BHI-01710
Rev. 0

105-F Reactor Interim Safe Storage Project Final Report

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

Submitted by: Bechtel Hanford, Inc.

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For ERC Review

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ACRONYMS

BHI	Bechtel Hanford, Inc.
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CMU	concrete masonry unit
CVP	cleanup verification package
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DQO	data quality objective
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERC	Environmental Restoration Contractor
ERDF	Environmental Restoration Disposal Facility
Ecology	Washington State Department of Ecology
FIG	field implementation guide
FSB	fuel storage basin
FY	fiscal year
ISS	interim safe storage
LSFF	105-DR Large Sodium Fire Facility
PCB	polychlorinated biphenyl
RCT	radiological control technician
RESRAD	RESidual RADioactivity dose model
RL	U.S. Department of Energy, Richland Operations Office
ROD	Record of Decision
S&M	surveillance and maintenance
SAP	sampling and analysis plan
SSE	safe storage enclosure
TP&L	temporary power and lighting
TSD	treatment, storage, and disposal
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
VAC	volt-alternating current

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
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
Area			**Area**		
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	0.836	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
Mass (weight)			**Mass (weight)**		
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
Volume			**Volume**		
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			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerels	0.027	picocuries

1.0 SCOPE

The following information documents the decontamination and decommissioning (D&D) of the 105-F Reactor facility and placement of the reactor core into interim safe storage (ISS). The D&D of the facility included characterization, engineering, removal of hazardous and radiologically contaminated materials, equipment removal, decontamination, demolition of the structure, and restoration of the site. The ISS work also included the construction of the safe storage enclosure (SSE), which required the installation of a new roofing system, power and lighting, a remote monitoring system, and ventilation components.

2.0 FACILITY DESCRIPTION AND CONDITIONS

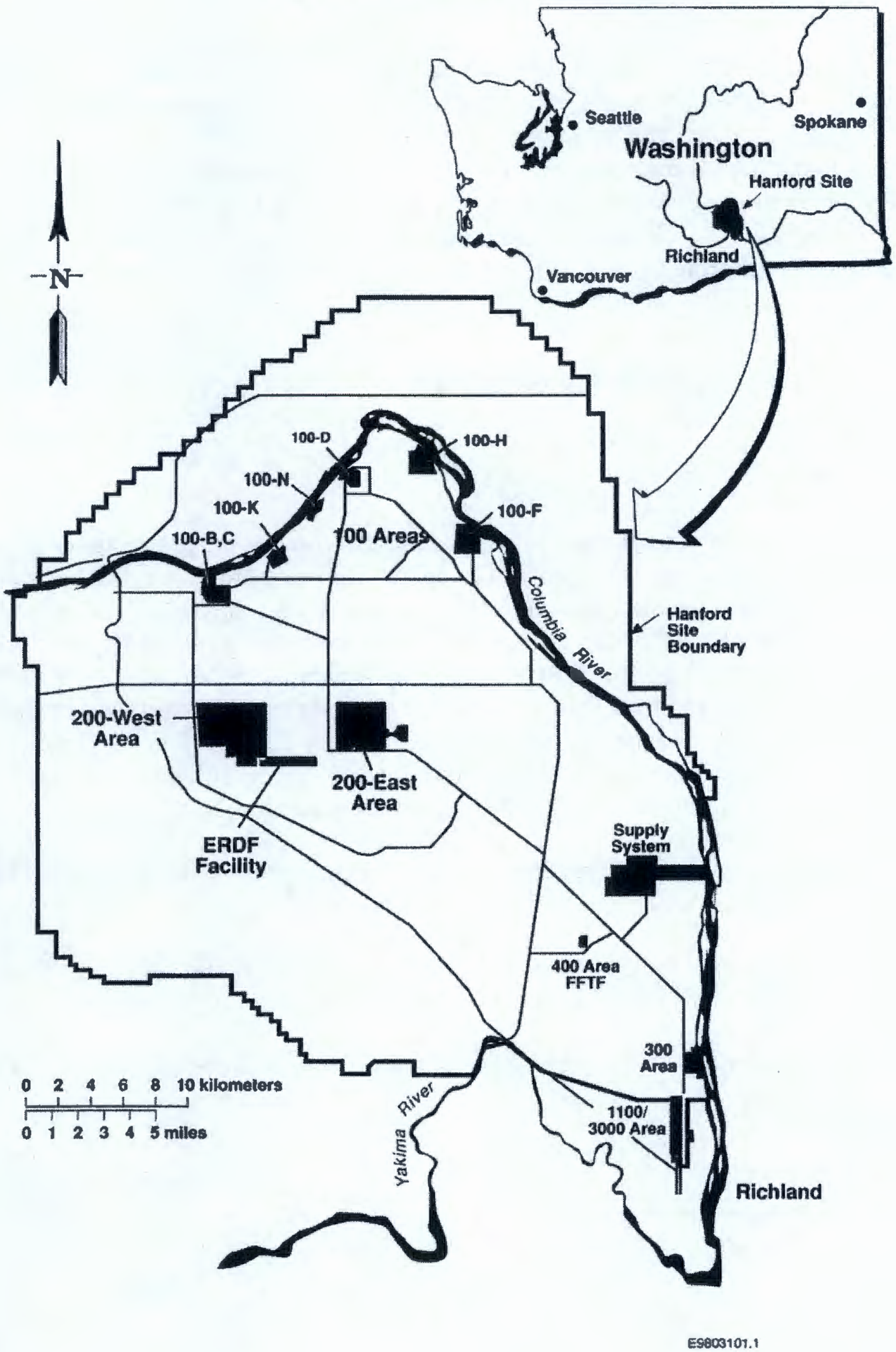
2.1 HISTORY

In 1942, the U.S. Government commissioned the Hanford Site for the production of plutonium for use in weapons production. Between 1942 and 1955, eight water-cooled, graphite-moderated production reactors were constructed along the Columbia River in the 100 Areas of the Hanford Site. The construction of the first three Hanford reactor facilities (B, D, and F Reactors) utilized the same design drawings. The 105-F Reactor facility is located in the 100-F Area of the Hanford Site, as shown in Figure 1. Construction of the F Reactor was initiated in December 1943. Initial startup of the reactor was achieved on February 25, 1945. The F Reactor was shut down on June 25, 1965. Until the start of the Interim Safe Storage (ISS) Project, the F Reactor had been in a condition of minimum surveillance and maintenance (S&M).

In the years following deactivation, several significant cleanup efforts were completed at the 105-F Reactor complex:

- The 105-F and 105-H fuel storage basin (FSB) sediment was stabilized in place in 1970 with approximately 6 m (20 ft) of soil backfill, and was left in place (UNI 1986b).
- The 105-F Reactor exhaust stack (116-F) was demolished in 1983 (UNI 1985) (UNI 1986a).

Figure 1. Hanford Site Map.



2.2 FACILITY DESCRIPTION

The 105-F Building was 82.7 by 95.8 by 28.3 m (271.3 by 314.3 by 92.9 ft) in height. The lower levels of the building and the central portions surrounding the reactor are constructed of reinforced concrete. A floor plan layout at ground level is shown in Figures 2 and 3. The massive reinforced-concrete walls surrounding the reactor are 0.9 to 1.5 m (3 to 5 ft) thick. The upper portion of the building and many of the at-grade ancillary rooms were steel framed, enclosed with either sheet metal or concrete masonry unit (CMU) blocks. The existing roof panels were removed from the FSB, transfer bay, process area, D elevator, and front-face work area in 1994 and 1995 and were replaced with steel decking, which was secured to the existing roof framing and concrete walls. The new steel roof decking was covered with sheetrock, polyurethane foam, and two applications of silicon rubber. An aerial photo looking east is shown in Figure 4. An aerial photo looking south is shown in Figure 5.

2.3 DECOMMISSIONING DECISIONS

After deactivation, the 105-F Reactor was in a condition of minimum S&M. Significant deterioration occurred, particularly in the roof sections over the fan room and work area. Permanent decommissioning alternatives for the Hanford Site production reactors were assessed in the *Final Environmental Impact Statement, Decommissioning of the Eight Surplus Production Reactors at the Hanford Site* (DOE 1992). A Record of Decision (ROD) was issued by the U.S. Department of Energy (DOE) (58 *Federal Register* [FR] 48509). The ROD alternative selected is to place the reactors into a safe storage condition for up to 75 years. After ISS, the reactors would be transported in one piece to a specially prepared burial facility in the 200 West Area of the Hanford Site.

The 105-C Reactor was the first reactor to complete ISS in September 1998 (BHI 1998a). The 105-DR and 105-F Reactors were selected to be the next follow-on reactors to be placed in ISS in order to reduce the costly burden of maintaining and cleaning up inventory of the aging reactors. The 105-DR Reactor was placed in ISS in September 2002 (BHI 2003a).

The plan for the ISS of the 105-F Reactor included removing all portions of the reactor facility outside of the reactor block shield walls. The areas removed include the FSB, outer rod room, control room, electrical room, switchgear room, lunch room, office space, fan supply and exhaust rooms, sample rooms, ready room, upper reactor framing and roofing, and other miscellaneous rooms and tunnels. The remaining portion of the reactor facility (the areas inside the concrete shield walls) is called the SSE, and the design and construction is discussed in detail in Section 8.0.

Figure 2. Pre-Demolition Floor Plan Layout at Ground Level.

