No. 5 (electrical equipment): Oil in seismometer (PCBs, semi-volatile organics), light bulbs (mercury in fluorescent tubes, lead in incandescent bulbs).
- Process work area: Batteries in emergency lights (lead and caustics), floor drains (heavy metals, asbestos, solvents, etc.), light bulbs (mercury in fluorescent tubes, lead in incandescent bulbs), oil/grease in overhead crane (PCBs, heavy metals, organics), potentially pressurized gas cylinders on display, the inspection platform on the south wall should be inspected for potential hazardous materials stored on it. Items on display could be picked up and carried off by visitors; items should be fastened down or a barrier setup to prevent visitors from reaching the items. There is a potential for some display items to contain hazardous materials such as cadmium, lead, pressurized containers, and radioactive material. Suggest all items associated with the museum be inventoried and an inventory/identification number placed on each item.
- Room No. 4 (accumulator room): Oil in panellit test compressor and in hydraulic units located behind the accumulators (PCBs, heavy metals, organics), asbestos on piping, light ballast (PCBs), flaking paint in the stairs (lead), and potential mercury/hazardous materials in floor drains.
- Control room: Light ballast, flaking paint, asbestos tiles; verify no mercury switches in panellit gauges or in instruments/chart recorders; check instruments/recorders for batteries (doors to instruments were locked).
- Room No. 3 (IFSM&T No. 11): Asbestos, light ballast, floor tiles (asbestos).
- Room No. 2 (IFSM&T No. 10): Light ballast, floor tiles.
- Room No. 5: Door closer, asbestos pipe lagging, emergency lights (batteries), flaking paint on transformer.
- IFSM&T No. 7: Asbestos pipe lagging.
- Room No. 10 (IFSM&T No. 1): Light ballast.
- Hallway to maintenance shop: Light ballast.
- Room No. 27 (IFSM&T No. 2): Light ballast.
- Maintenance shop: Flaking paint on transformer.
- Basin viewing room: Light ballast, asbestos pipe lagging, oil separators on air line.

- Fuel storage basin: Lead sheet, accumulator site glass contains oil and water, drinking fountain with CFC refrigerant. Team had to stay on designated path over middle of basin due to radiation areas. There may be hazardous materials in areas the team could not see.
- Room No. 26: Asbestos pipe lagging, light ballast.
- IFSM&T No. 4: Graphite, CFCs in old air conditioners, transite, floor drains.
- Outside 105-B: Flaking paint, asbestos, and transite.
- Fan rooms: Oil in motors and fans, hydraulic pistons on dampers, emergency lights, batteries and hydraulic fluid in Kwik Stak fork truck.
- No. 8 fan supply room: Oil in air line accumulators, calcium chloride or similar desiccant in moisture absorbers on air lines.
- No. 9 fan cell: oil in moisture separator.
- Valve pit: Oil/grease in valves, asbestos gaskets.
- See Joe Zoric's and Dave Parthree's assessments for backside of the building; hazardous chemicals also identified were asbestos gaskets, grease in grease guns and lead.
- Did not identify potential hazardous materials that were removable with a forklift or smaller (i.e., 55-gal drums, 5-gal buckets, etc.). These items are to be removed as part of the legacy waste project.

Some of the identified hazards may not be accessible to the public at this time. However, they could pose a hazard if gaskets or joints failed (oil and grease in equipment, mercury in instruments), from routine maintenance (fluorescent tubes, light ballast) or through aging of the item (asbestos tiles, asbestos lagging, lead-based paint). These hazards have been identified so the museum committee is aware of the potential problems they could cause if not identified and handled properly.

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APPENDIX H

SUMMARY OF 105-B REACTOR BUILDING HAZARD IDENTIFICATION

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This appendix documents the preliminary hazards analysis (BHI-01172) conducted in support of the 105-B Reactor. The hazards analysis consists of two parts: a hazard identification (Section 3.0) and a hazard evaluation (Section 4.0).

The scope of this analysis includes the 105-B Reactor Building and ancillary facilities described below.

FACILITY SUMMARY DESCRIPTIONS

Reactor buildings. For hazards analysis purposes, the buildings have been divided into four areas: Module 1, Module 2, the reactor blocks, and the fuel storage basins (FSBs).

Module 1. Module 1 provided support areas during the former reactor operations. These areas included office areas, change rooms, ventilation equipment areas, and other infrastructure support. The retired support areas are free of reactor process areas, except for the outer rod room.

