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BHI-01385

Rev. 0

# 105-B Reactor Museum Phase II Project Supplemental Cost Estimate

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

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*Submitted by: Bechtel Hanford, Inc.*

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DISCLM-5.CHP (11/99)

**APPROVAL PAGE**

**Title:** 105-B Reactor Museum Phase II Project Supplemental Cost Estimate

**Concurrences:** R. P. Henckel, Project Manager, Decommissioning Projects

RP Henckel 6/26/00  
Signature Date

D. C. Smith, Project Manager, DOE Restoration Division, Projects Division

D. C. Smith 6/26/00  
Signature Date

**Approvals:** P. W. Griffin, Task Engineer, Decommissioning Projects

P. W. Griffin 6-26-00  
Signature Date

M. A. Mihalic, Task Lead, Decommissioning Projects

MA Mihalic 6-26-00  
Signature Date

The approval signatures on this page indicate that this document has been authorized for information release to the public through appropriate channels. No other forms or signatures are required to document this information release.

BHI-DIS W JUN 26 2000

# 105-B Reactor Museum Phase II Project Supplemental Cost Estimate

## **Authors**

P. W. Griffin  
Bechtel Hanford, Inc.

L. M. Douglas  
TRUTech, L.L.C.

## **Date Published**

June 2000

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## ACRONYMS

Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
BHI	Bechtel Hanford, Inc.
DOE	U.S. Department of Energy
ERC	Environmental Restoration Contractor
FSB	fuel storage basin
PCB	polychlorinated biphenyl
S/M&T	Surveillance/Maintenance and Transition

## METRIC CONVERSION CHART

<b>Into Metric Units</b>			<b>Out of Metric Units</b>		
<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>	<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>
<b>Length</b>			<b>Length</b>		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
<b>Area</b>			<b>Area</b>		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	.0836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
<b>Mass (weight)</b>			<b>Mass (weight)</b>		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
<b>Volume</b>			<b>Volume</b>		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
<b>Temperature</b>			<b>Temperature</b>		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit

## 1.0 INTRODUCTION

This document serves as a supplement to BHI-01384, *105-B Reactor Museum Feasibility Assessment (Phase II) Project*, prepared for Bechtel Hanford, Inc. by MACTEC, Inc (BHI 2000). The Phase II 105-B Reactor assessment was performed to provide a basis for identifying and mitigating the hazards in specific areas of the B Reactor facility to support public tours. This supplemental report provides a broad overview of required actions with a rough order-of-magnitude cost estimate for mitigating hazards in additional areas of the facility with regard to public access and staff assigned to the building.

During facility inspections and preparation of this report, the 105-B Reactor facility was evaluated based on the proposed use and function of specific areas. The hazard identification and mitigation were then addressed using a graded approach based on the specific area's use and function. These areas include the following:

- Existing tour route (see BHI-01384 [BHI 2000])
- Proposed tour areas (including exterior of facility)
- Available facility use areas (limited to tour staff access)
- Ancillary areas (limited to Surveillance/Maintenance and Transition [S/M&T] personnel access).

Table 1 contains a list of the rooms in these areas, and Figure 1 shows a ground-level map of B Reactor with these areas identified. For a complete project description and brief summary of the 105-B Reactor facility, refer to BHI-01384, *105-B Reactor Museum Feasibility Assessment (Phase II) Project* (BHI 2000).

**Table 1. Area Descriptions. (2 Pages)**

Room No. <sup>a</sup>	Existing Tour Route	Room No. <sup>a</sup>	Proposed Tour Areas	Room No. <sup>a</sup>	Facility Use Areas	Ancillary Areas
09	Work area	N/A	Fan room	01	Electrical room	Balance of 105-B Facility
24-25	Main corridor	14	Lunch room areas	N/A	Storage closet	
11	Control room	20	Electrical equipment	N/A	Clerk's office	
23	Office	N/A	Instrument repairs	N/A	Air conditioning equipment room	
22	Office	02	Men's restroom	N/A	Tool storage	
06	Valve pit egress	21	Women's restroom	N/A	Change room	
		N/A	Cushion corridor			

**Table 1. Area Descriptions. (2 Pages)**

Room No. <sup>a</sup>	Existing Tour Route	Room No. <sup>a</sup>	Proposed Tour Areas	Room No. <sup>a</sup>	Facility Use Areas	Ancillary Areas
		N/A	Fuel storage basin viewing room			
		N/A	Exterior of facility			

<sup>a</sup> N/A = not applicable. Refer to Figure 1 for room locations.

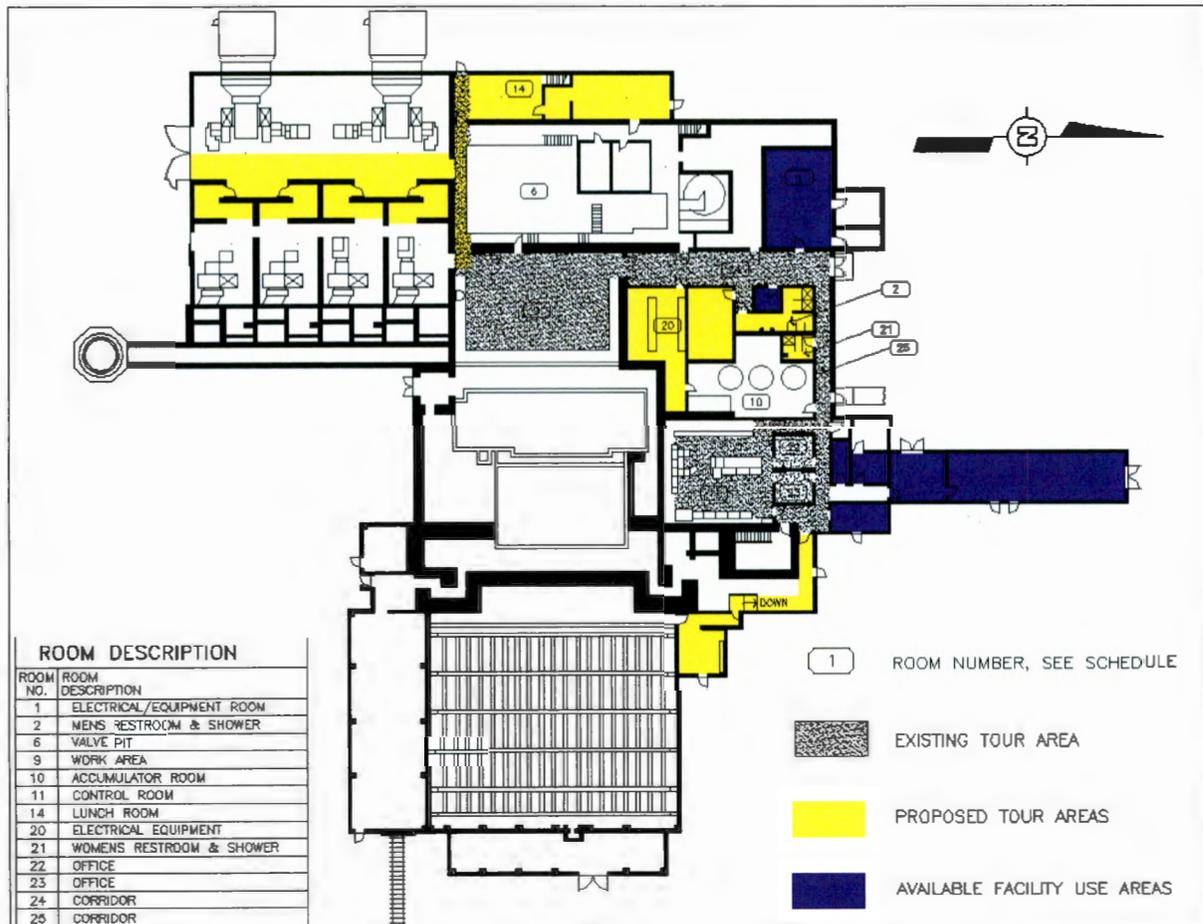
## 2.0 PURPOSE

In support of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1998) Milestone M-93-05, Bechtel Hanford Inc. (BHI) was requested to provide an additional hazards assessment of the 105-B Reactor facility and proposed upgrades for hazard mitigation outside of the existing tour route (i.e., the remainder of the facility). The purpose of this supplemental assessment is to identify the potential hazards within those areas outside of the existing tour route at the 105-B Reactor facility and to provide a rough order-of-magnitude cost estimate for mitigating these hazards within the additional proposed tour areas. This supplement is not a substitute for a detailed engineering analysis and cost estimate, but is intended to provide an overview of the actions required to expand the existing tour area while providing general cost information to assist in evaluating the various tour alternatives and other uses of the facility.

## 3.0 SCOPE

The scope of this supplement includes quantifying the identified hazards within the 105-B Reactor facility (excluding those hazards previously investigated within the existing tour route). Based on the degree of the hazard, mitigation alternatives are proposed within areas that would be accessible, either by the general public or facility staff. A rough order-of-magnitude cost estimate and corresponding activity duration are also provided for these hazard mitigation activities.

**Figure 1. Existing and Additional Tour Routes and Use Areas for the 105-B Reactor.**



## 4.0 APPROACH

Several walk-throughs of the 105-B Reactor facility were performed to identify potential hazards. The hazards were evaluated based on the specific area's proposed use, as identified in previous B Reactor assessments (see BHI-01282, *Hanford B Reactor Building Hazard Assessment Report* [BHI 1999]). Appendices A through C contain a summary of these inspections and the proposed corrective action and cost estimate for the proposed accessible portions of the facility. Appendix D contains an itemized list of assumptions and observations that were made during the walk-throughs to formulate the basis for the estimate.

The areas that received the greatest degree of inspection and analysis included the proposed tour areas. In addition, certain areas were identified as "available staff use areas," which consist of areas that contain minimal hazards but have not been considered for the additional tour route. These areas could be made readily available for use, with minimal effort, for storage of materials or other staff needs and could also be easily converted to tour areas if the need arises.

## 5.0 LIMITATIONS AND ASSUMPTIONS

This limited hazard assessment was performed strictly for the purpose of identifying the major hazards associated with the facility to support the generation of a rough order-of-magnitude cost estimate. The assessment did not include any formal characterization activities (e.g., sample/analysis) for the purposes of identifying suspect hazardous materials. Any required characterization would be performed as part of the hazard mitigation. For example, it is assumed that the damaged paint contains lead. Prior to abatement activities, confirmation samples would be analyzed to determine if mitigation activities are required.

Additionally, code compliance was not addressed. The potential exists that requirements found in U.S. Department of Energy (DOE) design criteria, asset management, and health and safety orders may require additional modifications to the facility. These requirements would have to be evaluated in conjunction with Uniform Building Codes and other facility-specific requirements while integrating the historical preservation regulations. While the suggested hazard mitigation activities include all attempts to maintain originality of the facility, the final detailed designs must be fully compliant with all applicable codes and regulations or must receive appropriate waivers from the governing authority when conflicts are encountered.

### 5.1 ROOF

The roof of the 105-B Reactor facility is generally in fair to poor condition. Maintenance of the reactor roofs at the Hanford Site is currently the responsibility of the Environmental Restoration Contractor (ERC) S/M&T organization. The current plan is to repair the damaged portions of the existing roof with new tar and ballast in July 2000. This repair should extend the life of the

existing roof for 2 to 3 years, at which time the need for additional repairs would need to be evaluated. The existing replacement roof is currently several years beyond its 20-year design life.

## **5.2 AIR HANDLING DUCTS**

Several large overhead air-handling ducts are located above the roof areas of various portions of the reactor. The majority of these ducts are in varying degrees of deterioration and may be structurally unsound. It is possible that the duct supports could fail and allow the ducts to fall, potentially damaging the underlying roof and/or striking someone in the nearby vicinity of the reactor. A detailed inspection of the ducts is planned during the roof repairs (discussed in Section 5.1). Following the inspection, a plan will be developed to mitigate the potential hazards associated with the ducts, with full consideration given to the historical significance of the ducts.

## **5.3 RADIOLOGICAL**

For the purpose of this assessment, additional radiological surveys were not performed for the purpose of characterizing the facility's radiological status. However, radiological surveys are performed on a regular basis as part of the surveillance and maintenance program. A set of radiological maps has been generated based on the latest survey results (see Figures 2 through 10) that show the current status of the facility. It should be noted that the radiological status of specific areas within the facility may change due to ongoing maintenance activities.