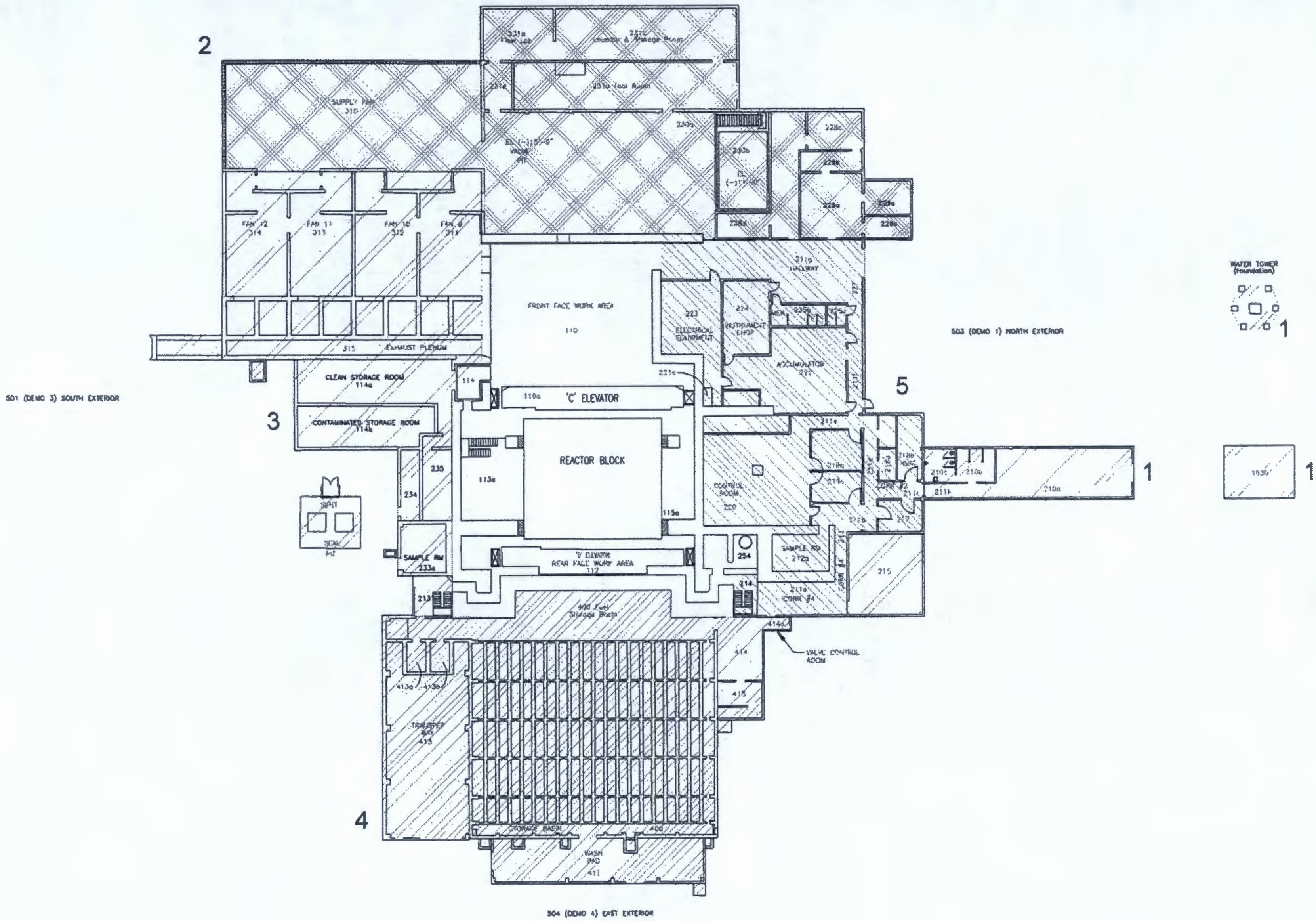


Figure 3. General Plan of 105-F Safe Storage Enclosure at Ground Level.

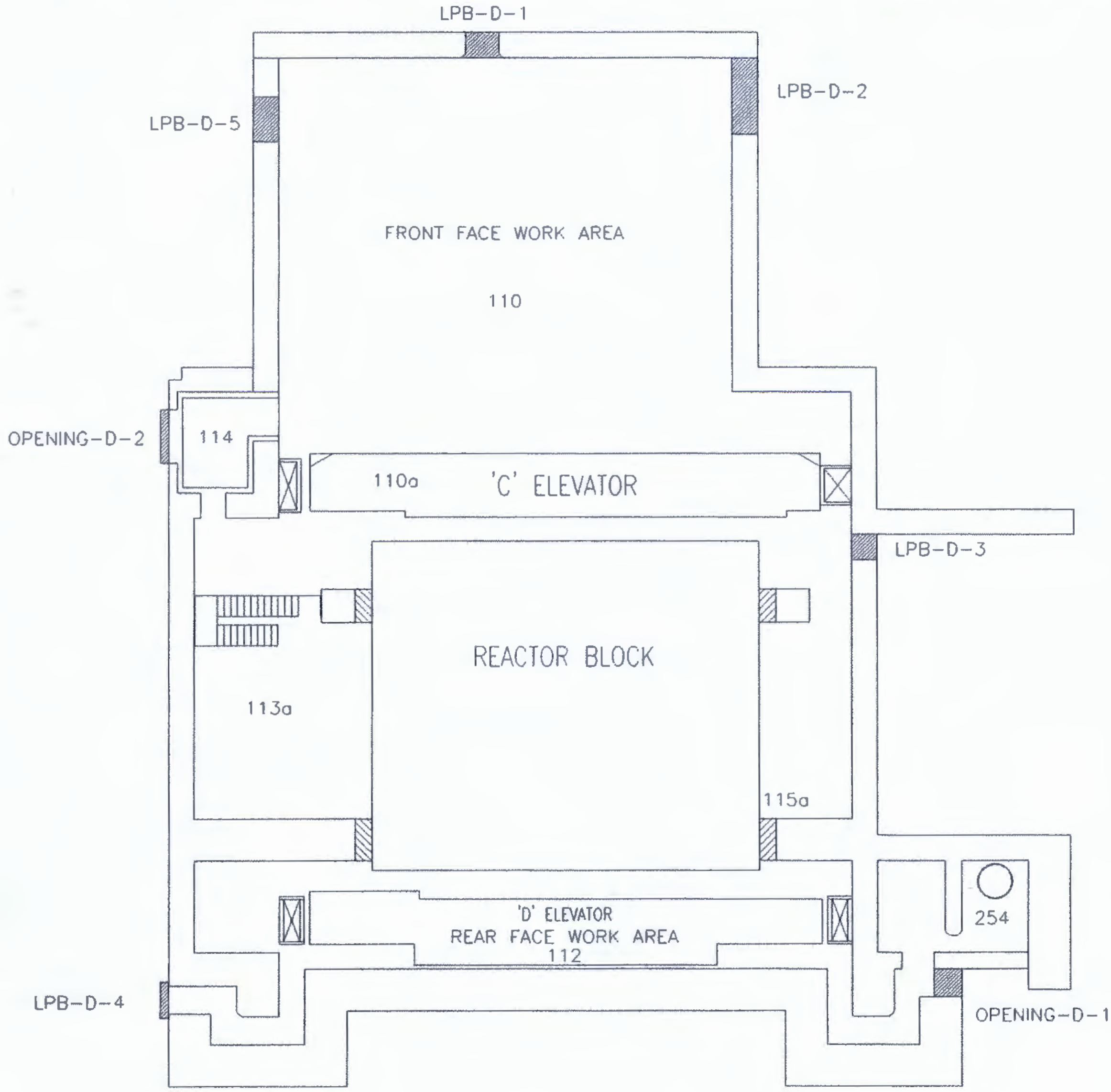
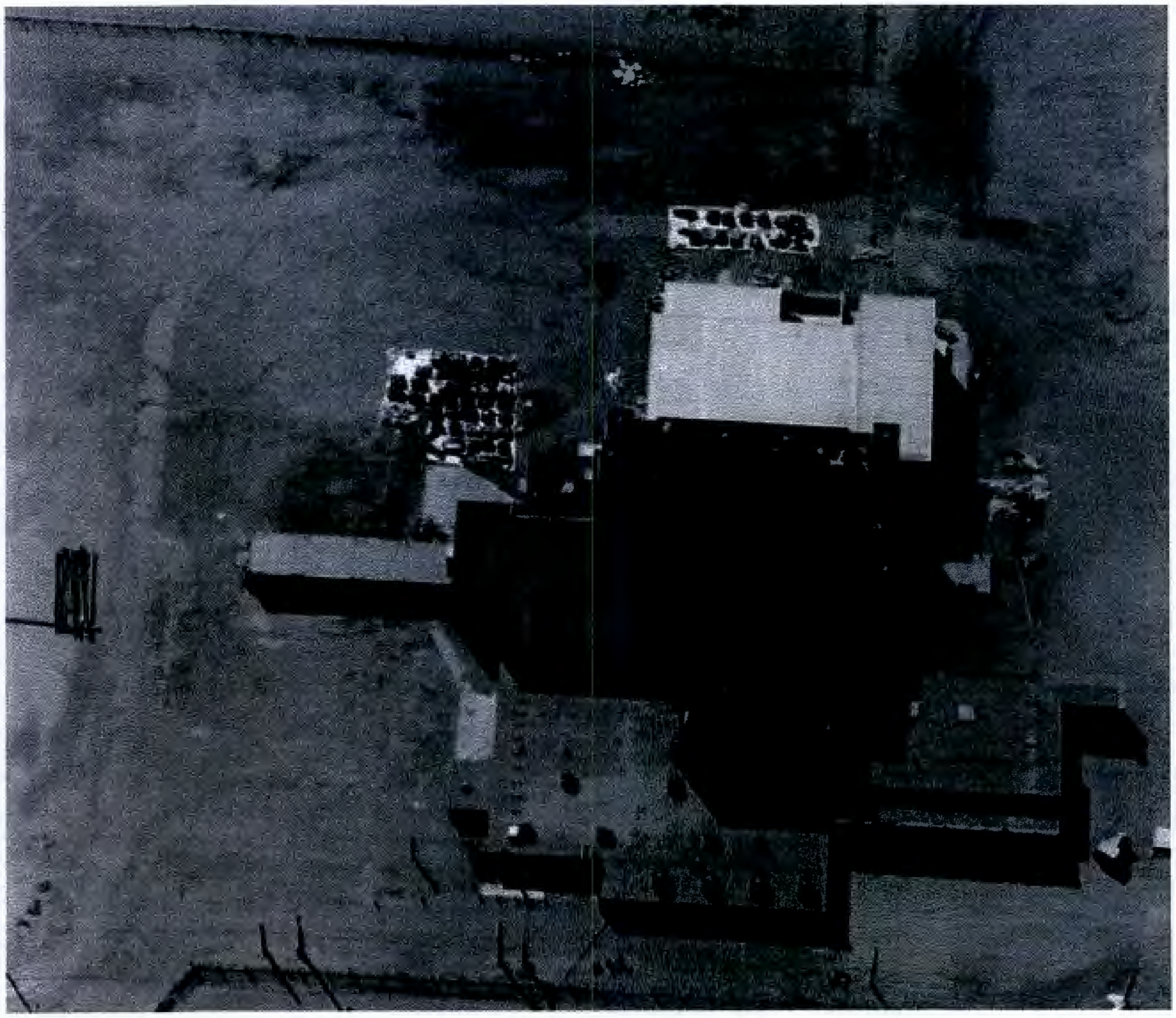


Figure 4. Pre-D&D Aerial Photo (Looking East to West).