Module 2. Module 2 is the area inside the shield walls, excluding the reactor block. Module 2 includes such areas as the front face work area, inner rod room, discharge area, sample room, C and D elevators, elevator machinery room, electrical equipment rooms, ball room, process radiation monitoring, gas instrument room, tunnels, laboratory, and tool dolly.

Reactor block. The reactor building consists of a graphite moderator stack encased in an overlapping cast-iron thermal shielding, a 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, horizontal control rods (HCRs), and other equipment)
- The aluminum and Zircaloy-2 process tubes that held the uranium metal fuel elements and provided channels for cooling water
- Horizontal control rods (HCRs), 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 surveillance and maintenance (S&M) activities.

Fuel storage basins. The 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 105-B FSB has been drained and cleared of debris, and a fixative has been applied to radiologically contaminated surfaces. The removed sludge was placed in the transfer pit, where it remains covered by a layer of sand and a wood deck.

ANCILLARY FACILITIES

116-B Reactor exhaust stack. The stack was used to discharge ventilation air 200 ft above grade from the 105-B Reactor Building. The stack has been isolated from sources of potential contamination within the reactor building.

119-B Building. The unlabeled 119-B Building was used as a storage building and should not be confused with the 119-B exhaust sampling enclosure. A 119-B exhaust sampling enclosure did exist, but is not within the scope of this auditable safety analysis (ASA). The unlabeled 119-B Building was used as a storage building. The building is now empty.

1608-B gas line pressure/vacuum seal house. (Effluent waste water pumping station designation number was used because 105-B Reactor facility did not have a lift station building.) The building contained the apparatus to provide a gas line pressure vacuum for the 105-B Reactor gas system. The facility is no longer used.

PRELIMINARY HAZARDS IDENTIFICATION

The hazardous materials associated with the inactive reactors and their ancillary facilities, and the energy sources capable of interacting with the materials, were identified by (1) researching potentially relevant documentation, (2) interviewing personnel familiar with the historic operations and current status of the buildings and structures, (3) performing walk-downs of several facilities, (4) conducting a hazards workshop involving personnel from different disciplines, and (5) using engineering judgment. This information was used to obtain historic operations information, S&M information, inventory data, and information regarding the current status of structures and equipment. Bechtel Hanford, Inc. (BHI) and U.S. Department of Energy, Richland Operations Office (RL) personnel assisted in the hazard identification process by providing information on features and hazards requiring inclusion, defining the level of detail appropriate for the facilities and the long-term S&M mission and reviewing interim hazard identification documentation.

The preliminary hazard identification is documented in Table H-1. The table has six columns, which are described below:

Column 1. Hazard Type

This column identifies the type of hazard investigated. Hazard types investigated include: radioactive material, direct radiation, fissile material, hazardous material (i.e., toxic, carcinogenic), biohazards, asphyxiant, flammable/combustible material, reactive material, explosive material, electrical energy, thermal energy, kinetic energy, and high pressure.

Column 2. Location

This column identifies the location investigated for the presence of the hazard type. Because the 105 Reactor Building is relatively large, it is subdivided into specific areas (e.g., Module 1, Module 2, FSB, and reactor block) for hazards identification purposes. Refer to the facility descriptions, for detailed information.

Column 3. Form

This column specifies the form of the hazard type. Note that this column is not intended to provide a detailed identification of the chemical (e.g., oxide) or physical (e.g., crystalline) form of the hazard type. Such detail is not considered at the hazard identification stage of a safety analysis.

Column 4. Quantity

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

Column 5. Remarks

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

Column 6. References

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

REFERENCES

All reference information in this appendix section can be found discussed in the following document:

BHI, 1998, *Surplus Reactor Auditable Safety Analysis*, BHI-01172, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Table H-1. Summary of 105-B Reactor Building Hazard Identification. (6 pages)