## **5.4 EXHAUST STACK**

Several of the exhaust stacks at similar reactors on the Hanford Site have been demolished. Based on an assessment of the condition of the concrete in the last stacks that were demolished at the 105-D and 105-DR Reactor facilities (in 1999), the structural integrity of the stack at B Reactor may be of concern. A structural assessment of the exhaust stack is beyond the scope of this project; however, for estimating purposes, the required analysis and preservation design requirements are estimated to cost approximately \$30,000.

## **5.5 RADON**

An assessment for potential radon hazards associated with the proposed expanded tour route was not performed for this supplemental assessment. However, radon monitoring was performed during the previous Phase II feasibility assessment that showed the radon levels at the extremities of the proposed route (i.e., fuel storage basin [FSB], viewing room, and fan room) had the lowest levels monitored. It is, therefore, assumed that the ventilation upgrades that have been suggested for the current tour route will be sufficient to mitigate the potential radon hazard in the proposed tour area.

Figure 2. 105-B Reactor Ground Floor Radiological Status.

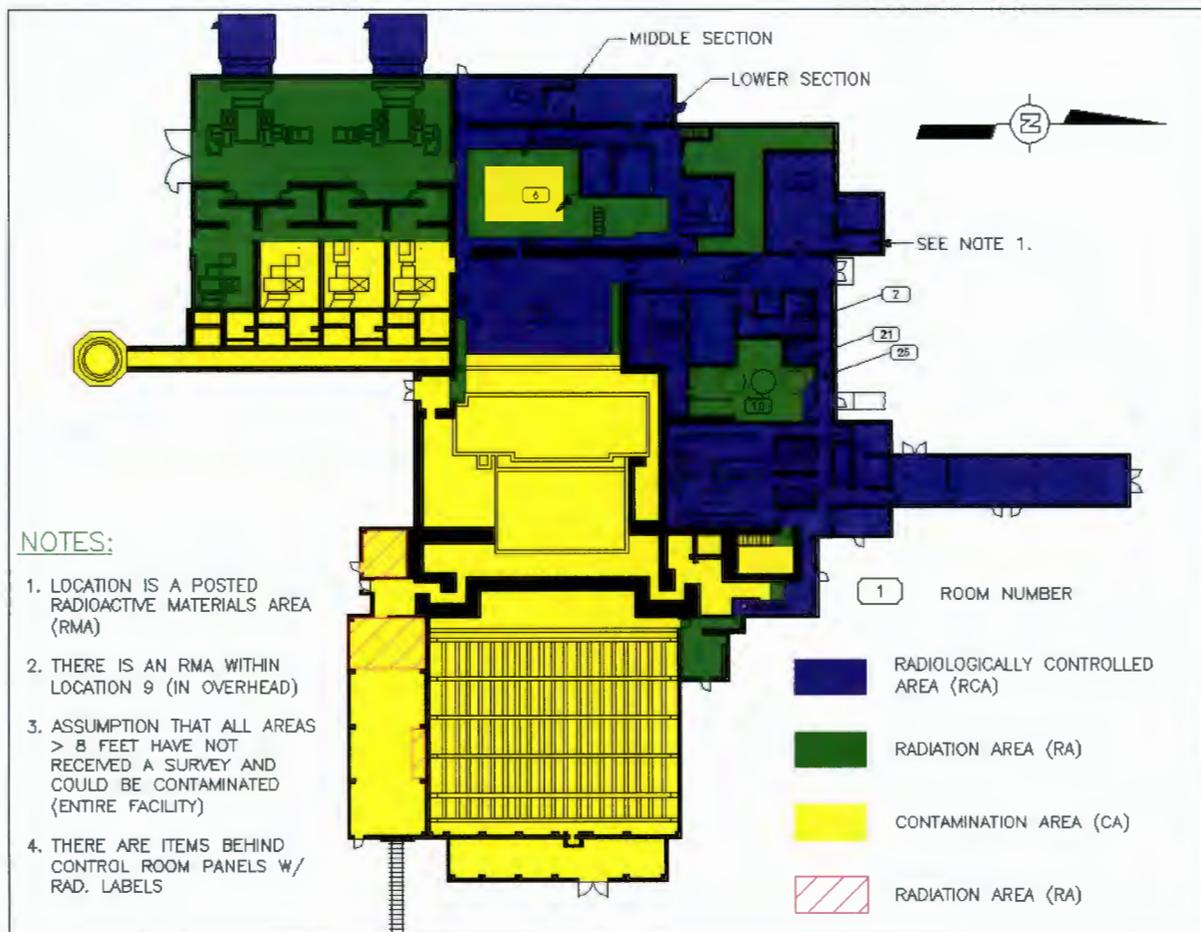


Figure 3. 105-B Reactor Elevation 13-Foot Radiological Status.

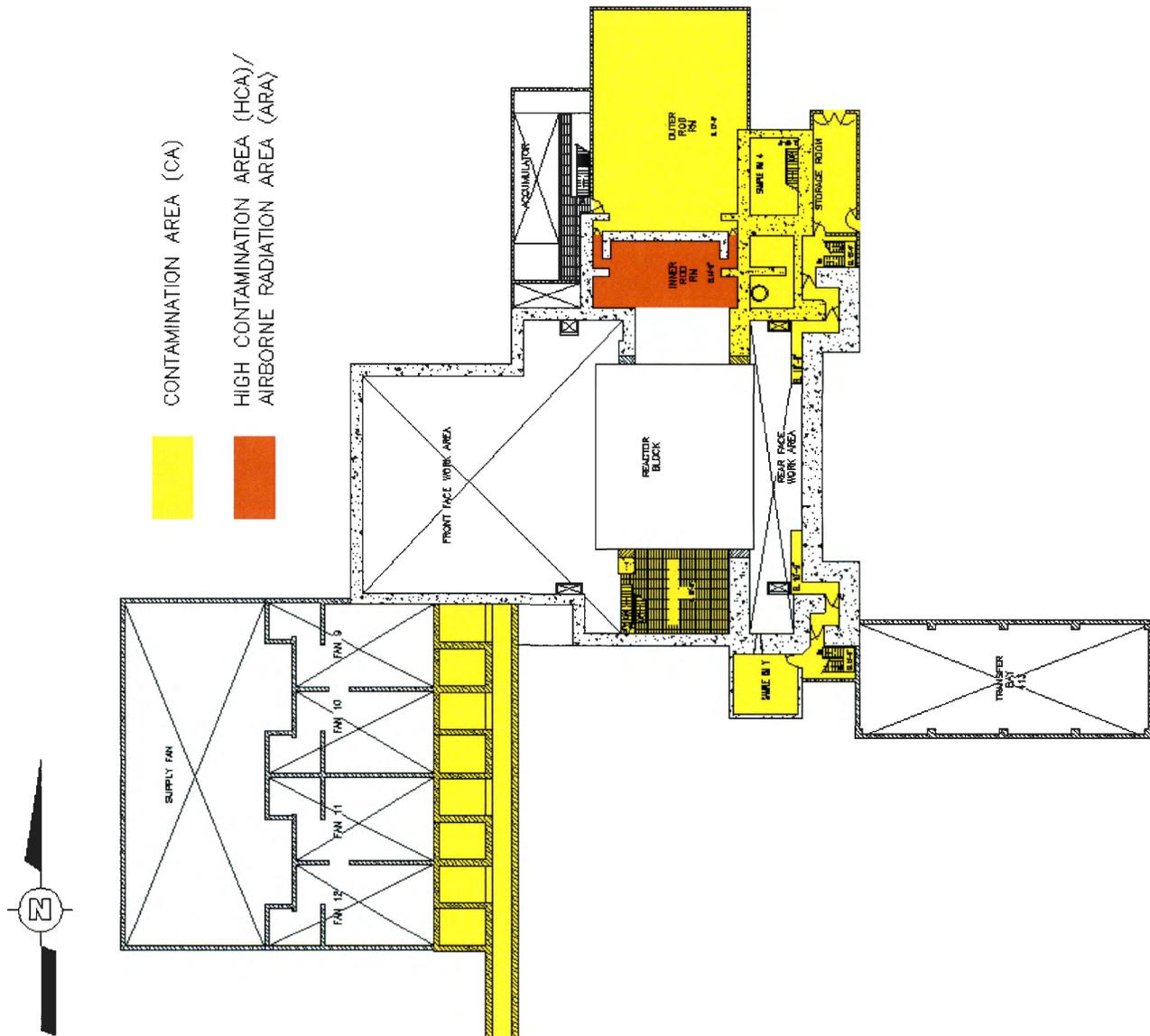


Figure 4. 105-B Reactor Elevation 21-Foot Radiological Status.

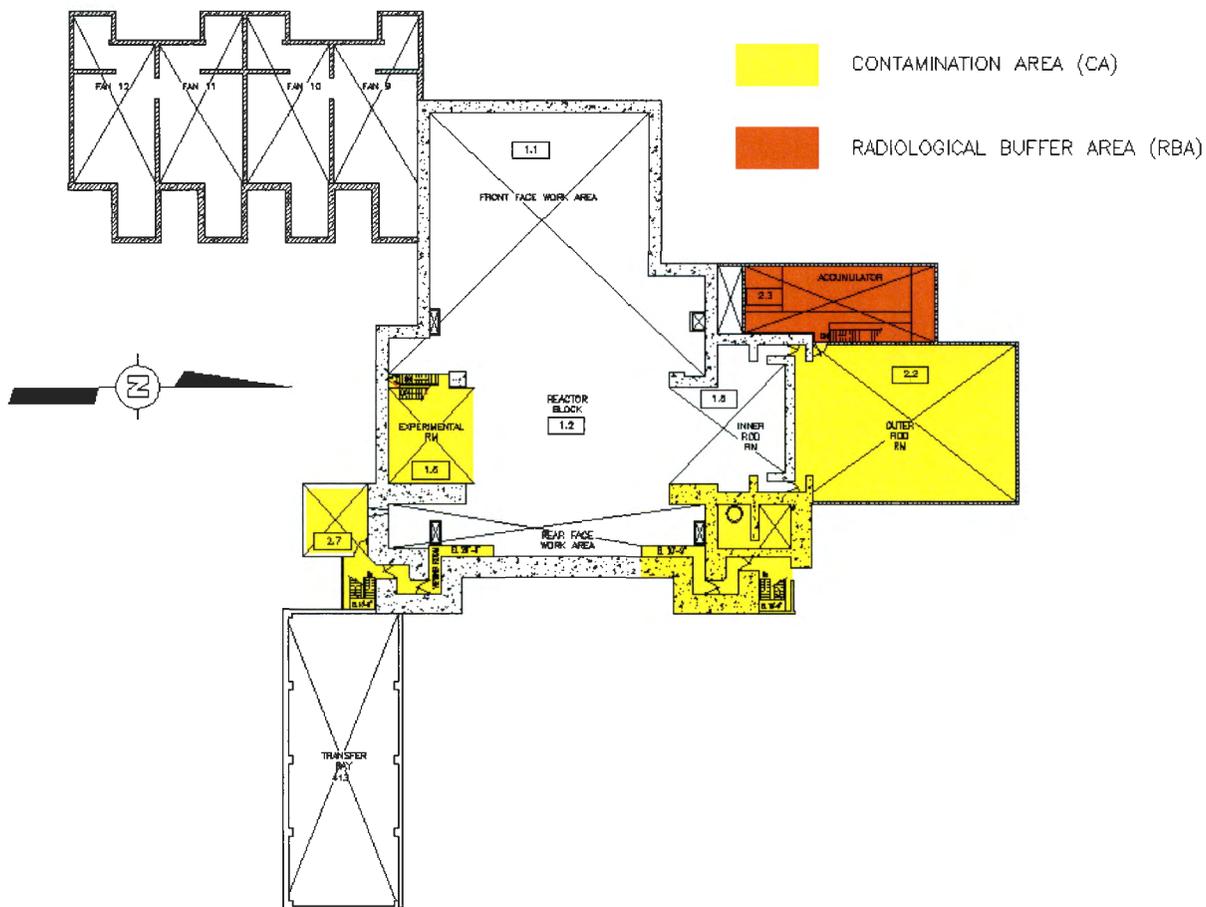


Figure 5. 105-B Reactor Elevation 30-Foot Radiological Status.