Figure 5. Pre-D&D Aerial Photo (Looking North to South).



The planning process for the 105-F ISS Project was conducted jointly between the U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (Ecology), and the U.S. Department of Energy, Richland Operations Office (RL). The up-front planning for the project allowed waste disposal to the Environmental Restoration Disposal Facility (ERDF) and streamlined the process for releasing DOE real property. The working relationships between DOE, EPA, and Ecology were greatly strengthened through open communication and cooperation for developing solutions to streamline the D&D planning process. The 105-F ISS Project was the third D&D reactor implementing the process for conducting decommissioning under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) at the Hanford Site (which is a joint strategy between EPA and DOE). Additionally, the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1998b) was revised to reflect the planning process employed by the 105-F ISS Project, including milestones for 105-F and the follow-on reactors.

3.0 ENGINEERING EVALUATION/COST ANALYSIS

The *Engineering Evaluation/Cost Analysis for the 105-DR and 105-F Reactor Facilities and Ancillary Facilities* (DOE-RL 1998a) (EE/CA) resulted in the recommendation to decontaminate and demolish the contaminated reactor buildings (except for the reactor blocks and shield walls) and the ancillary facilities, and to construct an SSE over the reactor. The recommendation was approved in an action memorandum (Ecology et al. 1998a) signed by Ecology, EPA, and DOE. The DOE is the agency responsible for implementing the removal actions in the 105-D/DR and 105-F Areas. Ecology is the lead regulatory agency for facilities in the 100-D/DR Area, and EPA is the lead regulatory agency for facilities in the 105-F Area.

4.0 PROJECT ACTIVITIES

4.1 ENGINEERING AND PERMITS

A removal action work plan (DOE-RL 2002a) was prepared to satisfy the requirements in the action memorandum (Ecology et al. 1998a), outlining how compliance with and enforcement of applicable regulations will be achieved for cleanup and ISS of the reactor building. Additionally, DOE-RL (2002a) serves as the decommissioning plan and project management plan for the 105-F ISS Project. The removal action work plan was prepared in accordance with Section 7.2.4 of the Tri-Party Agreement (Ecology et al. 1998b) and approved by RL and the regulators.

The removal action work plan established the methods and activities to perform the following removal action functions:

- Modify structure, as necessary, and construct ISS enclosure for the 105-F Reactor building
- Remediate waste sites within the reactor footprint or provide for deferral to the remedial action waste disposal program (with approval from the lead regulatory agency)
- Manage and dispose of all waste generated during these actions.

The action memorandum (Ecology et al. 1998a) specifies other deliverables that must be submitted by DOE to the lead regulatory agencies for review and approval. The removal action work plan describes the deliverables and provides a schedule for meeting the deliverables. The deliverables specified in the action memorandum and discussed in the removal action work plan include the following:

- Sampling and analysis plans (SAPs) for waste and soil characterization and disposal (DOE-RL 1998b, 1998c)
- Treatment plans if treatment is necessary prior to waste disposal in the ERDF
- Verification SAPs for soil and below-grade structures (see Section 4.9)
- Cleanup verification package (CVP) (planned for completion in FY 2004).

The intent of the removal action work plan (DOE-RL 2002a) is to identify the basis and provide guidance for preparation of work packages for the project tasks. Using the most recent information concerning facility conditions, field-level work packages were developed to direct work activities and instruct workers in the most applicable work methods.

The 105-F ISS and ancillary building project schedule, which encompasses the workscope through project completion, presents the logical progression of events and estimated durations for each activity.

The removal action objectives were as follows:

- To the extent practicable, reduce potential future releases of hazardous substances contained within facilities to acceptable protection levels established in applicable or relevant and appropriate requirements
- Protect workers from the hazards posed by these facilities
- Prevent adverse impact to cultural resources and threatened or endangered species
- Safely manage (e.g., treat or dispose) waste streams generated by the removal action
- Reduce or eliminate the need for future S&M activities
- Place the 105-F Reactor Building into ISS
- Coordinate with the Bechtel Hanford, Inc. (BHI) remedial action waste disposal program to address waste sites or activities that may interfere with the disposition of the 105-F Reactor Building or ancillary facilities.

Prior to the ISS Project, the 105-F Reactor was under the control of the Surveillance/ Maintenance and Transition Projects group. The control of the building was temporarily assigned to D&D Projects to perform the ISS work. A memorandum of understanding (BHI 1998c) accomplished this change of control.

An ecological and cultural review (BHI 1998b) was performed prior to mobilization at the 105-F Reactor site. The findings of the ecological review (BHI 1998b) for the 105-F Reactor Building revealed no species of concern, and impacts to ecological resources were not anticipated. Mitigation strategies were evaluated and implemented, as appropriate, throughout the life of the project. In the spring of 2001 and 2003, a Horned Owl nested on an exterior section of the SSE (beam pocket and stairway landing, respectively) and raised a fledgling. Necessary activities, such as pourback placement in the stairway landing, were delayed until the fledgling had matured and left the nest. During SSE construction live specimens of small-footed Myotis bats and Pallid bats were found within the reactor building, and numerous small deposits of scattered feces were found throughout. At the completion of the SSE, a one-way bat door was placed on the only remaining exit from the building, and bat houses specifically designed for Myotis and Pallid bats were placed on the exterior walls of the building. The presence of both types of bat droppings at the base of the one-way bat door and at the bat houses verified that the Myotis and Pallid bats had exited the building and were using the bat houses at the time the bat door was removed and the building sealed. No other species of concern were identified either inside or in areas surrounding the 105-F Reactor Building.

Plant forces work reviews were performed on the entire scope of work required to bring the 105-F Reactor into its final state of ISS. The plant forces work reviews are documented in BHI (1998d, 1998e, 1998h, 1998i).

The final hazard classification and auditable safety analysis for the 105-F ISS Project (BHI 2001) summarizes the inventories of radioactive and hazardous materials present within the 105-F Reactor. BHI (2001) also documents the operations associated with the ISS Project, which include decontamination, demolition, and construction of the SSE. This document also identifies accident scenarios, performs a bounding evaluation of the consequences of the potentially significant accident scenario, and establishes a hazard classification based on the bounding consequence evaluation. The result of the evaluation is that the final hazard classification for the 105-F ISS Project is "radiological."

4.2 MOBILIZATION

Site mobilization activities in support of pre-demolition house cleaning, asbestos and hazardous material removal, and liquid pipe checks were initiated in January 1998 (FY 1998). Initial activities consisted of setting up the field support and radiological control technician (RCT) lunch trailers, and the associated electrical and telephone systems. Parking areas were graded and graveled for the workers, which completed mobilization activities outside the reactor fence.

Inside the fence, MODEC trailers and water trailers were set up for the asbestos workers, and numerous trailers were set up for D&D equipment and supplies. The final step in mobilization was to utilize the temporary power and lighting (TP&L) system marked as "In Service" previously installed by the BHI Surveillance/Maintenance and Transition Projects.

Electrical isolation was ensured by visual inspection of the TP&L to assure no old feeds to the original AC power distribution system back feeds remained.

4.3 READINESS ASSESSMENTS

The project manager determined that the reactor ISS Projects following C Reactor ISS would conduct the pre-work demolition activities "readiness evaluation" using a graded approach in accordance with the requirements of BHI-MA-02, *ERC Project Procedures*, Procedure 8.2, "Readiness Assessments." The F Reactor was the first to commence follow-on ISS demolition activities. The readiness evaluation used the standard field support construction checklist (with modifications) as the basis for the remedial assessment. The readiness evaluation was conducted prior to initiating work on the F and DR Reactor ISS Projects (BHI 1998f). The primary objectives of the pre-work readiness evaluation was to determine if (1) the projects were ready to begin from an administrative standpoint, (2) all the required resources were available, and (3) all work activities could be accomplished safely.

The readiness evaluation concluded that the projects were ready to proceed as scheduled, pending completion of specified pre-start and post-start construction punchlist items (BHI 1998g).

4.4 HAZARDOUS MATERIAL REMOVAL

The scope of the demolition project included removing and properly disposing flammable and hazardous materials (e.g., oils, grease, asbestos-containing material, mercury, lead, and polychlorinated biphenyls [PCBs]). All known flammable and hazardous material was removed inside and outside of the SSE, with the exception of nonremovable lead (as discussed below). All of the removed material was typically removed prior to heavy equipment demolition, with the exception of the lead joints in bell and spigot piping and a few heavy pieces of lead-encased equipment (which was carefully removed during the demolition).

4.4.1 Asbestos (Excluding Transite)

Asbestos monitoring was performed in support of asbestos-removal activities. Removal work activities included the use of glovebags, a cut-and-wrap technique, and negative-pressure enclosures. Applicable areas were sprayed with lock-down after the asbestos work. An asbestos clearance sampling and inspection program was implemented to release each area from asbestos concerns following the asbestos abatement in each area. Approximately 187 m^3 (6,600 ft^3) of asbestos insulation was removed.