Hazard Type	Location	Form	Quantity	Remarks	References
Radioactive Material	105-B Reactor Building: Module 1 (general ancillary area of the reactor building, excluding the FSB).	Mixed fission products (primarily Sr-90); minor amount of fixed surface contamination.	<0.046 Ci total activity	The radionuclide inventory for Module 1 is assumed to be equivalent to the inventory determined for the 105-C Reactor Building Module 1. The majority of the inventory in Module 1 of the 105-C Reactor Building is found in the lift station sump. The 105-B Reactor Building does not have a lift station sump, as dirty drain water was discharged into the effluent system. Therefore, the inventory assumed is known to be conservative.	BHI-00831 (BHI 1996a), Appendix A, provides the development of the 105-C Reactor Building's inventory. The relationship between the 105-C Reactor Building inventory and the 105-B Reactor Building inventory is further developed in BHI-01172, Section 4.1.2.1 (BHI-1998).
	105-B Reactor Building: Module 2 (area within reactor shield excluding reactor block).	Mixed fission products, primarily present as surface contamination.	<5.1E-04 Ci total activity (excluding the reactor block)	The radionuclide inventory for Module 2 is assumed to be equivalent to the inventory determined for the 105-C Reactor Building Module 2 (excluding the reactor block).	BHI-00831, Appendix A (BHI 1996a), provides the development of the 105-C Reactor Building's inventory. The relationship between the 105-C Reactor Building inventory and the 105-B Reactor Building inventory is further developed in BHI-01172, Section 4.1.2.1 (BHI-1998).
	105-B Reactor Building: Module 2 Reactor block (e.g., reactor moderator stack, process tubes, HCRs, gun barrels, thermal and biological shields).	Primarily activated material in the graphite stack, thermal shield, and corrosion film on process tubes.	2.34E+04 Ci total activity 1.3 Ci alpha activity	Contamination entrained in reactor block and shielding.	UNI-3714 (p. 45) (UNC 1987).
	105-B Reactor Building: FSB/transfer pit.	Activation and corrosion products.	1.1E+02 Ci total activity 2.1 Ci alpha activity	Asphalt emulsion fixative in FSB, sludge has been moved into the transfer pit and covered with a layer of sand and a plywood cap.	UNI-3714 (p. 41) (UNC 1987).

Table H-1. Summary of 105-B Reactor Building Hazard Identification. (6 pages)

Hazard Type	Location	Form	Quantity	Remarks	References
Direct Radiation	105-B Reactor Building: Module 1 (general ancillary area of reactor building excluding the FSB).	Mixed fission products, primarily present as fixed contamination.	<0.046 Ci total activity	The radionuclide inventory for Module 1 is assumed to be equivalent to the inventory determined for the 105-C Reactor Building Module 1. The majority of the inventory in Module 1 of the 105-C Reactor Building is found in the lift station sump. The 105-B Reactor Building does not have a lift station sump, as dirty drain water was discharged into the effluent system. Therefore, the inventory assumed is known to be conservative.	BHI-00831, Appendix A, (BHI 1996a) provides the development of the 105-C Reactor Building's inventory. The relationship between the 105-C Reactor Building inventory and the 105-B Reactor Building inventory is further developed in BHI-01172, Section 4.1.2.1 (BHI-1998).
	105-B Reactor Building: Module 2 (area within reactor shield walls excluding reactor block).	Mixed fission products, primarily present as surface contamination. Location is subject to direct radiation emitted from the reactor block.	<5.1e–04 Ci total activity within Module 2 (excluding the reactor block)	The radionuclide inventory for Module 2 is assumed to be equivalent to the inventory determined for the 105-C Reactor Building Module 2 (excluding the reactor block). Moderate to high exposure rates in the immediate vicinity of the inner control rod rooms, reactor rear face, mezzanine, and top of reactor vertical safety control rod actuators, due to nearby radioactively contaminated reactor block.	BHI-00831, Appendix A, (BHI 1996a) provides the development of the 105-C Reactor Building's inventory. The relationship between the 105-C Reactor Building inventory and the 105-B Reactor Building inventory is further developed in BHI-01172, Section 4.1.2.1 (BHI-1998).
	105-B Reactor Building: Module 2 reactor block.	Activated material in moderator stack, thermal and biological shields and corrosion film on process tubes.	2.34E+04 Ci total activity 1.3 Ci alpha activity	Energetic gamma emitters possible in immediate vicinity (e.g., Ball 3X system) of activated structures (e.g., graphite stack, thermal shield); however, breach of the reactor block is excluded from current surveillance and maintenance activities.	UNI-3714 (p. 45) (UNC 1987)
	105-B Reactor Building: FSB/transfer pit.	Activation and corrosion products.	1.1E+02 Ci total activity 2.1 Ci alpha activity	Asphalt emulsion fixative in FSB, sludge has been moved into the transfer pit and covered with a layer of sand and a plywood cap.	UNI-3714 (p. 41) (UNC 1987)

Table H-1. Summary of 105-B Reactor Building Hazard Identification. (6 pages)