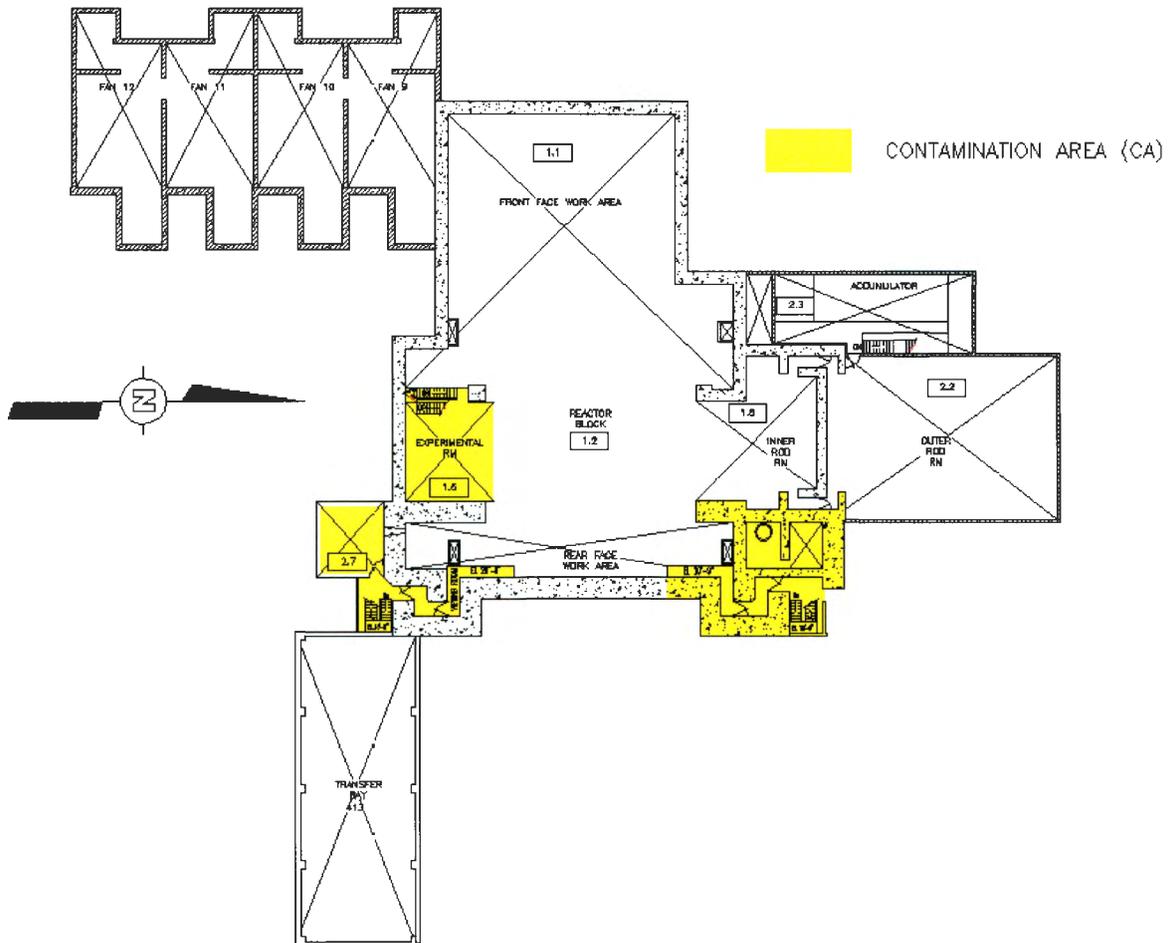


Figure 6. 105-B Reactor Elevation 42-Foot Radiological Status.

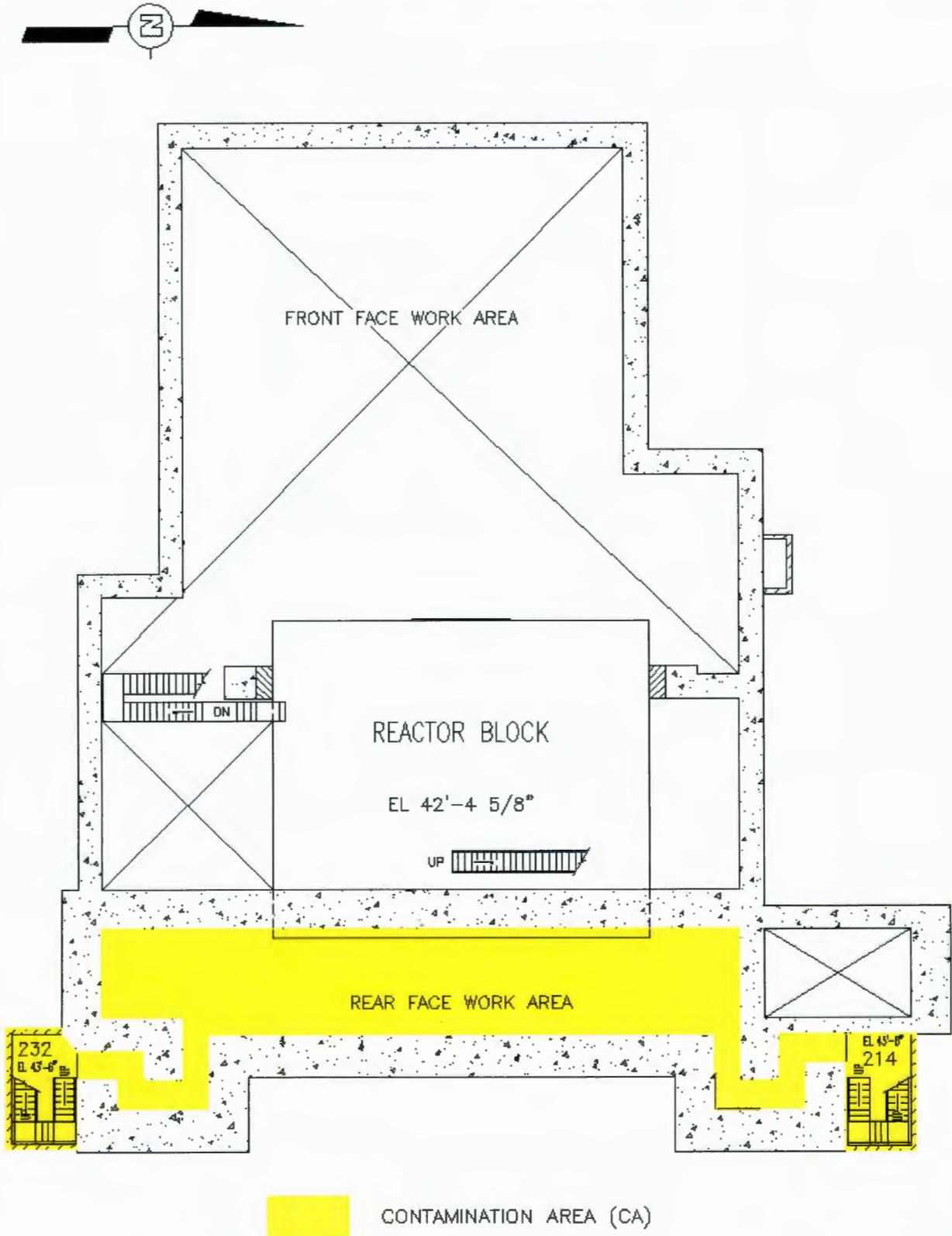


Figure 7. 105-B Reactor Elevation 56-Foot Radiological Status.

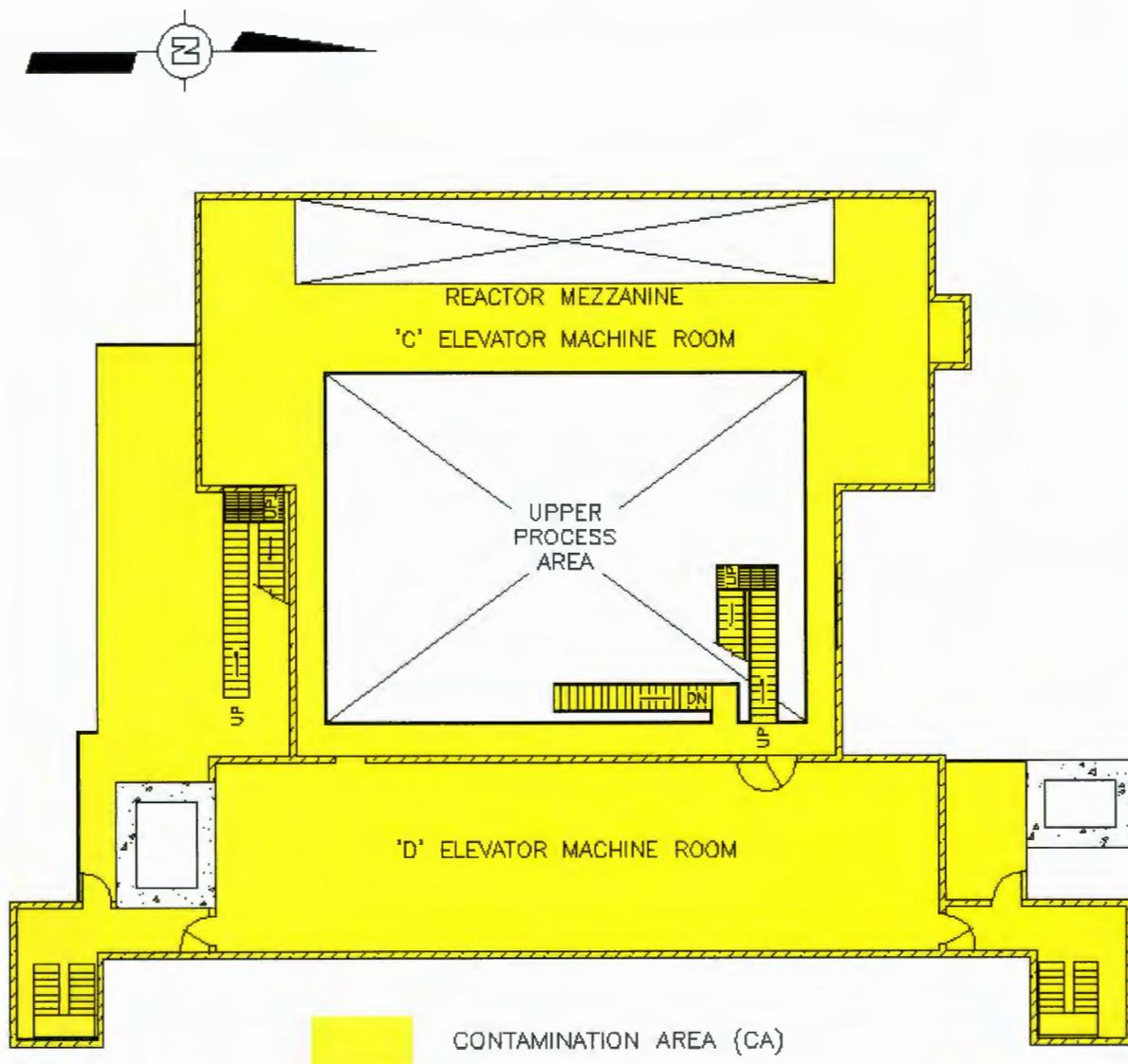
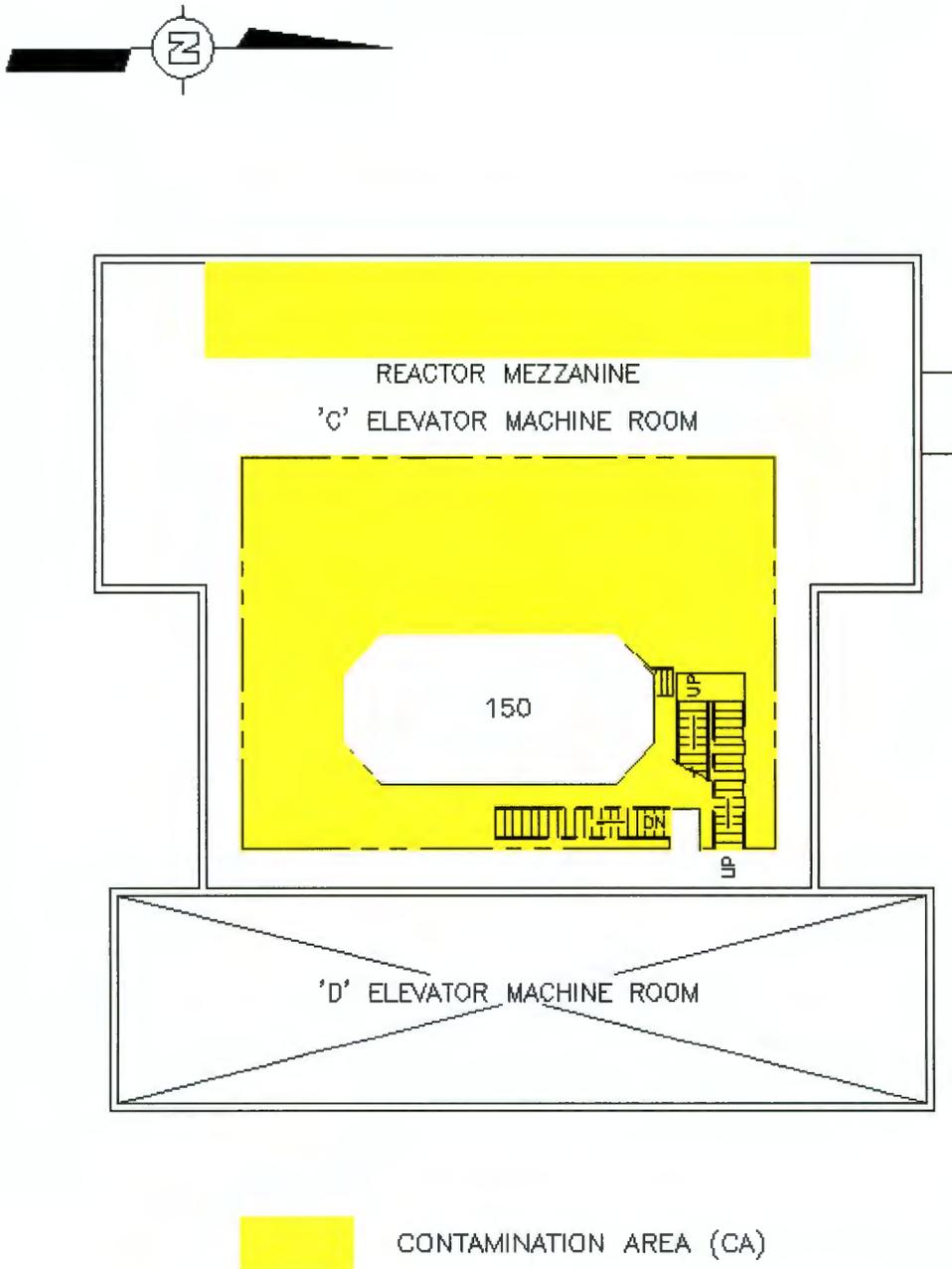