4.4.2 Transite (Cement Asbestos Board)

There were double transite panels in most of the interior rooms. Many panels were radiologically released and were disposed offsite. Radiologically contaminated transite was shipped to the ERDF for disposal.

4.4.3 Lead

Lead-based paint was originally used throughout the facility, but resultant concentrations were determined to be below regulatory limits. The majority of lead encountered during D&D was in the form of bricks; however, lead was encountered in additional forms, as follows:

- Sheet material
- Small lead balls
- Lead poured around piping and p-traps
- Lead poured into interior cavities of equipment (e.g., turrets)
- Lead joints from bell and spigot drain piping
- Light bulbs.

Appendix G of the *Radionuclide Inventory and Source Terms for the Production Reactors at Hanford* (UNI 1987) provided a list of the lead inventory at the 105-F Reactor. The ISS Project could not remove lead from inside the reactor block (72,575 kg [160,000 lb]).In addition, the ISS Project identified six lead items as components that are not practical to remove. The locations and estimated weights are as follows:

Horizontal control rod shielding	8,618 kg (19,000 lb) (attached to the rod rack)
Vertical rod tip shield block	11,340 kg (25,000 lb) (not practical to remove)
"D" elevator overhead lights	1.4 kg (3 lb) (attached to work area ceiling)
East and West Experimental Room Shield Walls	45,000 kg (99,000 lb) (attached to SSE walls)

UNI (1987) inventoried 95 metric tons (105 tons) of lead. During D&D, 8 metric tons (9 tons) of lead was removed from the reactor building and macroencapsulated at ERDF.

4.4.4 Mercury

Mercury was found in numerous switches, manometers, and instruments. Approximately 3.8 L (1 gal) of mercury was collected and amalgamated for disposal in the ERDF.

4.4.5 Polychlorinated Biphenyls

No regulated quantities of PCBs were found in any of the grease or oil. The main transformer was the property of the Hanford Utility Group, who handled its disposal. Light ballasts and some applied dried paints were the only PCB waste stream requiring 105-F ISS Project disposal.

4.5 EQUIPMENT REMOVAL

Some of the major equipment removed during the ISS Project is listed in Table 1.

Table 1. Major Equipment Removed During the ISS Project.

Description	Location
29 vertical safety rod drives	Upper reactor
Vertical safety rod drive crane	Upper reactor
Ball 3X delivery system	Upper reactor
Rear-face elevator drive equipment	Upper reactor
Front-face elevator drive equipment	Upper reactor
East Side counterweight (West Side counterweight was lowered but not removed)	East Side exterior of SSE
Horizontal control rod drives and cooling equipment	Outer rod room
Control room equipment	Control room
Leak detection turrets	Sample rooms
Fan equipment	Fan supply and exhaust rooms
Fuel loading equipment	Metal storage room
Heat exchanger	Valve pit
Cask crane	Transfer bay
Compressor	Compressor room
Vacuum receiver	Vacuum system room
Gas piping	Gas tunnel 13
Water supply piping	North and south water tunnels
Electrical equipment	Upper electrical room
Switchgear equipment	Switchgear room

The reactor block itself was disturbed as little as possible.

- During initial deactivation in 1965, the 9 horizontal control rods and the 29 vertical safety rods were placed in the "full-in" position into the reactor (GE 1965). The ISS Project did not touch the rods, but their drive shafts and cables were disconnected and removed.

- Also during deactivation, all 2,004 process tubes were emptied and a "plastic noodle" was placed through the tube to verify that the tube was empty (GE 1965). The ISS Project did not remove any process tube caps on the front or rear face.

- The Ball 3X system has the ball-hoppers full of boron-steel balls. The Ball 3X system was left intact and each of the 29 hoppers contains about 420 kg (925 lb) of balls.

- Concrete pourbacks (61 cm [24 in.] thick) were placed in the gas tunnel in line with the remainder of the SSE shield wall. Thus, the gas tunnel piping was severed inside of this pourback.

4.6 DEMOLITION OF ABOVE-GRADE STRUCTURES

After the hazardous materials and isolations were performed (as discussed in Sections 4.4 and 4.5), the above-grade structures were ready for demolition. Demolition was performed based on whether the areas were relatively radiologically "clean" or contaminated.

Many areas of the reactor (e.g., fan supply room, office spaces, control room, and electrical room) had very little radiological contamination. For these areas, surveys were performed and local contamination was removed. These areas were then ready for clean demolition, and the resulting waste recycled or sent offsite for disposal.

For contaminated areas of the building, it was not cost effective or safe to decontaminate entirely. The major portion of the loose contamination was removed and a fixative was applied as required. Figure 7 shows demolition in progress on the outer rod room.

The building structure was demolished using excavator-mounted hydraulic shears and a hoe-ram. The debris was segregated for disposal or salvage.

The original footprint area of the reactor building was approximately 4,994 m^2 (53,750 ft^2). The final footprint area of the SSE is 999 m^2 (10,750 ft^2) (see Figure 2, white area is SSE footprint, shaded areas were demolished). Thus, the footprint area of the reactor was reduced by 80%. To avoid confusion, the footprint area is strictly the at-grade area and does not include the square footage of any above-grade rooms (e.g., sample rooms, ready room, upper electrical room, or exhaust plenums) or below-grade rooms/tunnels.

Figure 6. Photo Showing Exhaust Fan Room and Exhaust Tunnels Demolition in Progress.

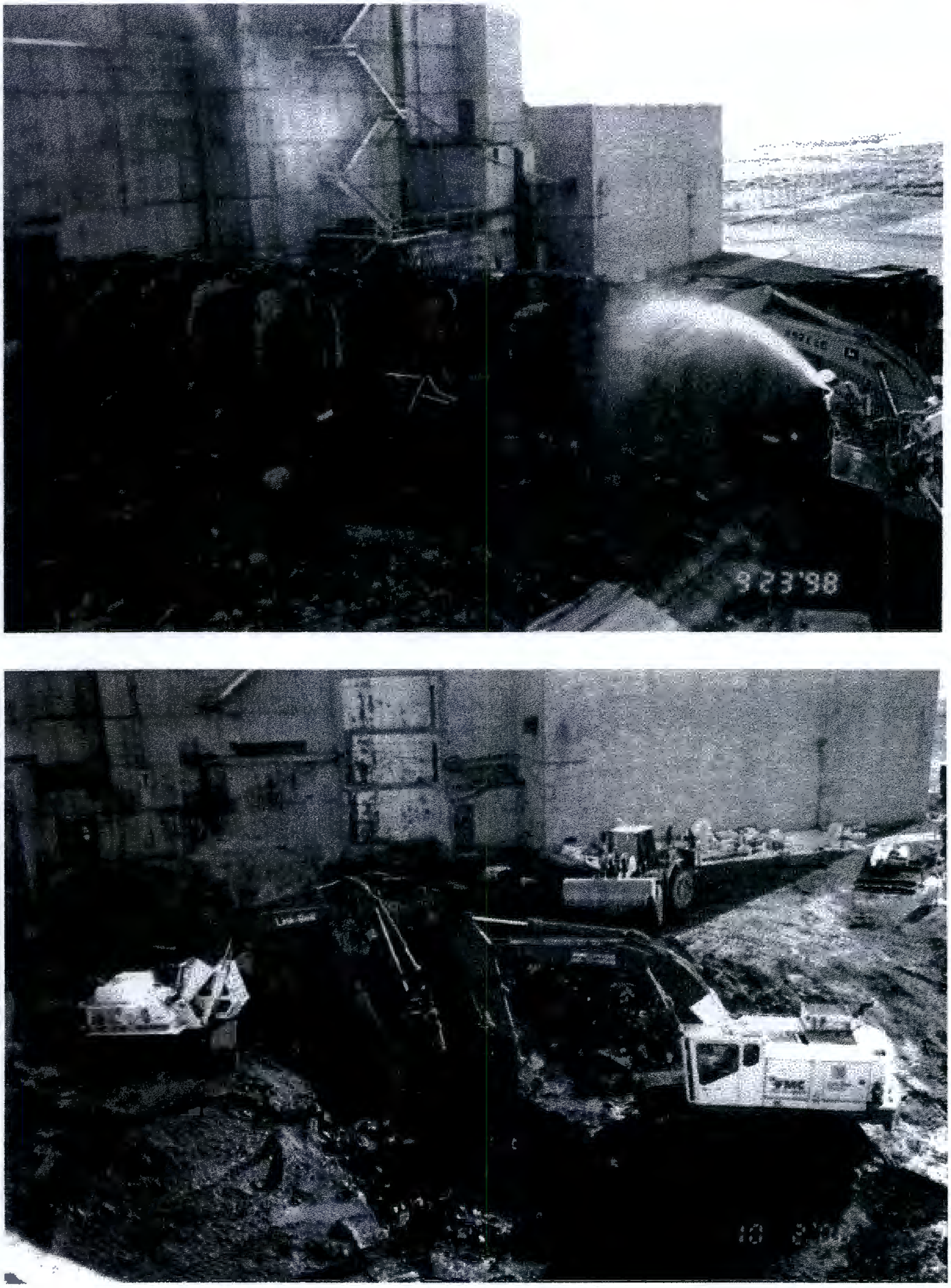
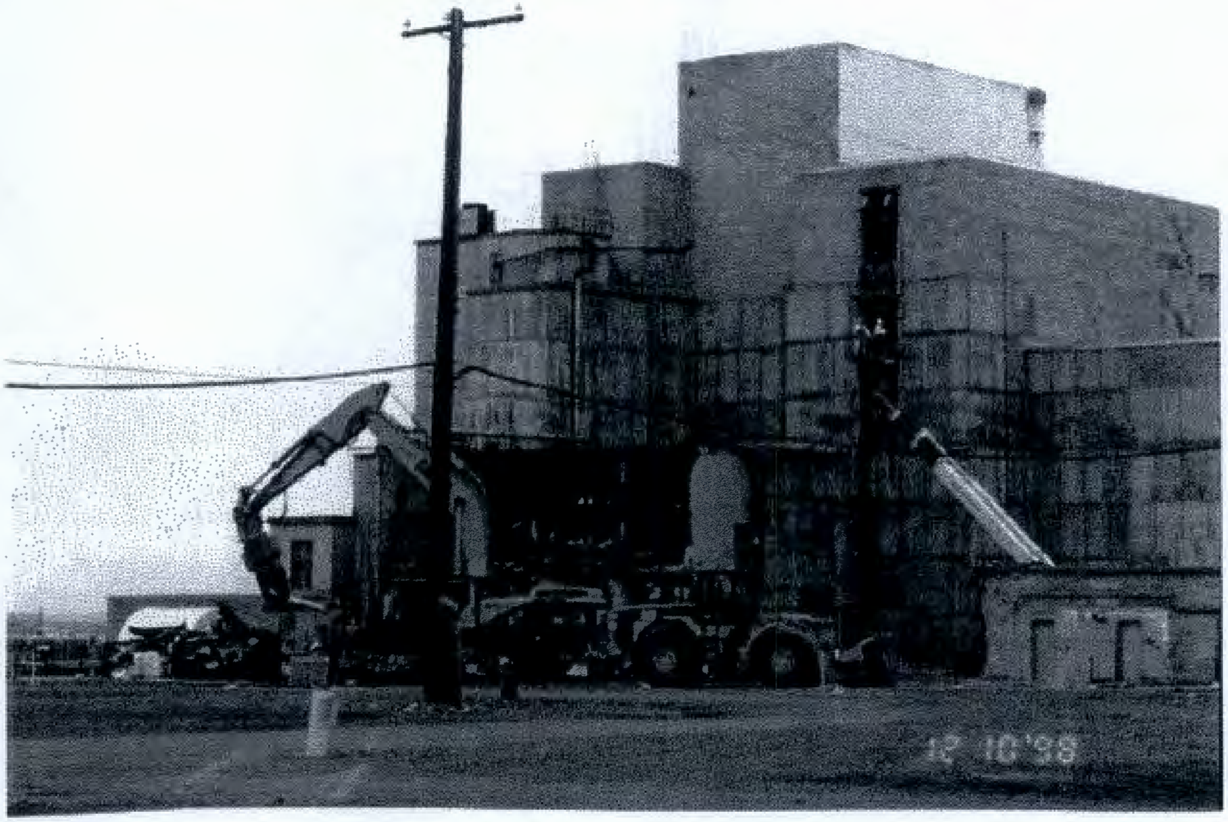