Hazard Type	Location	Form	Quantity	Remarks	References
	105-B Reactor Building: Tour route (control room, hallway, and front face).	Mixed fission products.		Periodically 105-B Reactor Building is toured by members of the public. CCN 052780 (letter by T. N. Turpin, 1997) states that adolescents (between the ages of 16 and 18 years) are not allowed in areas where dose rates are greater than 50 μrem/yr.	CCN 052780 (p. 2) (Turpin 1997) 10 CFR 835
Fissionable Material	105-B Reactor Building: Module 2 reactor block.	Pu-239 present in the graphite stack.	1.0 Ci (in 1985)		UNI-3714 (p. 45) (UNC 1987)
	105-B Reactor Building: FSB/transfer pit.	Activation and corrosion products.	0.075 Ci Pu-238 1.6 Ci Pu-239 0.5 Ci of Am-241 (in 1985)		UNI-3714 (p. 41) (UNC 1987)
Hazardous Material (e.g., toxic, carcinogenic)	105-B Reactor Building: All areas.	Asbestos in the form of piping insulation, transite wall board, ventilation components, and insulation (friable if degraded or damaged).	Unknown quantities	Abatement program in place to remove asbestos from facility. Majority of asbestos is in non-friable form, and is located in radiation zones and in transfer area where surveillance and maintenance activities occur infrequently.	BHI-00066 (p.2-3) (BHI 1997) BHI-00221 (p.3-6) (BHI 1994b) WHC-EP-0619 (p. 3-3) (WHC 1993) WHC-SP-0331, Rev. 1, (p. A-17) (WHC 1994)
	105-B Reactor Building: All areas.	Lead shielding in the form of lead shot, brick, and cast forms; also lead-based paint.	98.5 tons	Abatement program in place to remove lead from facility. Majority of lead is in non-dispersible form, and is located in radiation zones and in transfer area where surveillance and maintenance activities occur infrequently. Greater oxidation rates of lead occur than anticipated based on arid climatic conditions, resulting in dispersible lead oxide.	BHI-00066 (p.2-3) (BHI 1997) BHI-00221 (p. 3-6) (BHI 1994b) WHC-EP-0619 (p. 3-3) (WHC 1993) WHC-SP-0331, Rev. 1 (p. A-17) (WHC 1994)
	105-B Reactor Building: All areas.	Mercury contained in switches and instruments.	Unknown quantities.	Not readily dispersible; not significantly impacted by surveillance and maintenance activities.	BHI-00221 (p. 3-6) (BHI 1994b)
	105-B Reactor Building: All areas.	PCBs contained in electrical and lighting equipment.	Unknown quantity.	PCBs are contained and do not present a hazardous material concern.	Historical knowledge

Table H-1. Summary of 105-B Reactor Building Hazard Identification. (6 pages)

Hazard Type	Location	Form	Quantity	Remarks	References
	105-B Reactor Building: All areas.	Miscellaneous.	Negligible.	Miscellaneous chemicals remaining have been removed during 5-year cleanup campaign. Potential exists to discover old containers of chemicals	Staff interview.
	105-B Reactor Building	Tank with heel.	300-gal tank, unknown quantity of heel.	Heel emitting strong odor.	BHI-00221 (p. 3-6) (BHI 1994b)
Biohazard	105-B Reactor Building	Rodents, insects, snakes; birds, and animal feces.	Greater activity than normally occupied facilities.	Because there is very little human activity in and around the 105-B Reactor Building, increased rodent, insect, and snake activity can be expected. Animal feces are considered a health hazard and may be radioactively contaminated.	BHI-00066 (p. 2-3) (BHI 1997) BHI-00221 (p. 3-6) (BHI 1994b) WHC-EP-0619 (p. 3-4) (WHC 1993) WHC-SP-0331, Rev. 1 (p. A-17) (WHC 1994)
Asphyxiant/ Confined Spaces	105-B Reactor Building: All areas.	Unventilated below grade structures as well as above-grade areas.	Not quantified.	Unventilated below grade structures not appropriately posted as CONFINED SPACES. Areas that were checked for oxygen were found safe. Numerous confined spaces under concrete cover blocks, in accessible water basins, and in drains, manways, and valve pits around the building.	BHI-00066 (p. 2-2) (BHI 1997) WHC-EP-0619 (p. 3-5 and C1-9) (WHC 1993) WHC-SP-0331, Rev. 1 (p. A-16) (WHC 1994)
Flammable/ Combustible Material	105-B Reactor Building: Module 2 reactor block.	Graphite blocks.	1,028 cubic meters	While graphite can burn, there is no ignition source of sufficient energy present in the facility to ignite the graphite.	Staff interview
	105-B Reactor Building: FSB/transfer pit.	Wooden planking over basin.	39 cubic yards	Power is provided to the structure. The wooden planking is fire resistant, however, the ability to resist combustion will have decreased due to the age.	BHI-00066 (p.2-2) (BHI 1997) WHC-SP-0331, Rev. 1 (p. A-16) (WHC 1994)
Reactive Material	105-B Reactor Building	Residual process and deactivation chemicals.	Residual quantities.	Potential exists to discover old containers of chemicals that, if mixed, could generate heat/gas.	BHI-00052 (p. B-2) (BHI 1994a) BHI-00066 (p. 2-3) (BHI 1997)
Explosive Material	105-B Reactor Building	Hydrogen gas.	Unknown quantity of lead-acid batteries.	Hydrogen gas can be generated during charging of batteries.	WHC-EP-0619 (p. 3-7) (WHC 1993)