Figure 8. 105-B Reactor Elevation 71-Foot Radiological Status.



**Figure 9. 105-B Reactor Elevation 80-Foot Radiological Status.**

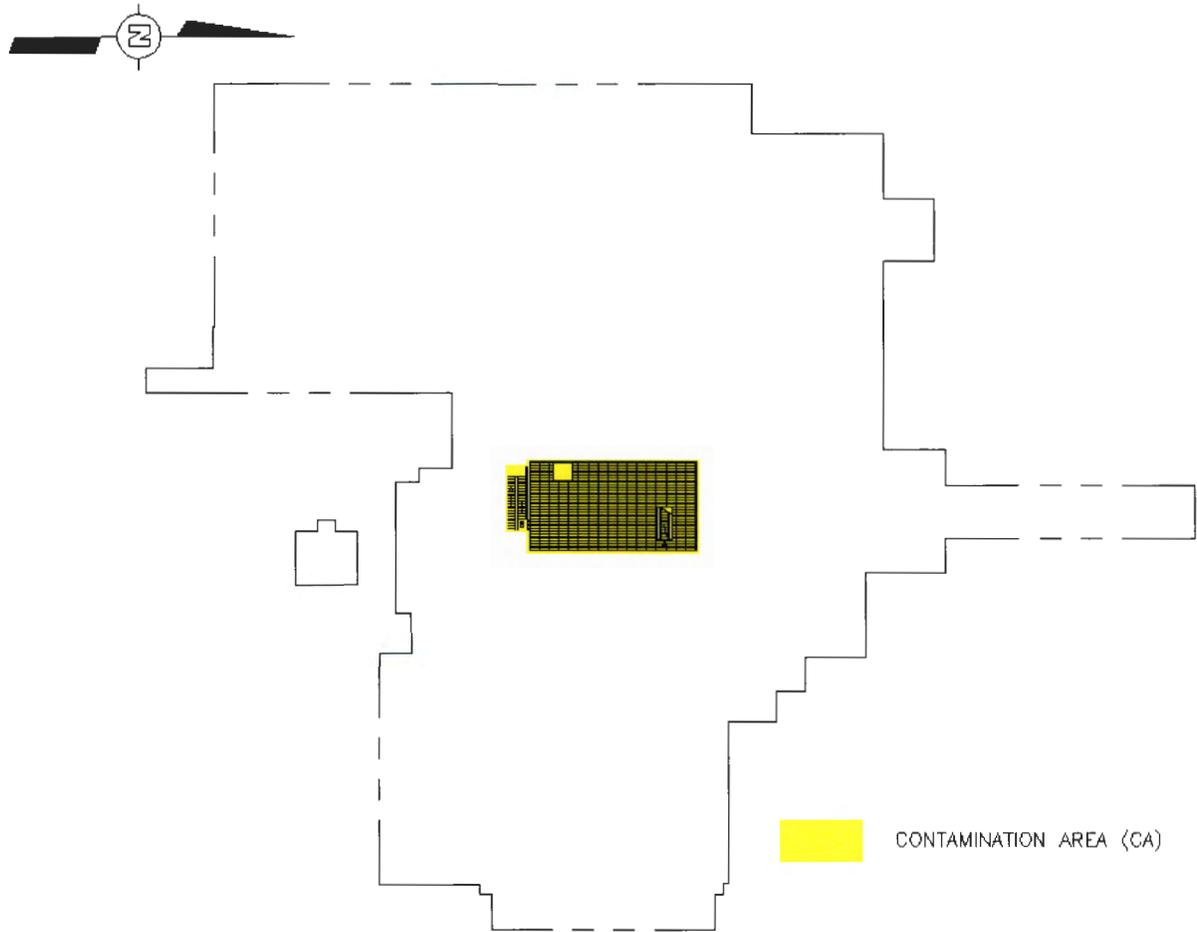
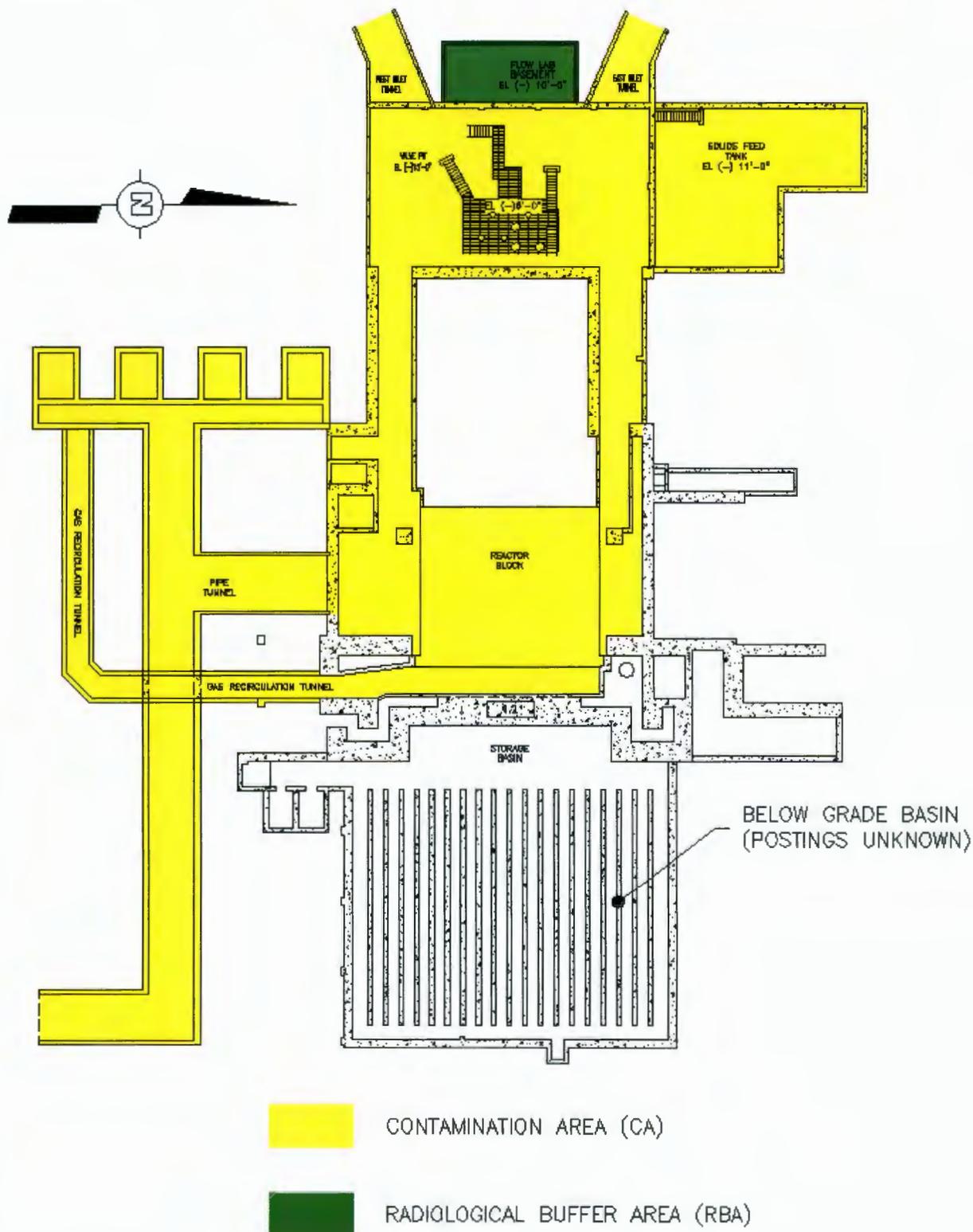


Figure 10. 105-B Reactor Below Grade Level Radiological Status.



## 5.6 POWER

An electrical power upgrade has been proposed for the existing tour route to mitigate the hazards and correct deficiencies with the existing system. It is assumed, for the purposes of this supplemental study, that the proposed 400-amp service will adequately supply the necessary power for the expanded use of the facility. For estimating purposes, it was assumed that each room used as either a proposed tour area or facility use area would have two power outlet boxes installed. The electrical requirements for the ancillary areas of the reactor were addressed in the Phase II feasibility assessment.

## 5.7 LIGHTING

During the facility walk-throughs, the old fluorescent light ballasts were identified for removal due to the potential polychlorinated biphenyl (PCB) hazards. For estimating purposes, it was assumed that these fixtures would be replaced with an equal number of new replacement fixtures. For areas without fluorescent fixtures slated for replacement, it was assumed that an average of two functional fixtures per room would be adequate to meet the lighting requirements.

## 5.8 FLOOR DRAINS

Floor drains were considered to be a hazard due to the potential for hazardous chemicals and/or radiological contamination to have accumulated in the traps or other low points in the lines. These drains could be a hazard source if enough water (either from roof leak or broken supply line) ever filled the line and backed up into an occupied area.<sup>1</sup>

It is possible that hazardous materials have never accumulated in the drain lines. However, rather than performing characterization sampling, it was assumed for the purpose of this assessment that all drains did contain hazardous materials. To mitigate this potential hazard, it is proposed that the drains be isolated by installing a plug and sealing the line under the cover plate with foam (or a similar substance).

## 6.0 RESULTS

In general, the majority of the hazards found are identical to those found in all industrial facilities similar in age to the 105-B Reactor facility. These hazards include asbestos pipe insulation and floor tiles, potential PCBs in the fluorescent light ballasts, potential lead-based paint, and the potential for hazardous material accumulation in drain traps. While these potential hazards do not pose a direct threat to the health and safety of facility occupants until the materials are disturbed, the potential hazards should be removed and/or securely contained in areas that are

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<sup>1</sup> The process sewer lines were blocked off at the perimeter of the facility during previous decommissioning activities.

accessible to the general public or tour staff personnel. The radiological hazards were addressed by proposing decontaminating the area and/or preventing access.

The following sections provide a brief room-by-room narrative of the hazards identified (other than the common hazards described above) during the facility walk-throughs. In addition to the common hazards, the majority of the rooms within the proposed tour areas have access doorways leading to areas that contain potential hazards. These doorways would need to be secured shut with existing doors or have Plexiglas barriers installed for viewing purposes.