Figure 7. Photo Showing Outer Rod Room Demolition in Progress.



The front- and rear-face elevators were secured in place by shimming and/or blocking so the elevator floor could serve as a working platform to access the front and rear faces of the reactor block. The rear-face elevator is part of the path for performing surveillance.

The roofs of the north and south water tunnels, gas tunnel, vacuum system room, and the compressor room were removed prior to performing the surveys and sampling discussed in Section 4.9. The piping and equipment in these areas was also removed. This was required due to the extreme congestion and unsafe conditions in the tunnels, and the high background in the gas tunnel, vacuum system room, and the compressor room. After the piping, equipment, and debris were removed, these areas were available for surveying and sampling (as discussed in Section 4.9).

4.7 UTILITY AND DRAIN ISOLATION

4.7.1 Electrical System

The power supply to the entire reactor complex utilized the In Service system during the ISS Project.

4.7.2 Water Systems

All Hanford Site water supply lines have been isolated to the 105-F Reactor SSE. The two fire hydrants inside the 105-F Reactor fence remain active.

4.7.3 Equipment and Floor Drains

All operations at the 105-F Reactor have been shut down since June 25, 1965, and the liquids have been flushed and drained to the extent possible as part of the shutdown and deactivation process. Liquid pipe checks have been performed at low points of the piping systems to ensure that no liquids remain. Contaminated piping systems (e.g., the gas piping and process effluent piping) remaining in the facility have been sealed as part of the SSE modifications.

Floors were drained in the past to the 1608-F lift station (demolished in 1987). Floor drains were checked for liquid and mercury, and the floor drains have been sealed to provide isolation. There were no sanitary sewers inside the SSE.

4.8 SAFE STORAGE ENCLOSURE DEMOLITION

Demolition work on the reactor complex was divided between plant forces and the SSE subcontractor in accordance with the requirements of Plant Forces Work Reviews 8850-018-98, 8850-020-98, 8850-020-98, Rev. 1, and 8850-058-98 (BHI 1998d, 1998e, 1998h, 1998g). The SSE subcontractor performed the structural demolition on the portions of the reactor complex inside the SSE concrete shield walls. This structure was mainly composed of several levels of steel framing with CMU block walls (see Figure 8). The SSE subcontractor was also required to remove any large equipment required to place the reactor block into its final SSE configuration. Thus, the SSE subcontractor removed all the upper reactor equipment listed in Section 4.5.

After the elevators were shimmed into place by plant forces (see Section 4.6), upper drive units and synchronizing shafts were disconnected and removed. It was not safe to remove the front-face elevator (C elevator) west side counterweight or rear-face (D elevator) counterweights; therefore, the weights, chains, and cables were lowered to the bottom of their shafts.

4.9 BELOW-GRADE VERIFICATION SURVEYING AND SAMPLING

The goal of the data quality objective (DQO) process is to establish the sampling and analysis design strategy to support decontamination and closeout decisions. The historical information for the 105-F Reactor explains the mechanism by which the below-grade structures and the underlying soils were contaminated, what contamination can be documented, which constituents are eliminated from further consideration, and which constituents are the subject of the sampling and analysis design. This process, along with the closeout criteria and procedures, is documented in the DQO summary report (BHI 1999a).

Figure 8. Photo Showing Upper Reactor Roof Demolition in Progress.

Figure 9. Photo Showing Upper Reactor Equipment Removal in Progress.

Using the DQO summary report as the basis, the *Sampling and Analysis Plan for the 105-F and 105-DR Phase III Below-Grade Structures and Underlying Soils* (DOE-RL 2000a) was developed to present the rationale and strategies for the sampling, field measurements, and analyses of the below-grade (excluding the FSB) concrete and soil. The regulators (i.e., EPA and Ecology) were instrumental in helping RL and the Environmental Restoration Contractor (ERC) team develop the SAP. The significant aspects of the SAP include the following:

- Shallow- and deep-zone distinctions for both structures and soil
- The applicable or relevant and appropriate requirements are consistent with the 100 Area ROD (EPA 1999) (15 mrem/yr above background, and the *Model Toxics Control Act* [WAC 173-340] for residual contamination levels in structures and soils).

For the actual implementation of the SAP, two field implementation guides (FIGs) were developed to provide a clear, concise set of instructions to radiological survey personnel and samplers in the field. FIG 0100F-IG-G0002 (BHI 1999b) provides the instructions for performing the Phase III, Stage 1 sampling and surveys in the FSB and the radiological surveys in the remainder of the below-grade structures. FIG 0100F-IG-G0003 (BHI 1999c) provides the instructions for the Phase III, Stage 2 sampling and surveys in all non-FSB below-grade structures.

Using the DQO summary report as the basis, the *Sampling and Analysis Plan for the 105-F Phase IV Fuel Storage Basin* (DOE-RL 2000b) and the *Addendum to the Sampling and Analysis Plan for the 105-F Fuel Storage Basin* (DOE-RL 2002c) were developed to present the rationale and strategies for the sampling, field measurements, and analyses of the FSB concrete and soil. The regulators (i.e., EPA and Ecology) were instrumental in helping RL and the ERC team develop the SAP. The significant aspects of the SAP include the following:

- The verification sampling and characterization of the upper portion of the fill material to determine if the upper portion of the fill can be reused as backfill at a remedial action D&D site.
- The verification sampling and characterization of the soils underlying and adjacent to the 105-F FSB to allow for interim closure in support of the reactor ISS project.
- Characterization of the waste streams generated during removal of the fill inside the 105-F FSB, and the demolition of the FSB to allow for disposal of the solids in the ERDF and liquids in the Effluent Treatment Facility.

The survey results and sample analysis results are subjected to a data quality assessment to verify that the objectives of the DQO have been satisfied. The data will then be used in the RESidual RADioactivity (RESRAD) dose model and RESRAD-BUILD computer model to verify that cleanup criteria are satisfied. A brief summary of the data and the analysis results will be included in a CVP that was being generated at the time this report was finalized. The CVP is a brief report that summarizes and compares the results against the cleanup criteria.

4.10 BELOW-GRADE DEMOLITION

Figure 12 shows the supply water tunnel entrances and valve pit room demolished (the floors and walls ready for radiological surveys and sampling). Following radiological surveying, sampling, and analysis in the below-grade structures, the facility outside the SSE was demolished to 1 m (3.3 ft) below grade. The basement structure, located greater than 1 m (3.3 ft) below grade, was left in place only if the cleanup criteria were satisfied (See DWG H-1-87172). All below-grade areas were backfilled to eliminate future subsidence. Some of the valve pit concrete walls and floor areas required removal for disposal because of chromium contamination.

4.11 FUEL STORAGE BASIN DEMOLITION AND TRANSFER PIT REMOVAL

In 1970, the FSB water level was pumped down to 0.6 to 1.2 m (2 to 4 ft.), the on-grade floor (wood planking) was dropped into the basin, and the basin was backfilled to grade level (see Figure 11).

Figure 10. Photo Showing Below-Grade Excavation of Fuel Storage Basin.

Figure 11. Photo Showing the Fuel Storage Basin Backfilled to Grade Prior to D&D Activities.