Table H-1. Summary of 105-B Reactor Building Hazard Identification. (6 pages)

Hazard Type	Location	Form	Quantity	Remarks	References
	105-B Reactor Building	Miscellaneous chemicals.	Negligible.	Miscellaneous chemicals remaining have been removed during 5-year cleanup campaign. Potential exists to discover old containers of chemicals. Only a few chemicals can produce an explosive condition.	BHI-00066 (BHI 1997) BHI-00221 (BHI 1994b) WHC-EP-0619 (WHC 1993) WHC-SP-0331, Rev. 1 (p. A-17) (WHC 1994)
Electrical Energy	105-B Reactor Building	The building is supplied by 480 V.	Not applicable.	Abnormal conditions are presented in WHC-EP-0619 (WHC 1993) (e.g., inconsistencies in tagging and labeling, a lack of regular preventative maintenance). Also note frequent presence of offsite tour groups.	WHC-EP-0619 (p. 3-3) (WHC 1994) BHI-00066 (p. 2-2) (BHI 1997) WHC-SP-0331, Rev. 1 (p. A-16) (WHC 1994)
Thermal Energy	105-B Reactor Building	Portable space heaters.	Two heaters: one in the control room and one in the hallway.	None outside that routinely encountered in industry.	
Kinetic Energy	105-B Reactor Building	Structural components.	Not applicable.	Structure occupied occasionally during surveillance and maintenance activities and for tours; roof structures in fair condition.	BHI-00066 (p. 2-2) (BHI 1997)
	105-B Reactor Building	Aircraft crash.	Not applicable.	Probability of event is extremely low.	WHC-SD-CP-SAR-021, Rev. 1 (WHC 1996)
	105-B Reactor Building	Vehicle crash.	Not applicable.	Probability of event is low.	
High Pressure	105-B Reactor Building	Not applicable.	None.	Available references provided no information regarding high pressure; however, based on the current phase of the building, it is anticipated that there is no high pressure.	WHC-EP-0331, Rev. 0 (WHC 1988)
Natural Phenomena	105-B Reactor Building	Earthquake of sufficient magnitude to result in failure of structural components.	Not applicable.	The potential exists for an earthquake to induce the failure of building structural members, which then can interact with the radioactive and hazardous material inventory.	None.

Table H-1. Summary of 105-B Reactor Building Hazard Identification. (6 pages)

Hazard Type	Location	Form	Quantity	Remarks	References
Natural Phenomena	105-B Reactor Building	Flood of sufficient magnitude to result in structural intrusion.	Not applicable.	The potential exists for water to interact with radioactive and hazardous materials within the building as a result of flooding.	None.
Natural Phenomena	105-B Reactor Building	Volcanic activity produces sufficient ashfall to result in the failure of structural members.	Not quantified.	Ashfall has the potential to result in structural members interacting with radioactive and hazardous materials.	None.
Natural Phenomena	105-B Reactor Building	Precipitation infiltrates the building structure. Precipitation in the form of snow results in failure of structural members.	Not quantified.	Precipitation could infiltrate the structure and interact with radioactive and hazardous materials. Snow has the potential to result in structural members interacting with radioactive and hazardous materials.	None.
Natural Phenomena	105-B Reactor Building	Lightning strike on the building structure.	Not applicable.	Lightning could potentially strike the building and interact with the radioactive and hazardous material inside.	None.
Natural Phenomena	105-B Reactor Building	High winds of sufficient magnitude to result in the failure of structural members.	Not quantified.	High winds could potentially induce the failure of structural members and a resultant interaction with radioactive and hazardous materials.	None.

FSB = fuel storage basin
HCR = horizontal control rod
PCB = polychlorinated biphenyls

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