For a complete room hazard list, refer to Appendices A through C for a summarized list of the hazards found for each area and the correlating recommended corrective actions with the associated cost estimate.

## **6.1 PROPOSED TOUR AREAS**

### **6.1.1 Fan Room<sup>1</sup>**

The fan room will be made accessible via the proposed egress corridor through the valve pit area. A corridor running north-south through the middle of the room will be surveyed for a complete release from radiological controls for public access and will then be bounded by 6-ft Plexiglas panels. This will prevent the public from coming into contact with potentially contaminated materials and equipment while eliminating the costly process of performing a complete characterization of the entire area and performing decontamination and verification sampling as required for radiological release.

Several roof panels were observed with cracks. These will be further inspected and repaired with the Unistrut system used in other areas of the reactor. The other alternative would be to replace all of the panels with high-quality replacements in conjunction with a roof upgrade project. While this alternative is beyond the scope of this study, it will be investigated following the roof assessment to be performed in July 2000 by the ERC S/M&T organization.

The asbestos in the fan room is in generally good condition. A corridor will be installed within the room so the asbestos will not be accessible to tourists. Sealant will be applied to the exposed asbestos to prevent the potential release of asbestos fibers, and routine inspections will be performed in conjunction with the ongoing surveillance and maintenance activities.

The installation of the tour corridor introduces two new hazards relating to fire safety that need to be addressed. The first hazard is the lack of emergency egress, which will be mitigated by installing the proper hardware and signs on the existing door at the south end of the corridor. The second hazard is the lack of alarm equipment (e.g., pull box and/or audible and visual alarm), which will be addressed by installing the required equipment.

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<sup>1</sup> Refer to Figure 1 for location.

### **6.1.2 Lunch Room Areas (Room 14)**

The lunch room areas will be made accessible via the proposed egress corridor through the valve pit area. In addition to the standard facility hazards, a small section of ceiling has fallen, exposing insulation materials. This section of ceiling would need to be inspected and repaired to ensure that additional panels would not fall on room occupants. Similar to the fan room, this area would require emergency egress at the north end of the room. The existing door will require upgrades to meet current code requirements.

### **6.1.3 Electrical Equipment Room (Room 20)**

This area is accessed from the main corridor and contains two large, glass-front electrical cabinets (approximately 10-ft-wide by 7-ft-high) that contain exposed conductors and switches. While eliminating the power to the facility mitigates the electrical shock potential, there is a potential that the glass could be inadvertently broken, potentially cutting room occupants. Installing large Plexiglas panels in front of the cabinets will mitigate this hazard.

### **6.1.4 Instrument Room<sup>1</sup>**

The instrument room is adjacent to the electrical equipment room and contains minimal hazards, which are limited to the potential for PCBs in the light ballasts and a non-secured door to the accumulator room.

### **6.1.5 Men's Restroom (Room 02)**

Located off of the main corridor, the men's restroom contains the standard hazards, including PCB light fixtures and floor drains. Additionally, this room will require a barricade to prevent access when the proposed restroom facility is constructed and the 105-B Reactor's water and septic have been isolated. The septic lines and the toilet will be plugged to prevent septic gases from entering the room.

### **6.1.6 Women's Restroom (Room 21)**

Similar to the men's restroom, the women's restroom is located off of the main corridor and will require a barricade and fixture isolation after the utilities are shut down.

### **6.1.7 Cushion Corridor<sup>1</sup>**

Extending east from the main corridor, the cushion corridor runs from the control room to the FSB viewing room. The cushion corridor also serves as the step-off pad for accessing the contaminated (upper areas) of the 105-B Reactor. For aesthetic purposes, it will be necessary to relocate this step-off pad further back in the corridor and then survey, decontaminate, and perform confirmation surveys as needed to release the contaminated portions of the corridor. A Plexiglas barricade will be extended from the existing partition to the fixed contamination area on the floor and across to the wall in order to isolate this access area.

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<sup>1</sup> Refer to Figure 1 for location.

This area has several damaged roof panels that will require repair, as described for the fan room in Section 6.1.

### **6.1.8 Fuel Storage Basin Viewing Room<sup>1</sup>**

The FSB viewing room is located at the end of the cushion corridor and contains a large glass window for viewing activities within the FSB. This window has several cracked panes that will need replaced and a barricade will need to be installed to prevent reoccurring breaks in the glass. This area is posted as a radiological buffer area that will necessitate surveys and potential decontamination activities to facilitate a release from radiological controls for public access of the area.

In addition to the standard facility hazards, the FSB viewing room (being located at the end of a corridor) will require an emergency egress route and fire protection equipment. The existing door will be modified and equipment will be installed similar to the fan room (described in Section 6.1). The door to the FSB will also require a secure lock to prevent unauthorized access.

### **6.1.9 Exterior Hazards**

There are many hazards located around the perimeter of the facility that would need to be corrected to allow full public access up to the facility walls. The most cost-effective solution, if limited access were an option, would be to install a barricade approximately 3 to 4 ft from the perimeter of the building. While this would mitigate the majority of the hazards described in the following paragraphs, several hazards would still need to be addressed (as noted).

Many of the painted surface areas around the facility are flaking and peeling. It is assumed that this is lead-based paint, which requires removal and repainting. The majority of the painted surface areas are on the roof flashing and on wooden handrails and decks located above grade level. As a result of the deteriorated paint, the exposed wood is extremely weathered and may be deteriorated to the point of losing structural integrity. Similarly, much of the metal flashing has worked loose from the wooden trim and has fallen or is hanging from a single fastener. Extreme wind could dislodge the damaged flashing or wood, causing a striking hazard to people below. The damaged wood and flashing will required inspection and repair as needed.

Pipes, conduits, and various other items extend from the reactor walls at varying heights. Some of these items have become loose and could fall if disturbed or are located at heights at or below head-level, thus, posing a striking hazard in their present configuration. These items will need to be inspected for structural integrity, repaired if needed, and properly marked and/or barricaded to prevent inadvertent striking by tourists.

Many of the external pipes have been insulated with asbestos-containing materials, most of which have been painted pink and, in some cases, have been covered with metal jackets to protect and contain the asbestos. However, due to years of weather exposure and inadvertent contact, some of the encapsulation has become damaged and/or the ends of the pipe insulation have become exposed. These areas will have to be re-encapsulated. In addition, the tool storage

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<sup>1</sup> Refer to Figure 1 for location.

room and supply fan enclosures have transite walls. While the material appears to be in very good condition, the exposed surfaces and edges should be sealed to protect the material.

Some of the abandoned electrical transformers outside of the facility adjacent to the electrical room have been left with their doors open, allowing animal intrusion, resulting in an accumulation of animal wastes and possible carcasses, creating a potential biohazard. These areas must be cleaned up and the transformers secured.

Similar to the transformers, there is an old shack located adjacent to the exhaust plenum that has been left open and has an accumulation of animal waste and debris. In addition to the potential biohazard, the paint (assumed to be lead-based) is severely peeling and flaking. This room will need cleaned out, scraped, and repainted and the openings will need to be sealed.

Many of the wooden exterior doors and/or door casings have deteriorated to the point where they could be breached with minimal effort. If full public access is the chosen option, these doors should be thoroughly inspected and the damaged doors should be replaced.

While the general surface area around the 105-B Reactor is level, the area is covered with gravel and rocks, many in excess of 6 in. in diameter. In addition, the ground is littered with broken glass, lag bolts, wire pieces, and other sharp objects. The tour route would need to be smoothed out and cleaned up to facilitate safe access.

## **6.2 AVAILABLE STAFF USE AREAS**

### **6.2.1 Electrical Room (Room 01)**

The electrical room is located adjacent to the main corridor on the north end of the facility. This room would require minimal hazard mitigation efforts, with the exception of damaged asbestos that is present in overhead pipe insulation and in displaced floor tiles. Two doors provide access to adjacent offices and will need to be secured.

### **6.2.2 Storage Closet<sup>1</sup>**

The storage closet, located off of the main corridor, is currently used to store cleaning and other janitorial-type supplies. The door to this room will need to be secured and a potential PCB light fixture will need to be replaced.

### **6.2.3 Clerk's Office<sup>1</sup>**

The clerk's office is located off of the cushion corridor. It is in relatively good condition and will only require the replacement of potential PCB light fixtures.

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<sup>1</sup> Refer to Figure 1 for location.

#### **6.2.4 Air Conditioning Equipment Room<sup>1</sup>**

Located adjacent to the clerk's office (Room 28), the air conditioning equipment room is in similar condition, with the additional requirement of isolating a floor drain. An asbestos-insulated pipe is present but is in good condition and will require only standard surveillance and maintenance to ensure that it remains undamaged.

#### **6.2.5 Tool Storage Area<sup>1</sup>**

The tool storage area extends from the north side of the building and is currently used for staging tour display items. The only modification for this room would include applying a clear-coat fixative to the transite wall panels to prevent surface damage and the subsequent release of asbestos fibers.

#### **6.2.6 Change Room<sup>1</sup>**

The change room, located off of the cushion corridor, is currently in use with no identified hazards.

### **6.3 ANCILLARY AREAS**

The ancillary areas will not be accessed by the general public or by facility staff personnel. As such, no upgrades will be required for these areas, with the exception of securing doors and eliminating access as included in the previous room-by-room discussion. Routine surveillance and maintenance will be performed to ensure that existing hazards do not increase or migrate to accessible areas of the facility.

The FSB (and associated transfer bay) does have residual contaminated materials left in place from previous decommissioning activities. As noted in Appendix C, lead shielding has been placed on the decking of the FSB immediately adjacent to the FSB viewing room's viewing window to shield an unknown source within the basin. The heavily oxidized lead should be replaced with steel or equivalent nonhazardous shielding material to reduce the current dose rate to normal facility background levels. This area will remain secured and off limits to the public and facility staff.

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<sup>1</sup> Refer to Figure 1 for location.

## 7.0 SUMMARY

### 7.1 HAZARD SUMMARY

The majority of the hazards present in the 105-B Reactor facility are relatively minor for a nuclear facility constructed in the early 1940s. Table 2 provides a list, by functional area, of the number of occurrences of each type of hazard found. In reviewing Table 2, it must be noted that the ancillary areas were not inspected based on full public access, but rather to note the general hazards present. Furthermore, several locations within the ancillary areas were inaccessible for inspection due to potential high radiation levels (e.g., inner rod room) or confined space restrictions.

**Table 2. Hazard Summary.**

Hazard Category	Proposed Tour Areas	Staff Use Areas	Ancillary Areas
Striking/cutting	11	0	6
Asbestos	6	3	6
Radiological	6	0	26
Hazardous area access	6	1	N/A <sup>a</sup>
PCBs	5	3	10
Lead	5	0	9
Chemical	5	2	13
Electrical shock	3	0	3
Biohazard/intrusion	3	0	6
Egress	2	0	N/A <sup>a</sup>
Fire	2	0	N/A <sup>a</sup>
Tripping/falling	2	0	22
Confined space	0	0	2

<sup>a</sup> Hazards were not identified for these areas because they were not considered for occupancy. Most of these areas are above/below-grade areas and would have multiple occurrences of these types of hazards if considered for public use.  
N/A = not applicable

The high occurrence of "striking/cutting" for the proposed tour area is due to several instances of damaged roof panels and unstable/deteriorated fixtures attached to the exterior of the facility that may fall over time. The "asbestos" occurrences result from damaged floor tile and transite siding that currently is in good condition but should be sealed to prevent deterioration. The "asbestos" instances are somewhat misleading in that a single occurrence for the exterior of the facility actually accounts for approximately 30 areas of potentially damaged pipe insulation. The "radiological" occurrences result from accessing the fan room and the cushion corridor/FSB viewing room. The portions of these rooms proposed for public access currently serve as buffer

areas. The securing of doorways to prevent access easily mitigates the “hazardous area access” situations. The “PCB” hazards result from the potential of PCB oils to be in the fluorescent light fixtures and possibly leaking into accessible areas. “Lead” is assumed to be in the flaking/peeling paint, as well as in bulk form (for shielding uses) throughout the facility. The majority of the “chemical” hazards are from assumed chemical residues in floor drains. The “electrical shock” hazards will be eliminated with the proposed isolation of the current electrical service. The remaining hazards are insignificant in either the hazard magnitude or the number of occurrences.