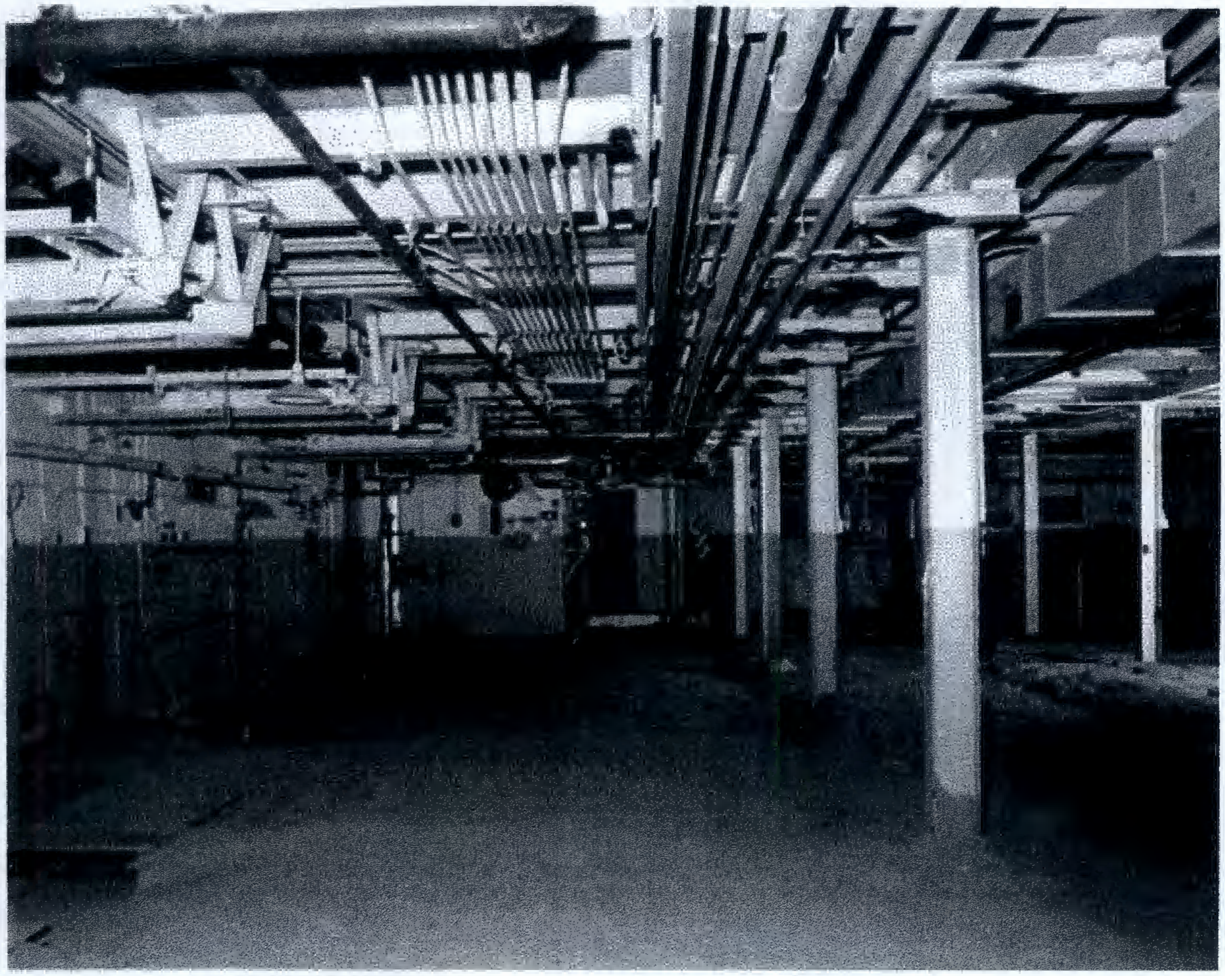


Figure 12. Photo of Valve Pit Below-Grade Demolition in Progress.

Upon deactiviation the FSB was determined to be a leaker and had to be removed in its entirety for ISS. A readiness evaluation for the removal of the upper fill (fill to -17 ft) was completed in November 2000. Upper fill removal was completed in February 2001. The readiness assessment for lower fill removal, including fuel baskets and other materials, process sediment, fuel, and the below-grade structure, was completed in June 2001. Lower fill removal was completed in November 2002. Seventeen pieces of fuel were identified and shipped to K Basins as part of this effort. The excavated site was confirmed to meet the deep zone cleanup criteria in the SAP. The west side slope area of the FSB failed shallow zone criteria and was deferred to future remediation.

4.12 INTERFACE AT THE 105-F WATER TUNNELS

In preparation of the 105-F Reactor below-grade demolition, the remaining section of water tunnel piping and conduit running from 190-F to 105-F was removed (most had previously been demolished with 190-F).

4.13 SITE RESTORATION

Upon completion of the demolition activities, the area was backfilled with a minimum of 1-m (3.3-ft)-thick soil/aggregate surface layer placed over the footprint of the facility and graded to match the surrounding terrain. The backfill was obtained from Pit 18, the 100-F Area borrow pit.

4.14 INTERFACE WITH REMEDIAL ACTION

Meetings were held with remedial action project personnel to coordinate the interface point between the D&D and remedial action projects. In general, it was agreed that D&D would remove drain lines to approximately 1 m (3.3 ft) outside the boundary of the building, and the two process sewers (effluent lines) would be removed up to the expansion box (approximately 3 m [10 ft] from the building edge). Additionally, drain/effluent piping exposed during excavations would be removed by the 105-F ISS Project (this resulted in significantly more pipe being removed than originally anticipated).

4.15 INTERFACE WITH SURVEILLANCE AND MAINTENANCE

During the ISS Project, the 105-F Reactor was temporarily under the control of the D&D Projects to perform the ISS work (BHI 1998c). At the completion of the ISS Project and the completion of the endpoint criteria, the 105-F Reactor was reassigned to the S&M Project, which was accomplished by a memorandum of understanding (BHI 2003b).

An S&M plan (DOE-RL 2002b) was developed as one of the endpoint criteria. The S&M Project has estimated that its cost will be $5,000 per year for yearly radiological surveys and tumbleweed removal. Every fifth year, the S&M cost will be $41,000 in order to perform the surveillance of the inside of the SSE. The decreased S&M costs for the SSE result in an average annual savings of $190,000 per year (this value excludes any major costs, such as the major roof repair that would have been required).

4.16 DEMOBILIZATION

At the time this report was being drafted trailers, tools, equipment, and miscellaneous items were in the process of being removed from the project site during demobilization activities.

Figure 13. Photo of Completed Safe Storage Enclosure (Looking Southwest).

Figure 14. Photo of Completed Safe Storage Enclosure (Looking East).

5.0 COST AND SCHEDULE

5.1 SCHEDULE

Some key dates for the 105-F ISS Project include the following:

• Trailer mobilization initiated	January 1998
• Initiated F Reactor characterization and design	March 1998
• D&D work started	March 1998
• Regulator SAP approval (Phase I)	June 1998
• Initiated structure demolition	October 1999
• Stack demolition	1983
• Regulator SAP approval (Phase II)	July 2001
• Awarded SSE subcontract	May 2001
• Completed SSE roof	August 2003
• ISS work completed	September 2003
• S&M plan to regulators September 2003	(Target completion December 2003)
• 105-F returned to the Surveillance/Maintenance and Transition group	October 2003

5.2 COST

The total ISS Project cost of $21,478K (exclusive of the 1997 characterization task) is summarized by fiscal year. The tasks associated with each fiscal year are briefly described in Section 5.1.

FY 1998	1,723K	
FY 1999	1,756K	
FY 2000	3,452K	
FY 2001	4,526K	
FY 2002	4,870K	
FY 2003	2,928K	
FY 2004	50K	(estimate at completion)
	$19,305K	

The SSE subcontractor's costs associated with FY 2002 and 2003 are summarized below:

FY 2002	201K
FY 2003	1,972K
	$2,173K

6.0 RECYCLED MATERIAL AND WASTE DISPOSAL

One of the objectives of the 105-F Reactor ISS Project was to support recycling and waste minimization.

6.1 RECYCLING AND WASTE MINIMIZATION

The 105-F Reactor field crew loaded material into recycle trucks, and the material was then sold for salvage. The project has successfully demonstrated good waste minimization practices where applicable. Materials listed in Table 2 were recycled during the 105-F Reactor ISS Project.

Table 2. 105-F Area Recycle/Redistribution Log.

Description of Material	Amount (lb or gal)	Date	Vendor
Miscellaneous scrap steel (E-31,800/F-47,400)	15,600 lb	11/18/98	Pacific (107)
Miscellaneous scrap steel (E-35,320/F-43,960)	8,640 lb	11/20/98	Pacific (106)
Railroad rails (E-30,980/F-67,720)	36,740 lb	12/21/98	Pacific
Railroad rails (E-32,480/F-66,140)	33,660 lb	12/22/98	Pacific
Railroad rails and spikes (E-32,400/F-97,420)	65,020 lb	12/22/98	Pacific
Misc. steel and crushed drums (E-31,480/F-51,720)	20,240 lb	1/11/99	Pacific
Misc. steel and crushed drums (E-31,420/F-51,000)	19,580 lb	1/18/99	Pacific
WD-40	120 oz.	9/02/99	Mechanic (Mobile)
Air tool oil	2 qt.	9/02/99	Mechanic (Mobile)
Contaminated water from FSB	1,500 gal	10/03/01	Shipped to ETF
Alkaline batteries – 100F-01-0001 various AA, AAA, and D cell	130 lb	9/05/02	Consolidation Center

ETF = Effluent Treatment Facility

6.2 WASTE DISPOSAL

Waste disposed, transferred, or recycled from the 105-F Reactor ISS project included the following:

- Approximately 1,585 bulk containers of low-level debris were shipped to ERDF, accounting for approximately 21,613 metric tons (23,775 tons) (about 13,636 kg [30,000 lb] average per container).
- 22.8 metric tons (25 tons) of asbestos tiles, lagging, and transite was disposed.
- 378 L (100 gal) of mixed (radioactive and dangerous) waste oil was sent to the Central Waste Complex.
- More than 1514 L (400 gal) of oil was transferred offsite for energy recovery.
- 3.8 L (1 gal) of mercury was recycled.
- Over 28,181 kg (62,000 lb) of lead (primarily shot and bricks) was macroencapsulated at ERDF.
- Over 559 kg (1,230 lb) of PCB ballasts was shipped to the ERDF.

7.0 OCCUPATIONAL EXPOSURES

7.1 PERSONNEL INJURIES

During the duration of the project there were zero lost workdays and zero Occupational Safety and Health Administration recordable cases. A total of approximately 212,000 hours (manual and nonmanual) was spent by the ERC team on the entire project. In addition, the subcontractor spent approximately 24,000 hours in construction of the SSE.

7.2 PERSONNEL RADIOLOGICAL EXPOSURES

There were no clothing or skin contaminations during the demolition of the ancillary sections of the 105-F Reactor by the plant forces, or during the construction of the SSE roof by subcontractor work forces.

The total, combined dose of all 105-F Reactor personnel was approximately 1,345 person-mrem for the entire project duration. The majority of the dose was received during basin clean-out activities.

8.0 SAFE STORAGE ENCLOSURE

The Hanford Site's 105-F Reactor was chosen as the third reactor to be placed into long-term safe storage due to advanced deterioration on roof sections of the reactor building that would require major maintenance expenditure. The primary objective of the 105-F Reactor ISS Project is to provide storage up to 75 years with minimal maintenance required. Design objectives are summarized as follows:

- Safe storage for up to 75 years
- No credible releases of radionuclides to the environment under normal design conditions
- Interim inspection required only on a 5-year frequency, further evaluation of extending this frequency will be done by the project group upon completion of the first 5-year surveillance
- SSE configuration will not preclude or significantly increase cost of any final decommissioning alternative.

8.1 ROOF

After the upper reactor demolition was completed, new structural steel was combined with the remaining existing structural steel, and attached to the top of the concrete shield walls with undercut anchor bolts to form the SSE framework. Galvalum-coated steel roofing (22 gauge) and siding (24 gauge) was then attached to the framework. Galvalum (also referred to as 55% Al-Zn) is a coating that contains 55% aluminum and 45% zinc. The excellent corrosion resistance of galvalum is achieved by combining the barrier protection of an aluminum coating with the galvanic protection of a zinc coating. Refer to Section 10.1 for structural concrete, steel, and roofing/siding drawings.

8.2 ELECTRICAL SYSTEM

Electrical power for the SSE facility is 120/240 volt-alternating current (VAC), 1 phase, and is supplied from a 13.8-kV overhead line. From a pole-mounted 13.8kV/120V/240V transformer, the power cables are connected to a disconnection switch (DS-1). DS-1 feeds a distribution panel (DP-1) located inside the SSE utility room. DP-1 provides power for lighting, power receptacles, and the instrumentation system. Backup power capability to these loads is not provided. Refer to Section 10.2 for power and lighting drawings.

The 105-F SSE has permanent lighting installed along the surveillance route located on the lower level, grade, and upper levels and stairwells. In the interest of safety, all facility personnel and visitors must carry a spare light source that will be used for egress if the lighting system should fail during entry.

110-VAC receptacles are located at the -9-ft level in the passage leading to the lower instrument room and tunnels. Several are located at the 0-ft level along the surveillance route and in the SSE access room. Additional receptacles are located on the 13-ft, 24-ft, 42-ft, 56-ft, and 80-ft levels.

NOTE: See Section 8.4 for information regarding portable generator power for the portable ventilation exhauster.

8.3 REMOTE MONITORING SYSTEM

The 105-F SSE is configured with two sets of temperature sensors (resistance temperature detectors) and a set of flooding sensors (float switch), which include the installed spares for each sensor. Temperature sensors are located at grade level on the west side of the reactor near the west stairwell. Temperature sensors are also located at the 80-ft level near the west side of the attic space. The flooding sensors are located at the west side of the –9-ft level near the west stairwell.

The remote sensors are controlled through a programmable logic controller powered from DP-1. Signals are transmitted (via modem and a cellular phone) and routinely monitored at the operation supervisor workstation currently located in the 1112-N Building. Note: The system is portable and can be relocated, should the monitoring location change. When an alarm comes in at the remote monitoring station, personnel will evaluate the alarm and, if required, will go to the 105-F Reactor and take appropriate corrective actions.

Due to the need for changes in the location of the remote monitoring station, the system is portable and can be relocated if required.

A loss of continuity to a resistance temperature detector will result in a loss of signal error to the monitoring station. The flooding sensor is normally closed-circuit so that a loss of continuity failure will result in a flooding alarm at the monitoring station. The flooding circuit is directly wired to the programmable logic controller. The temperature monitoring circuits operate on a 4-20-mA current loop from transmitters. The transmitters are supplied with 120 VAC for operating power. In the event of an instrument failure, monitoring for the temperature sensors can be manually switched to previously installed spares from the SSE utility room, eliminating the need to make a special entry into the SSE. The redundant flooding sensors can be electronically switched from the remote monitoring station. Thus, instrument replacements will normally be accomplished during regularly scheduled surveillance periods.

8.4 VENTILATION

The 105-F Reactor SSE is a deactivated facility that is uninhabited and locked during storage, except during S&M activities. Many of the reactor's components were removed as part of the stabilization effort for SSE. Remaining equipment and components that contain radiological inventory have been sealed during the implementation of the SSE Project. Many accessible areas of the building's interior have had a fixative applied to limit the potential spread of contamination.

No mechanical ventilation of the building is necessary, either during normal storage or during periodic surveillance. A provision has been made to ventilate the facility with exhaust fans for entry and/or maintenance. The 105-F Reactor SSE has been designed to use a 255-m^3/min (9,000-ft^3/min) portable exhauster for building exhaust ventilation during nonroutine maintenance. If building exhaust ventilation is required, the interior access door to the SSE shall be placed in the open position. Air is drawn into the SSE through the utility room vents. The size of these openings is sufficient to provide proper flow, even when the exterior door to the SSE utility room is closed. A separate ventilation system is provided for the inner rod room through the steel door exhaust ventilation flange connection and a door makeup air vent that is accessed from the platform inside the north side sheet-metal enclosure.

A ventilation system flow diagram can be found on drawing 0100X-DD-M0012 (see Section 10.4). The exhauster draws air through flanged, galvanized carbon-steel vent openings located on the north side of the SSE. When the portable exhauster is not connected, the connection point is sealed with bolted flanges. Additionally, welded stainless-steel security bars are provided behind the bolted flanges in the event the flanges are maliciously removed.

8.5 SECURITY

Access to the 105-F Reactor SSE is through the utility room. During periods of storage, the door to the SSE (located inside the utility room) will be locked and welded shut. The door to the utility room will be locked except during routine S&M activities. The SSE is entered only for periodic S&M activities. The 0.9 to 1.5-m (3 to 5-ft)-thick concrete walls and the welded door provide the security barrier for the facility; therefore, a locked fence around the SSE is not required. There are no intrusion alarms or routine security patrols for the 105-F Reactor SSE. The Hanford Patrol continues to provide routine security patrols in the vicinity as part of its patrol throughout the 100 Areas. There are two other welded doors into the SSE (the inner rod room and the rear face) to allow greater flexibility if maintenance is required, but these doors will not be used as entrances for typical surveillance activities.

9.0 LESSONS LEARNED AND RECOMMENDATIONS

The 105-F Reactor was the third ISS project to complete placement of the reactor core into an SSE. The ISS work (excluding FSB clean-out) was accomplished without any significant problems, in part, because of lessons learned from the 105-C Reactor ISS project. The FSB clean-out was a first-of-a-kind work process due to the uniqueness of the conditions, and many lessons learned were applied to 105-H Reactor FSB clean-out. Samples of the FSB lessons learned are included below (see BHI [2002] for a complete listing). SSE work was accomplished without any significant problems, also in part, because of lessons learned from the 105-C and 105-DR Reactor ISS projects. Delays and efficiency improvement are noted for future projects, which include the following examples.

- For the FSB work, it was important to ensure that all appropriate RCTs were trained on all onsite radiological equipment, troubleshooting the Automated Radiological Access Control System, fall protection, and lockout and tagout. Fall protection training was also important for the SSE subcontract coverage, as most of the work requires its use. It is also vital that replacement RCTs receive the appropriate training to ensure availability.

- Numerous spares/spare parts for all radiological equipment should be on hand (e.g., Amp 100, R0-7, scales, air monitors, and air samplers), and ensure that the equipment is maintained. Wireless systems are less vulnerable to malfunction then the hard-wire systems of the Amp 100.

- The 105-F Reactor was the second reactor in a design/build SSE subcontract. Issuing multiple reactors in the same subcontract worked well for the following reasons:

  - Design and construction lessons learned by the subcontractor and subtiers were automatically applied to the design and construction at 105-F.

  - Many aspects of the work for 105-DR and 105-F were the same/similar, which reduced the design and submittal process.

  - The subcontractor was able to bring back most of the same craft personnel for 105-F, which resulted in completion of the 105-F SSE portion of the subcontract 6 weeks and 5,000 man-hours earlier then the 105-DR portion of the subcontract.

- SSE subcontractor forces should include a full-time field engineer during construction. Many fit-up problems, due to differences between design and actual conditions discovered after demolition, would have been discovered prior to fabrication had a field engineer been onsite verifying the design as demolition opened up new areas. The field engineer would also be able to assist the quality assurance representative to ensure that the proper work processes (e.g., installation techniques, placement, and details) and materials were being used. When field changes arose, the field engineer would be able to relay pertinent information and suggestions to the design group, and coordinate the change process to reduce construction delays. For these reasons, addition of a full-time field engineer during SSE construction activities should be added to the key personnel list in future SSE subcontracts.