## 7.2 COST SUMMARY

The cost estimates performed are rough order of magnitude and should only be considered for preliminary evaluation purposes. A detailed investigation by subject matter experts should be performed to generate an itemized cost breakdown if any of these upgrades are considered for implementation. A cost summary is presented in Table 3, and a room-by-room breakdown of these costs is provided in Appendices A and B. Additional details and assumptions for the basis of estimates are included in Appendix D. The costs shown do not reflect facility operating costs or required surveillance and maintenance activities. However, as part of the overall hazard mitigation strategy, ongoing surveillance and maintenance will be performed to ensure that the overall condition of the facility does not deteriorate to create additional hazardous conditions. The design and design management costs do not reflect resources required for conflict resolution in instances where current code requirements conflict with historical preservation requirements but do include standard comment and review requirements.

**Table 3. Cost Estimate.**

	Subcontracted Costs	Project Management Costs
Preliminary design	\$270,000	\$25,000
Final design <sup>a</sup>	\$127,000	\$55,000
<b>Facility Upgrades</b>		
Proposed tour areas	\$600,000	\$216,000
Staff use areas	\$32,000	N/A <sup>b</sup>
Subtotal	\$1,029,000	\$296,000
<b>Total Project Cost: \$1,325,000</b>		

<sup>a</sup> This includes procurement of the design-build contract.

<sup>b</sup> Assumed negligible cost increase for adding staff use areas to proposed tour route workscope.

The project is estimated to take approximately 9 months to complete (3 months for engineering and design and 6 months for facility upgrades). However, this estimated schedule is dependant on many variables. The two variables having the greatest impact include regulatory approval of facility modifications and subcontractor crew size (allowing simultaneous activities to occur).

## 8.0 REFERENCES

- BHI, 1999, *Hanford B Reactor Building Hazard Assessment Report*, BHI-01282, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- BHI, 2000, *105-B Reactor Museum Feasibility Assessment (Phase II) Project*, BHI-01384, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- Ecology, EPA, and DOE, 1998, *Hanford Federal Facility Agreement and Consent Order*, (Tri-Party Agreement), 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

**APPENDIX A**  
**ROOM HAZARD LIST – PROPOSED TOUR AREAS**

## APPENDIX A

## ROOM HAZARD LIST – PROPOSED TOUR AREAS

Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action	Cost <sup>b</sup>
FR-A	Fan room	Four cracked roof panels have been observed. <b>Striking</b>	Repair with Unistrut system (ECN 600275) similar to repairs in valve pit area.	\$77,308
FR-B	Fan room	Supply fan ducts asbestos. Currently in good condition. <b>Asbestos</b>	Barricade area to prevent contact from visitors, or protect from bumping and perform regular inspections.	\$52,830
FR-C	Fan room, exhaust side	Transite wall panels exposed and cracked. Six panels (6 ft. x 8 ft each). <b>Asbestos</b>	Seal cracks, paint, and/or apply sealant to all exposed surfaces.	\$6,256
FR-D	Fan room	CA around several exhaust fans. Approx. 15-ft x 20-ft area plus 4-ft hallway. <b>Radiological</b>	Decontaminate entire area and seal openings to fans, or install enclosures around fans to isolate area. Perform required surveys to release accessible areas.	\$26,579
FR-E	Fan room	Corridor between EF #8 and EF #9 has contamination spots on concrete floor. <b>Radiological</b>	Can apply fixative (paint) if not accessible. If accessible to tours, scabble and patch to match surrounding floor.	\$10,347
FR-F	Fan room	Floor drains; traps may contain hazardous materials. <b>Chemical</b>	Install expandable plugs and seal cover plate. Seven total (three in supply fan area, four in exhaust fan area).	\$2,902
FR-G	Fan room	Lead-acid battery for lantern next to EF #10. <b>Chemical</b>	Remove/dispose of battery, anchor lantern in place.	\$1,615
FR-H	Fan room	Entire area is an RBA or CA. <b>Radiological</b>	Clean floor corridor from valve pit entrance to rear outside door to allow area observation. Perform required characterization/release survey(s).	\$14,430
FR-I	Fan room	Tour route becomes dead-end corridor at south end of room. <b>Egress</b>	Replace existing door with code compliant exit door. Install signage and lighting as required.	\$26,849

**Appendix A – Room Hazard List – Proposed Tour Areas**

Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action	Cost <sup>b</sup>
FR-J	Fan room	Fan room area has inadequate fire protection/alarm capabilities to support tour activities. <b>Fire</b>	Install fire protection equipment to include: alarm (audible and visible), pull-box, and fire extinguisher.	\$15,667
FR-K	Fan room	Once the electrical service is eliminated, this area will not have adequate lighting or electrical service. <b>Lighting<sup>c</sup></b>	Install new and/or retrofit existing lighting with new electrical service. Install electrical outlets as needed for maintenance.	\$37,870
14-A	Lunch room areas	Floor tiles missing (9 in. x 9 in.); exposure to asbestos tile edges and mastic. <b>Asbestos</b>	Remove loose tile, replace with non-asbestos tile or apply lock-down, and/or barricade doors preventing access.	\$1,811
14-B	Lunch room kitchen area	A section of ceiling insulation and tiles are missing. Approx. 12 ft x 4 ft. <b>Striking</b>	Replace missing insulation and tiles.	\$3,521
14-C	Lunch room areas	Peeling paint, assumed lead-based. <b>Lead</b>	Removed loose/detached lead-based paint. Repaint surfaces with appropriate paint.	\$12,624
14-D	Lunch room	Open doorways to staircase leading to lower area (safety shower area) and to valve pit. <b>Hazardous Area Access</b>	Install Plexiglas doors in door openings.	\$3,906
14-E	Lunch room	Tour route becomes dead-end corridor at north end of room. <b>Egress</b>	Replace existing door with code compliant exit door. Install exit pad, signs, and lighting as required.	\$13,259
14-F	Lunch room	Floor drain, traps may contain hazardous materials. <b>Chemical</b>	Install expandable plug and seal cover plate. One total.	\$1,670
14-G	Lunch room	Cracked concrete floor shifted up approximately 2 in. <b>Tripping Hazard</b>	Pour patch along lower shifted area to provide gradual slope or grind off high side to provide gradual slope.	\$7,611
20-A	Electrical equip. room	Bare wires and connections in unlocked energized cabinets. Asbestos insulation on wires. <b>Electrical Shock, Asbestos</b>	Lock cabinets and/or barricade door. (Note: Electrical upgrade plans may de-energize cabinets, but they should be secured to prevent unauthorized access.)	\$9,450
20-B	Electrical equip. room	Doorway provides access to accumulator room. <b>Hazardous Area Access</b>	Install Plexiglas doorway to allow viewing of accumulator room.	\$2,443

# Appendix A – Room Hazard List – Proposed Tour Areas

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Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action	Cost <sup>b</sup>
20-C	Electrical equip. room	Ceiling lights may contain PCB ballasts (three fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixtures.	\$9,915
IR-A	Instrument room	Ceiling lights may contain PCB ballasts (four fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixtures.	\$10,258
IR-B	Instrument room	Doorway provides access to accumulator room. <b>Hazardous Area Access</b>	Secure door in closed position and lock.	\$1,587
02-A	Men's restroom	P-trap in floor drain potential chemical hazards and/or contamination – Cover missing (approx. 4-in. <sup>2</sup> piece). <b>Chemical</b>	Plug drain, replace cover, and seal.	\$6,276
02-B	Men's restroom	Ceiling lights may contain PCB ballasts (five fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixtures.	\$11,531
02-C	Men's restroom	Access control.	The water and sewer utilities will be isolated once the new restroom facilities are constructed. Install barricade to prohibit restroom use.	Included with 21-C
21-A	Women's restroom	Ceiling light may contain PCB ballasts (two fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixture.	\$5,439
21-B	Women's restroom	Unsecured hazardous cleaning supplies. <b>Chemical</b>	Remove hazardous items or secure in locked cabinet.	\$1,713
21-C	Women's restroom	Access control.	The water and sewer utilities will be isolated once the new restroom facilities are constructed. Install barricade to prohibit restroom use.	\$3,908
CC-A	Cushion cham corridor	Roof panels; five damaged panels, one has been repaired with Unistrut per ECN 600275. No additional damaged panels observed. <b>Striking</b>	Evaluate need for repairing damaged panels based on previous engineering evaluations.	\$85,826
CC-B	Cushion cham corridor	Potential RCA; currently used as step-off pad for access/egress for contaminated portions of the reactor. <b>Radiological</b>	Relocate step-off pad to an unused portion of the reactor. Perform radiological characterization/decontamination for radiological release of area.	\$13,840

# Appendix A – Room Hazard List – Proposed Tour Areas

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Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action	Cost <sup>b</sup>
FV-A	FSB viewing room	Broken and cracked basin viewing windows. <b>Cutting, Radiological</b>	Repair broken and cracked glass. Install barricade to prevent visitors from contacting glass (railing or Plexiglas cover).	\$11,074
FV-B	FSB viewing room	Ceiling lights may contain PCB ballasts (four fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixtures.	\$10,856
FV-C	FSB viewing room	Door to FSB is not secured. <b>Hazardous Area Access</b>	Install new lock to secure door.	\$1,587
FV-D	FSB viewing room	Entire area is an RBA. <b>Radiological</b>	Perform required characterization /release surveys and perform decontamination as required for full release of area.	\$2,329
FV-E	FSB viewing room	Viewing room area has inadequate fire protection/alarm capabilities. <b>Fire</b>	Install fire protection equipment to include: alarm (audible and visible), pull-box, and fire extinguisher.	\$15,667
<b>Exterior Hazards</b>				
E-A	Exterior of entire building	Some metal flashing around building is loose, has fallen, and/or has flaking paint (assumed lead-based). <b>Lead, Striking</b>	Repair loose/fallen flashing. Remove loose paint, repaint with exterior primer/paint.	\$44,871
E-B	Exterior of entire building	All painted wooden surfaces are extremely weathered with peeling paint, assumed lead based. Exposed wood is in various stages of deterioration. <b>Lead, Striking</b>	Loose paint needs removed and surfaces repainted. Rotten wood should be replaced.	\$23,843
E-C	Exterior of entire building	Miscellaneous pipes and conduits are dangling from building that could break and fall. <b>Striking</b>	Reattach to building.	\$6,493
E-D	Exterior of entire building	Asbestos covered pipe in poor condition in various areas around building. Some insulation visible through damaged encapsulation. <b>Asbestos</b>	Repair damaged areas, or remove asbestos and reapply substitute covering.	\$44,364

## Appendix A – Room Hazard List – Proposed Tour Areas

Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action	Cost <sup>b</sup>
E-E	Exterior Roof of entire building	Roof is in various stages of deterioration, some sections in immediate need of repair. Water infiltration spreads contamination and deteriorates building.  <b>Intrusion</b>	Repair and/or replace existing roof sections. Evaluate need vs. ability for short term and long-term repair options.	N/A
E-G	Tool storage room	Transite siding panels are exposed to the elements, accelerating decay.  <b>Asbestos</b>	Re-caulk all joints and seams. Apply clear sealant over transite.	\$27,753
E-H	Outside elect. equip. room	Open transformers (abandoned) with exposed conductors, misc. biohazard debris.  <b>Electrical Shock, Biohazard</b>	Clean out transformers, secure all doors and cover openings.	\$9,994
E-I	Wood shack near exhaust plenum	Old wooden shack attached to exhaust plenum, structurally unsafe, peeling paint, contains biohazards.  <b>Striking Lead, Biohazard</b>	Demolish or restore. Restoration would include sealing all openings, repainting, re-roofing, and adding door.	\$22,567
E-J	Exterior wooden doors	Old wooden doors, minimal integrity, loose paint assumed lead-based.  <b>Lead, Intrusion</b>	Replace with similar metal doors. Repair/replace casing, as required.	\$103,337
E-K	Exterior of entire building	Surface is uneven (4-in. to 6-in. rocks in some areas) with various scattered debris.  <b>Tripping, Cutting</b>	Smooth out surface around perimeter. Pick up broken glass, miscellaneous hardware, etc.	Included with other activities
E-L	Exterior of entire building	Misc. pipes and equipment are protruding from the reactor walls.  <b>Striking</b>	Install appropriate barricades and/or place appropriate signage to warn of hazard.	\$4,784
E-M	Exterior of exhaust plenum	Broken conduit with exposed conductors. Conduit supports several overhead lights that could fall also.  <b>Electrical Shock, Striking</b>	Re-install conduits and light fixtures. Electrical shock hazard will be eliminated when reactor power is de-energized.	\$6,502
<b>TOTAL COST =</b>				<b>\$815,830</b>

<sup>a</sup> Hazard identification number refers to room numbering sequence (where applicable) shown in Figure 1.