- Pre-hot work inspections and hot work fire watch should include all areas below the hot work where sparks and slag may fall. The hot work form initially required inspection and monitoring within 10.7 m (35 ft). Slag from a subcontractor torch-cutting activity on an I-Beam fell 21.3+ m (70+ ft) and ignited a small fire. The hot work permit was revised to include inspection and fire-watch monitoring of all areas below the hot work where sparks and slag have access. No more fires occurred during subcontractor activities.

10.0 DRAWINGS

The following drawings show the as-built configurations for the 105-F Reactor SSE.

10.1 STRUCTURAL

Type	Number	Cross-Reference Number	Subject
DWG	0100F-DD-C0025	H-1-87172	105F BELOW-GRADE DEMOLITION ZONE
DWG	0105F-DD-C0001	H-1-87250 SHT01	0105F-DD-S001.0 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION GENERAL STRUCTURAL NOTES AND SPECIFICATIONS
DWG	0105F-DD-C0002	H-1-87251 SHT01	0105F-DD-S001.8 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION FOUNDATION PLAN
DWG	0105F-DD-C0003	H-1-87252 SHT01	0105F-DD-S001.9 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION FRAMING PLAN AT TOP OF CONCRETE
DWG	0105F-DD-C0004	H-1-87253 SHT01	0105F-DD-S001.10 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION ROOF FRAMING PLAN
DWG	0105F-DD-C0005	H-1-87254 SHT01	0105F-DD-S001.11 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION EAST ELEVATION VIEW
DWG	0105F-DD-C0006	H-1-87255 SHT01	0105F-DD-S001.12 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION NORTH ELEVATION VIEW
DWG	0105F-DD-C0007	H-1-87256 SHT01	0105F-DD-S001.13 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION WEST ELEVATION VIEW
DWG	0105F-DD-C0008	H-1-87257 SHT01	0105F-DD-S001.14 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION SOUTH ELEVATION VIEW
DWG	0105F-DD-C0009	H-1-87258 SHT01	0105F-DD-S001.15 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION LONGITUDINAL BUILDING SECTION VIEW
DWG	0105F-DD-C0010	H-1-87259 SHT01	0105F-DD-S001.16 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION TRANSVERSE BUILDING SECTION VIEW NEAR GRID 11

Type	Number	Cross-Reference Number	Subject
DWG	0105F-DD-C0011	H-1-87260 SHT01	0105F-DD-S001.17 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION TRANSVERSE BUILDING SECTION VIEW NEAR GRID 8
DWG	0105F-DD-C0012	H-1-87261 SHT01	0105F-DD-S001.17 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION TRANSVERSE BUILDING SECTION VIEW NEAR GRID 13
DWG	0105F-DD-C0013	H-1-87262 SHT01	0105F-DD-S002.1 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION CONCRETE AND FOUNDATION DETAILS
DWG	0105F-DD-C0014	H-1-87263 SHT01	0105F-DD-S002.2 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL CONCRETE AND FOUNDATION DETAILS
DWG	0105F-DD-C0015	H-1-87264 SHT01	0105F-DD-S002.3 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL CONCRETE AND FOUNDATION DETAILS
DWG	0105F-DD-C0016	H-1-87265 SHT01	0105F-DD-S003.1 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL ELEVATION VIEWS
DWG	0105F-DD-C0017	H-1-87266 SHT01	0105F-DD-S003.2 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL ELEVATION VIEWS
DWG	0105F-DD-C0018	H-1-87267 SHT01	0105F-DD-S003.3 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL ELEVATION VIEWS
DWG	0105F-DD-C0019	H-1-87268 SHT01	0105F-DD-S003.4 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL ELEVATION VIEWS
DWG	0105F-DD-C0020	H-1-87269 SHT01	0105F-DD-S003.5 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL ELEVATION VIEWS
DWG	0105F-DD-C0021	H-1-87270 SHT01	0105F-DD-S003.6 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL ELEVATION VIEWS
DWG	0105F-DD-C0022	H-1-87271 SHT01	0105F-DD-S003.7 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL ELEVATION VIEWS
DWG	0105F-DD-C0023	H-1-87272 SHT01	0105F-DD-S004.1 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL ELEVATION VIEWS
DWG	0105F-DD-C0024	H-1-87273 SHT01	0105F-DD-S004.2 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL SECTION VIEWS
DWG	0105F-DD-C0025	H-1-87274 SHT01	0105F-DD-S004.3 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL SECTION VIEWS
DWG	0105F-DD-C0026	H-1-87275 SHT01	0105F-DD-S005.1 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STEEL PURLIN AND GIRT CONNECTION DETAILS
DWG	0105F-DD-C0027	H-1-87276 SHT01	0105F-DD-S005.2 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STEEL PURLIN AND GIRT CONNECTION DETAILS
DWG	0105F-DD-C0028	H-1-87277 SHT01	0105F-DD-S005.3 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STEEL PURLIN AND GIRT CONNECTION DETAILS
DWG	0105F-DD-C0029	H-1-87278 SHT01	0105F-DD-S006.1 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL FRAMING DETAILS

Type	Number	Cross-Reference Number	Subject
DWG	0105F-DD-C0030	H-1-87279 SHT01	0105F-DD-S006.2 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL FRAMING DETAILS
DWG	0105F-DD-C0031	H-1-87280 SHT01	0105F-DD-S006.3 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL FRAMING DETAILS
DWG	0105F-DD-C0032	H-1-87281 SHT01	0105F-DD-S006.4 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL FRAMING DETAILS
DWG	0105F-DD-C0033	H-1-87282 SHT01	0105F-DD-S006.5 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL FRAMING DETAILS
DWG	0105F-DD-C0034	H-1-87283 SHT01	0105F-DD-S006.6 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL FRAMING DETAILS
DWG	0105F-DD-C0035	H-1-87284 SHT01	0105F-DD-S006.7 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL FRAMING DETAILS
DWG	0105F-DD-C0036	H-1-87285 SHT01	0105F-DD-S006.8 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL FRAMING DETAILS
DWG	0105F-DD-C0037	H-1-87286 SHT01	0105F-DD-S006.9 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL FRAMING DETAILS
DWG	0105F-DD-C0038	H-1-87287 SHT01	0105F-DD-S006.10 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL FRAMING DETAILS
DWG	0105F-DD-C0039	H-1-87288 SHT01	0105F-DD-S006.11 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION STRUCTURAL STEEL FRAMING DETAILS
DWG	0105F-DD-C0040	H-1-87289 SHT01	0105F-DD-S008.1 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION MISCELLANEOUS STRUCTURAL DETAILS
DWG	0105F-DD-C0041	H-1-87290 SHT01	0105F-DD-S008.2 - REACTOR BLDG 105-F SAFE STORAGE ENCLOSURE (SSE) CONSTRUCTION MISCELLANEOUS STRUCTURAL DETAILS

10.2 ELECTRICAL

Type	Number	Cross-Reference Number	Subject
DWG	0100F-DD-E0012	H-1-83676 SHT01	SSE PERMANENT POWER & LIGHTING SYSTEM ONE LINE DIAGRAM
DWG	0100F-DD-E0013	H-1-83677 SHT01	SSE POWER AND LIGHTING SYSTEM ELECTRICAL ARRANGEMENT - (-) GRADE / GRADE LVL
DWG	0100F-DD-E0014	H-1-83678 SHT01	SSE POWER AND LIGHTING SYSTEM ELECTRICAL ARRANGEMENT @ ABOVE GRADE 1 - 3
DWG	0100F-DD-E0015	H-1-83679 SHT01	SSE POWER AND LIGHTING SYSTEM ELECTRICAL ARRANGEMENT @ ABOVE GRADE 4 - 7
DWG	0100F-DD-E0016	H-1-83680 SHT01	PERMANENT ELECTRICAL DISTRIBUTION SYSTEM GROUNDING PLAN, ELEVATIONS AND DETAILS
DWG	0100F-DD-E0017	H-1-83681 SHT01	PERMANENT ELECTRICAL DISTRIBUTION SYSTEM XFMR & CUTOUT POLE DETAILS
DWG	0100F-DD-E0018	H-1-83682 SHT01	13.8KV - POLE DOWN GUY ASSEMBLY - DETAILS

10.3 INSTRUMENTATION

Type	Number	Cross-Reference Number	Subject
DWG	0100F-DD-E0012	H-1-83676 SHT01	SSE PERMANENT POWER & LIGHTING SYSTEM ONE LINE DIAGRAM
DWG	0100F-DD-E0013	H-1-83677 SHT01	SSE POWER AND LIGHTING SYSTEM ELECTRICAL ARRANGEMENT - (-) GRADE / GRADE LVL
DWG	0100F-DD-E0014	H-1-83678 SHT01	SSE POWER AND LIGHTING SYSTEM ELECTRICAL ARRANGEMENT @ ABOVE GRADE 1 - 3
DWG	0100F-DD-E0015	H-1-83679 SHT01	SSE POWER AND LIGHTING SYSTEM ELECTRICAL ARRANGEMENT @ ABOVE GRADE 4 - 7
DWG	0100F-DD-E0016	H-1-83680 SHT01	PERMANENT ELECTRICAL DISTRIBUTION SYSTEM GROUNDING PLAN, ELEVATIONS AND DETAILS
DWG	0100F-DD-E0017	H-1-83681 SHT01	PERMANENT ELECTRICAL DISTRIBUTION SYSTEM XFMR & CUTOUT POLE DETAILS
DWG	0100F-DD-E0018	H-1-83682 SHT01	13.8KV - POLE DOWN GUY ASSEMBLY - DETAILS

10.4 MECHANICAL

Type	Number	Cross-Reference Number	Subject
DWG	0100X-DD-M0011	H-1-85187 SHT01	SSE CONSTRUCTION AT 105-F/105-DR REACTOR BUILDINGS VENTILATION DETAILS
DWG	0100X-DD-M0012	H-1-85512 SHT01	105 DR/F AREAS SSE VENTILATION SYSTEM FLOW DIAGRAM

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