<sup>b</sup> Costs include BHI management, health physics technicians, and decontamination and decommissioning Craft support.

<sup>c</sup> This occurrence (inadequate lighting) would be true for all occupied areas after the power is isolated; however, it is called out here because no fluorescent lights are being changed out.

CA = contamination area

FSB = fuel storage basin

N/A = not applicable

PCB = polychlorinated biphenyl

RBA = radiological buffer area

**APPENDIX B**  
**ROOM HAZARD LIST – AVAILABLE STAFF USE AREAS**

## APPENDIX B

## ROOM HAZARD LIST – AVAILABLE STAFF USE AREAS

Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action	Cost <sup>b</sup>
01-A	Electrical room	A 20-ft length of 6-in. pipe asbestos insulation is damaged above ceiling panels. (Extends into Room 19). <b>Asbestos</b>	Abate asbestos and reapply similar insulation, or encapsulate.	\$8,002
01-B	Electrical room	Loose asbestos (9-in. x 9-in.) floor tiles. Approx. 36 ft <sup>2</sup> . <b>Asbestos</b>	Remove and replace.	\$3,190
01-C	Electrical room	Doorway provides access to Rooms #18 and #19. <b>Hazardous Area Access</b>	Secure and lock doors	\$1,843
SR-A	Storage	Unsecured hazardous cleaning supplies. <b>Chemical</b>	Secure and lock door.	\$1,843
SR-B	Storage	Light ballasts potential PCBs (two fixtures). <b>PCB</b>	Remove/replace ballasts. Dispose of as PCB waste.	\$3,856
CO-A	Storage/ clerk's office	Light ballasts potential PCBs (two fixtures). <b>PCB</b>	Remove/replace ballasts. Dispose of as PCB waste.	\$3,818
AC-A	Office/AC equip. room	P-trap in floor drain potential chemical hazards and/or contamination. <b>Chemical</b>	Plug drain and seal cover.	\$5,488
AC-B	Office/AC equip. room	Asbestos covered pipe. <b>Asbestos</b>	N/A. Asbestos insulation in good condition.	N/A
AC-C	Office/AC equip. room	Light ballasts, potential PCBs (four fixtures). <b>PCB</b>	Remove/replace ballasts. Dispose of as PCB waste.	\$3,818
TS-A	Tool storage area	Transite panels on walls. <b>Asbestos</b>	Apply clear-coat/paint to prevent surface damage.	Included in E-G
CR-A	Office/ change room	No hazards identified.	N/A	N/A
<b>TOTAL COST</b>				<b>\$31,858</b>

<sup>a</sup> Hazard identification number refers to room numbering sequence (where applicable) shown in Figure 1.

<sup>b</sup> Assumes activities performed in sequence with proposed tour area upgrades, reducing fixed costs.

AC = air conditioning

N/A = not applicable

PCB = polychlorinated biphenyl

**APPENDIX C**  
**ROOM HAZARD LIST – ANCILLARY AREAS**

APPENDIX C

ROOM HAZARD LIST – ANCILLARY AREAS

Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action
06-A	Valve pit	Roof panels; several damaged panels repaired with Unistrut per ECN 600275. No addition damaged panels observed. <b>Striking</b>	Continue roof panel surveillance, repair damaged panels per ECN 600275.
06-B	Valve pit	The 24-in. process supply line valves open with cover plates and operator detached. <b>Chemical, Radiological</b>	If accessible for tours, reassemble (one valve tagged as contaminated).
06-C	Valve pit walkways	Check grate openings against OSHA standards for public walkways. <b>Tripping</b>	Cover decking in any tour accessible areas that does not meet OSHA code.
06-D	Valve pit walkways	Handrail opening is not safe for tours. Openings are too large. <b>Falling</b>	Install tall clear barrier next to rails that are accessible for tours.
06-E	Valve pit near kitchen	3-X electrical power box missing panel cover. <b>Electrical Shock</b>	Current tour electrical upgrade will de-energize source. Confirm zero energy.
SS-A	Lunch room downstairs (safety shower)	Biohazards; animal droppings, animal carcass. <b>Biohazard</b>	Remove animal droppings/carcass. Seal openings to prevent future animal intrusion.
SS-B	Lunch room downstairs (safety shower)	P-traps in shower drains. Potential for hazardous chemicals and/or contamination. <b>Chemical</b>	Install 2-in.-diameter plugs in drains and seal covers over drain openings.
01-A	Office	Room currently used as radiological storage area. <b>Radiological</b>	Remove all radiological materials and secure door.
02-A	Office	Damaged floor tiles and some tiles missing. <b>Asbestos</b>	Replace damaged and missing floor tile.
02-B	Office	A section of ceiling insulation and tiles are missing. Approx. 12 ft x 4 ft. <b>Striking</b>	Replace missing insulation and tiles.

# Appendix C – Room Hazard List – Ancillary Areas

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Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action
02-B	Office	Light ballasts potential PCBs (two fixtures). <b>PCB</b>	Remove/replace ballasts. Dispose of as PCB waste.
EE-A	Electrical equip. room	Light ballasts potential PCBs (five fixtures). <b>PCB</b>	Remove/replace ballasts. Dispose of as PCB waste.
EE-B	Electrical equip. room	Transite panels on wall. Approx. 20 ft x 8 ft. <b>Asbestos</b>	Apply clear-coat/paint to prevent surface damage.
EE-C	Electrical equip room	Door threshold is 3-in.-high creating tripping hazard. <b>Tripping</b>	Paint with yellow paint. Install warning sign.
EE-D	Electrical equip room	Exposed electrical wires in open boxes and trays. <b>Electrical Shock</b>	Replace and secure covers.
EE-E	Electrical equip room	480-volt in-service electrical supply box is not locked. <b>Electrical Shock</b>	Lock box.
PR-A	Lower-level crib/chem. pump room	P-trap in floor drain potential chemical hazards and/or contamination. <b>Chemical</b>	Plug drain and seal cover.
PR-B	Lower-level crib/chem. pump room	Floor trench; approx. 2 ft x 1 ft x 20 ft filled with granular material (assumed hazardous and/or contaminated). <b>Chemical, Radiological</b>	Clean out trench, apply fixative and/or decontaminate and cover.
PR-C	Lower-level crib/chem. pump room	Solid injection pump; damaged asbestos. <b>Asbestos</b>	Repair damaged asbestos or remove.
PR-D	Lower level crib/chem. pump room	2-in.-diameter pipe with damaged asbestos insulation. <b>Asbestos</b>	Abate asbestos and reapply similar insulation, or encapsulate.
PR-E	Lower level crib/chem. pump room	Northeast floor sump; full of biohazard. <b>Biohazard</b>	Clean area approx. 4-ft x 8-ft x 2-ft-deep. Seal openings to prevent animal intrusion.
PR-F	Lower level crib/chem. pump room	Acid brick floor area; hazardous granular materials around bricks near trench. <b>Chemical</b>	Remove granular material from between trench.
10-A	Accumulator	RBA. <b>Radiological</b>	Survey accumulator room area to facilitate area down posting. Reduce RBA zone to stairs and rod room.

## Appendix C – Room Hazard List – Ancillary Areas

Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action
10-B	Accumulator	Ceiling lights may contain PCB ballasts (eight fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixtures.
MR-A	Sample/ mech. room Level 1	Ceiling lights may contain PCB ballasts (four fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixture.
MR-B	Sample/ mech. room Level 1	Lead – 60 gal lead shot, 26 lead bricks (approx. 2 in. x 4 in. x 8 in.), one partial 0.25-in. lead sheet, six 0.25-in. "LS" 24-in. x 24-in. x 6-in. plates. <b>Lead</b>	Remove and disposition lead.
MR-C	Sample/ mech. room Level 1	Peeling paint, assumed lead-based. <b>Lead</b>	Removed loose/detached lead-based paint. Repaint surfaces with appropriate paint.
SR-2A	Sample room Level 2	Lead; 30 gal lead shot. <b>Lead</b>	Remove and disposition lead.
SR-2B	Sample room Level 2	Ceiling lights may contain PCB ballasts (four fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixture.
SR-2C	Sample room Level 2	Biohazards; animal droppings. <b>Biohazard</b>	Remove animal droppings. Seal openings to prevent future animal intrusion.
SR-3A	Sample room Level 3	Lead; 30 gal lead shot. <b>Lead</b>	Remove and disposition lead.
SR-3B	Sample room Level 3	Ceiling lights may contain PCB ballasts (four fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixture.
SR-3C	Sample room Level 3	Biohazards; animal droppings. <b>Biohazard</b>	Remove animal droppings. Seal openings to prevent future animal intrusion.
SR-3D	Sample room Level 3	Damaged asbestos on pipe elbow, hanger area (approx. 24 in. total) and approx. twelve 6-in.-long asbestos sleeves are unmarked. <b>Asbestos</b>	Repair and/or remove damaged asbestos, properly identify remaining asbestos.
SR-3E	Sample room Level 3	P-trap in floor drain (approx. 8 in. diameter) potential chemical hazards and/or contamination. <b>Chemical, Radiological</b>	Plug drain and seal cover.

**Appendix C – Room Hazard List – Ancillary Areas**

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Hazard ID No. <sup>2</sup>	Room Name	Deficiency/Hazard	Corrective Action
SR-3F	Sample room Level 3	18-in. x 18-in. pipe run opening with no covering; potential path for hazardous substance migration. <b>Chemical</b>	Cover opening.
SR-3G	Sample room Level 3	Peeling paint, assumed lead-based. <b>Lead</b>	Removed loose/detached lead-based paint. Repaint surfaces with appropriate paint.
OR-A	Outer rod room	Oil leaks from nine HCR drive motors and from pump motor. <b>Chemical</b>	Drain oil from equipment; clean up drip area and equipment.
OR-B	Outer rod room	P-traps in floor drains (three total) potential chemical hazards and/or contamination. <b>Chemical, Radiological</b>	Plug drains, replace covers, and seal.
OR-C	Outer rod room	Door to outside is not lockable, potential fall hazard. <b>Falling</b>	Install lock.
FSB-A	Fuel storage basin	Lead; two 0.25-in. lead sheets (oxidized) shielding radiological source within basin. <b>Lead</b>	Replace lead sheets with equivalent thickness of steel plates (2 to 3 in.) Disposition lead sheets.
FSB-B	Fuel storage basin	Helium pump; oil in sight glass. <b>Chemical</b>	Remove oil from pump.
FSB-C	Fuel storage basin	Asbestos covered piping throughout the basin, is not painted pink, but otherwise is in good condition. <b>Asbestos</b>	Regularly inspect asbestos for damage, properly identify asbestos.
FSB-D	Fuel storage basin	Handrail opening is not safe for tours. Openings are too large. <b>Falling</b>	Install tall clear barrier next to rails that are accessible for tours.
FSB-E	Fuel storage basin	Wood decking covering basin may not be structurally sound for tours. <b>Falling</b>	Limit tour routes to accessible walkways that have been structurally approved.
FSB-F	Fuel storage basin	Potential contamination migration from below-grade areas onto tour pathways. <b>Radiological</b>	Cover tour walkways with solid decking to seal off opening between existing deck.
FSB-G	Fuel storage basin	Entire area is posted as an RBA. <b>Radiological</b>	Perform tasks necessary to down post entire above-grade area in FSB (decontaminate, survey).

# Appendix C – Room Hazard List – Ancillary Areas

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Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action
WP-A	FSB wash pad	Spline guide is rigged on dolly with ropes. (Heavy lead shielding unit.) <b>Striking</b>	The spline guide needs to be placed in a more stable position of rest.
WP-B	FSB wash pad	Lead bricks lining outside of wash tank. Painted surfaces. <b>Lead</b>	No action in that the bricks have a painted surface fixing radiological contamination and oxide surfaces.
WP-C	FSB wash pad	Entire area is, or has potential to be, contaminated. <b>Radiological</b>	Perform decontamination and/or seal off area.
WP-D	FSB wash pad	Ceiling lights may contain PCB ballasts (13 fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixture.
WP-E	FSB wash pad	Handrail opening is not safe for tours in elevator shaft. Openings are too large. <b>Falling</b>	Install tall clear barrier next to rails that are accessible for tours.
FSB-F	FSB wash pad	Biohazards; animal droppings, bird nest in elevator shaft. <b>Biohazard</b>	Remove animal droppings and bird nest. Seal openings to prevent future animal intrusion.
TB-A	Transfer bay	Filter press contaminated with alpha, beta, and gamma. Currently fixed with yellow paint. <b>Radiological</b>	Perform characterization activities, package and transport for burial. Decontaminate and/or encapsulate if disposal is not an option.
TB-B	Transfer bay	Five pallets of contaminated lead bricks. <b>Lead</b>	Package and transport for disposition at ERDF. (microencapsulate)
TB-C	Transfer bay	Contaminated Cunno filter. <b>Radiological</b>	Package, transport and grout internal voids for disposition at ERDF. Decontaminate and/or encapsulate if disposal is not an option.
TB-D	Transfer bay	FSB sediment stored in both pits (Category III radiological material). Interim storage in situ. <b>Radiological</b>	Encase in concrete monoliths by subcontractor forming/pumping cement similar to 105-C SSE activity.
TB-E	Transfer bay	P-traps in floor drains (three), potential chemical hazards, and/or contamination. <b>Chemical, Radiological</b>	Plug drain, replace cover, and seal.
TB-F	Transfer bay	Third pit handrail opening is not safe for tours. Openings are too large. <b>Falling</b>	Install tall clear barrier next to rails that are accessible for tours.

## Appendix C – Room Hazard List – Ancillary Areas

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Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action
TB-G	Transfer bay	Damaged asbestos pipe insulation located on west wall near third pit (approx. 2-in. pipe, 4 ft long). <b>Asbestos</b>	Repair and/or remove damaged asbestos, properly identify remaining asbestos.
NS-A	Nozzle shop, Level 2 (front side)	Ceiling lights may contain PCB ballasts (three fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixture.
NS-B	Nozzle shop, Level 2 (front side)	P-traps in floor drains (three), potential chemical hazards, and/or contamination. <b>Chemical, Radiological</b>	Plug drain, replace cover, and seal.
NS-C	Nozzle shop, Level 2 (front side)	Contaminated tools located on tool racks. <b>Radiological</b>	Decontaminate tools and tool rack and/or place clear barrier in doorway.
RF-A	Rear face/ D elevator	Several areas (far side, labyrinth level) covered with animal droppings. <b>Biohazard</b>	Remove animal droppings. Seal openings to prevent future animal intrusion.
RF-B	Rear face/ D elevator	Lead sheets suspended by chain. Five sheets approx. 10 ft x 4 ft x 0.25 in. <b>Lead</b>	Remove if not required for shielding. Package and transport for disposition at ERDF. (microencapsulate)
RF-C	Rear face/ D elevator	Handrail opening is not safe for tours. Openings are too large. <b>Falling</b>	Install tall clear barrier next to rails that are accessible for tours and/or install intermediate rail.
RF-D	Rear face/ D elevator	Reactor nozzles are accessible from D elevator. <b>Radiological</b>	Install tall clear barrier around perimeter of elevator (see 26-C).
RF-E	Rear face/ D elevator	Far-side stairway near landing at Level 2 is damaged and taped together. <b>Falling</b>	Replace top handrail.
TS-A	Tool storage, Level 2 (north side)	Concrete block lintel over doorway; left corner missing pieces. <b>Striking</b>	Repair or replace concrete door lintel and concrete block.
TS-B	Tool storage, Level 2 (north side)	Outside door can be opened, allowing two-story drop. <b>Falling</b>	Install lock on door.
TS-C	Tool storage, Level 2 (north side)	Roof access door can be opened, allowing access to roof. <b>Falling</b>	Install lock on door.

**Appendix C – Room Hazard List – Ancillary Areas**

<b>Hazard ID No.<sup>a</sup></b>	<b>Room Name</b>	<b>Deficiency/Hazard</b>	<b>Corrective Action</b>
TS-D	Tool storage, Level 2 (north side)	P-trap in floor drain. Potential for hazardous chemicals and/or contamination. <b>Chemical, Radiological</b>	Install plug in drain and seal cover over drain opening.
TS-E	Tool storage, Level 2 (north side)	Ceiling lights may contain PCB ballasts (four fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixture.
TS-F	Tool storage, Level 2 (north side)	Contaminated tools located on tool racks and shelves. <b>Radiological</b>	Decontaminate tools, tool racks, and shelves and/or place clear barrier in doorway.
DS-A	Decon shop, Level 3 (front side)	Ceiling lights may contain PCB ballasts (four fixtures). <b>PCB</b>	Remove/replace with nonhazardous light fixture.
DS-B	Decon shop, Level 3 (front side)	P-trap in floor drain, potential chemical hazards, and/or contamination. <b>Chemical, Radiological</b>	Plug drain, replace cover, and seal.
DS-C	Decon shop, Level 3 (front side)	Floor shaft; space between screen top and floor could allow access. <b>Falling</b>	Install clear barrier.
SW-A	Stairwell (front side)	Landing door to outside can be opened. <b>Falling</b>	Install lock on door.
MA-A	D machinery area	Two doors open to top of reactor. <b>Radiological</b>	Lock doors or install clear barrier.
MA-B	D machinery area	Two doors (near side and far side) open to the outside. <b>Falling</b>	Install locks on doors.
MA-C	D machinery area	Seven roof panels appear to have water stains and possible damage. <b>Striking</b>	Perform thorough inspection to determine condition of panels. Repair with Unistrut system (ECN 600275) if necessary.
TR-A	Top of reactor	This area is posted as a CA. <b>Radiological</b>	Decontaminate top of reactor or install clear barriers.
TR-B	Top of reactor	Stairs and front side guardrails have too large of an opening. <b>Falling</b>	Install tall clear barrier next to rails that are accessible for tours and/or install intermediate rail.
WA-A	Winch area	Stairs guardrails have too large of an opening for public access. <b>Falling</b>	Install tall clear barrier next to rails that are accessible for tours and/or install intermediate rail.

# Appendix C – Room Hazard List – Ancillary Areas

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Hazard ID No. <sup>a</sup>	Room Name	Deficiency/Hazard	Corrective Action
WA-B	Winch area	A roof panel appears to have possible damage. <b>Striking</b>	Perform thorough inspection to determine condition of panel. Repair with Unistrut system (ECN 600275) if necessary.
X1-A	X-1 level	Stair guardrail sections are missing, other sections have too large of an opening. <b>Falling</b>	Repair/reinstall stair guardrails and/or install tall clear barrier next to rails that are accessible for tours.
X1-B	X-1 level	Floor plate edging over decking overlaps exposing edge. <b>Tripping</b>	Remove steel plates or butt them together.
MS-A	Maintenance shop	Reactor components and shelving contain contaminated hardware. <b>Radiological</b>	Decontaminate area and downpost or install clear barrier.
IA-A	Instrument area below grade (front side)	Reactor instrumentation insertion components are contaminated. <b>Radiological</b>	Completely decontaminate area and components or install clear barrier.
IA-B	Instrument area below grade (front side)	Pipe trench is open to the pipes. <b>Falling</b>	Install clear barrier.
IA-A	Instrument area below grade (north side)	Stairs on left side of C elevator behind work area display allow access to this area. <b>Radiological, Confined Space</b>	Install clear barrier and identify as a confined space.
DV-A	Downcomer valve room	Valve room in cushion chamber corridor has heavy lead/steel door. Pipe has spool piece removed and is open. No guardrail around opening to bottom of vault. <b>Falling, Radiological</b>	Pin door open and install clear barrier or secure door in closed position.
PT-A	Pipe tunnels	The process water and gas recirculation tunnel entrances are accessible. <b>Falling, Radiological, Confined Space</b>	Install barriers and identify hazards present.

<sup>a</sup> Hazard identification number refers to room numbering sequence (where applicable) shown in Figure 1.

- CA = contamination area
- ERDF = Environmental Restoration Disposal Facility
- FSB = fuel storage basin
- HCR = horizontal control rod
- PCB = polychlorinated biphenyl
- OSHA = Occupational Safety and Health Administration
- RBA = radiological buffer area
- SSE = safe storage enclosure

**APPENDIX D**  
**ROOM HAZARD LIST – ESTIMATE ASSUMPTIONS**

## APPENDIX D

## ROOM HAZARD LIST – ESTIMATE ASSUMPTIONS

Hazard ID No.	Room Name	Cost Estimate Assumptions - Details
FR-A	Fan room	Roof repair; Unistrut cost \$2,300 (1994) assuming 8-ft ceiling installation; add for extra scaffolding and/or installing around pipes/obstructions.
FR-B	Fan room	Plexiglas barrier 87-ft-long x 6-ft-high.
FR-D	Fan room	Barriers = four at 10-ft-wide each.
FR-E	Fan room	Void.
FR	Fan room	Install lighting and fire protection equipment; room square footage = 7,800 total; corridor = 2,200; fire protection = one alarm (light and bell) and one pull-box (estimate location near exit door).
14-A	Lunch room areas	Approximately 30 damaged tiles throughout the entire floor. Entire area approx. 15 ft x 22 ft or 330 ft <sup>2</sup> .
14-B	Lunch room kitchen area	Ceiling looks like standard 0.5-in. drywall material.
14-C	Lunch room areas	Damaged paint area: north room along west wall approximately 22 ft x 5 ft, ceiling area of middle room approx. 10 ft x 12 ft, south room on transite wall next to staircase approx. 12 ft x 12 ft.
14	Lunch room	Total area is approx. 1,350 ft <sup>2</sup> .
14-G	Lunch room	Crack in floor is approximately 8-ft-long and 2-in.-high.
20-A	Electrical equip room	Install Plexiglas covers on the two panels, both approx. 10 ft x 7 ft.
20	Electrical equip room	Room area approx. 575 ft <sup>2</sup> .
IR-C	Instrument room	Install Plexiglas across room 6 ft by 6-ft-high.
IR-B	Instrument room	Room area approx. 375 ft <sup>2</sup> .
02-A	Men's restroom	Room area approx. 150 ft <sup>2</sup> .
21-A	Women's restroom	Room area approx. 50 ft <sup>2</sup> .
CC-A	Cushion cham corridor	Roof repair; Unistrut cost \$2,300 (1994) assuming 8-ft ceiling installation; add for extra scaffolding and/or installing around pipes/obstructions.
CC-B	Cushion cham corridor	Install Plexiglas barrier L-shaped 12 ft down center of corridor and 6 ft to the wall. Must include door for access to west corridor.

## Appendix D – Room Hazard List – Estimate Assumptions

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Hazard ID No.	Room Name	Cost Estimate Assumptions - Details
CC	Cushion cham corridor	Room area approx. 300 ft <sup>2</sup> .
FV-B	FSB viewing room	Room area approx. 352 ft <sup>2</sup> .
E-A	Exterior of entire building	Entire perimeter flashing will require scraping loose paint and repainting (assume lead-based); approximately 10% of this perimeter has metal flashing that is loose or has fallen to the ground. Assume perimeter of the building is 1,200 ft and flashing area is 12-in.-wide located approx. 12 ft above grade. Damaged flashing approx. 120 ft (at 4 ft each piece = 30 pieces to repair).
E-B	Exterior of entire building	Wooden areas: overhead handrails assumed to be constructed of three 2-ft x 4-ft on 8-ft sections. Estimate a total of 270 linear ft of railing sections. Above-grade decking: estimate approx. 250 ft <sup>2</sup> in need of scraping and painting. Assume 30% deteriorated to unsafe condition in five locations = 80 linear ft of railing and 75 ft <sup>2</sup> of decking to rebuild/replace.  Assume 20 occurrences of scraping and repainting total of 150 ft <sup>2</sup> of miscellaneous deteriorated lead-painted surfaces.
E-C	Exterior of entire building	Assume four occurrences of reattaching miscellaneous pipes/conduits, two at grade and two at 20 ft.
E-D	Exterior of entire building	There are approximately 25 pipe insulation ends that have breached the encasement. Additionally approximately 55 ft of damaged encasement occurring at three separate locations.
E-E	Exterior roof of entire building	Okay.
E-F	Tool storage room	Two 80-ft sides at 12-ft-high, plus one 17-ft end.
E-H	Outside elect. equip. room	Three transformers.
E-I	Wood shack near exhaust plenum	Shack is 6-ft-wide by 15-ft-long; 3-ft door opening. Tar roof appeared to be okay. All three sides need paint scraped and repainted. Clean out biohazards, install and seal Plexiglas door.
E-J	Door replacement	Door replacement (see map).
E-L	Exterior protrusions	Approximately 12 occurrences around the reactor.
E-M	Exterior of exhaust plenum	Approximately 50 ft total length, broken in the middle, approximately 25 ft above grade, with four overhead lights attached.

FSB = fuel storage basin

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