SPENT FUEL AND WASTE MANAGEMENT ACTIVITIES FOR CLEANOUT OF THE 105-F FUEL STORAGE BASIN AT HANFORD

M.R. Morton, T.J. Rodovsky, and R.S. Day
Bechtel Hanford, Inc.
3350 George Washington Way, Richland, WA 99352

ABSTRACT

Clean-out of the F Reactor fuel storage basin (FSB) by the Environmental Restoration Contractor (ERC) is an element of the FSB decontamination and decommissioning and is required to complete interim safe storage (ISS) of the F Reactor. Following reactor shutdown and in preparation for a deactivation layaway action in 1970, the water level in the F Reactor FSB was reduced to approximately 0.6 m (2 ft) over the floor. Basin components and other miscellaneous items were left or placed in the FSB. The item placement was performed with a sense of finality, and no attempt was made to place the items in an orderly manner. The F Reactor FSB was then filled to grade level with 6 m (20 ft) of local surface material (essentially a fine sand).

The reactor FSB backfill cleanout involves the potential removal of spent nuclear fuel (SNF) that may have been left in the basin unintentionally. Based on previous cleanout of four water-filled FSBs with similar designs (i.e., the B, C, D, and DR FSBs in the 1980s), it was estimated that up to five SNF elements could be discovered in the F Reactor FSB (1). In reality, a total of 10 SNF elements have been found in the first 25% of the F Reactor FSB excavation.

This paper discusses the technical and programmatic challenges of performing this decommissioning effort with some of the controls needed for SNF management. The paper also highlights how many various technologies were married into a complete package to address the issue at hand and show how no one tool could be used to complete the job; but by combining the use of multiple tools, progress is being made.

INTRODUCTION

Cleanout of the F Reactor FSB by the ERC is an element of the FSB decontamination and decommissioning and is required to complete ISS of the F Reactor. Following reactor shutdown and in preparation for a deactivation layaway action in 1970, the water level in the F Reactor FSB was reduced to approximately 0.6 m (2 ft) over the floor. Basin components and other miscellaneous items were left or placed in the FSB. The item placement was performed with a sense of finality, and no attempt was made to place the items in an orderly manner. The F Reactor FSB was then filled to grade level with 6 m (20 ft) of local surface material (essentially a fine sand).

This paper describes the process used to locate and remove any SNF that is discovered during cleanout of the F Reactor FSB for placement in safe, compliant storage at the 105-K FSBs (K Basins). In addition, the characterization, removal, and disposition of the fill material, contaminated and activated metal items found in the basin and disposed at the Environmental Restoration Disposal Facility (ERDF) will also be discussed.

To meet retrievability capabilities, SNF is defined (2) as pieces of fuel confirmed in accordance with project procedures and greater than or equal to a 2.5-cm (1-in.)-long by 3.8-cm (1.5-in.)-diameter fragment. The portable universal radiation spectrum analyzer (URSA)[a], which is a gamma spectrum multi-channel analyzer (MCA), is used to provide information on the types and amounts of radioactive material to identify irradiated SNF. Pieces with dimensions less than those defined above for SNF will contain less than 0.5 g of plutonium-239 fissionable material and will be handled as non-SNF radioactive waste and properly packaged for disposal (3).

PROJECT PLANNING

The total project consists of complete FSB cleanout and demolition of the basin. The building superstructure, the top 5.2 m (17 ft) of fill material and the concrete basin demolition are not described at length in this paper, as these are normal operations performed for a reactor decommissioning project.

Technical Issues

Stage I of the FSB cleanout involved removing the top approximately 5.2 m (17 ft) of fill material, including encountered debris that had been placed in the basin during the 1970 deactivation layaway action. Stage II involves removing the remaining 0.9 m (3 ft) of fill, which includes the material between the fuel bucket aisle curbs to the bottom of the basin. Material remaining from Stage I, including any SNF, is characterized by sampling the lower basin fill material and calculating the radionuclide content of the activated metals found in accordance with the project sampling and analysis plan (SAP) (4). Information obtained from the sludge sampling along with various radiological survey instrument findings form the basis of the characterization data. Plans for the location, removal, packaging, transportation, and receipt of SNF were developed based on historical data (1, 3, 5, 6) available to the project team.

At the 76.2-cm (30-in.) level, remote mapping of the remaining materials to identify radiological hot spots and possible fuel elements was first planned using the In Situ Object Counting System (ISOCS) and GammaCam[b] units. This effort was planned to locate all highly radioactive material remaining in the basin. The mapping was originally planned to show where any high dose materials of interest were located so careful excavation of those areas could be accomplished using a remote excavator such as the BROKK 330N[c]. The plan indicated that remote operations would remove any suspect SNF, and the basin could then be released from any fuel concerns so normal excavation and removal of the remainder of the fill could proceed.

Programmatic Challenges

Table I lists the various programmatic items that were resolved between the SNF custodians and the Decommissioning Project to allow the shipment of any SNF to the K Basins for interim storage.

Table I. Programmatic Challenges

Item	Resolution
Work Direction	U.S. Department of Energy, Richland Operations Office (DOE-RL) Letter of Direction (LOD) to Fluor Hanford, Inc. and Bechtel Hanford, Inc. (BHI) describing DOE's expectations of how the two projects would handle any SNF found in the basin (2). This document also sets the retrievability criteria for SNF for the project.
Transfer Plan (7)	Generation and content of this document were directed by the DOE-RL LOD to describe how the various aspects of any SNF transfer would occur.
Safety Analysis Report for Packaging (SARP) (8)	BHI had a subcontractor prepare the SARP, K Basins review, and DOE approval was obtained.
Canister Loading and Unloading Procedures	Each contractor was to prepare procedures that were reviewed by the other group.
Enrichment Verification of SNF	Process was covered in the transfer plan for K Basins to verify or witness inspection to determine the enrichment of any SNF prior to shipment to the K Basins for interim storage.
Authorization Basis and Air Permit	Process was covered in the transfer plan for each project to manage its own documents, but keep the other informed of the status and conditions of the documents.
Safeguards and Security	Process was covered in the transfer plan for when and how security would be involved when SNF was excavated and stored at the F Reactor FSB prior to shipment to the K Basins.
Resource Conservation and Recovery Act (RCRA)/ *Toxic Substances Control Act of 1976* (TSCA) Limits	The SAP (4) described how the sludge would be sampled to verify that no RCRA or TSCA contaminants were contaminating any SNF that would be shipped to K Basins. This sampling also forms the basis for the waste characterization for the fill materials.

Table I. Programmatic Challenges

Item	Resolution
Readiness Review	Each contractor was to prepare a readiness assessment of their own plans and procedures, conduct the assessments, and keep the other group informed of the status and outcome.
Integrated Schedule	Each contractor's project schedule details were reviewed to ensure compatibility and, as a shipment was imminent, day to day contact to coordinate craft support was initiated.

Flowcharting the Process

Due to the complex nature of the operations (e.g., many regulatory and safety limitations, waste management decisions, potential unknowns, and the need for equipment and operations contingencies), the decision was made to chart each major step for field use. These flowcharts (a total of 11 were needed) covered sampling, mapping, upper and lower fill removal, and all the aspects of SNF and waste handling. Figures 1 and 2 are examples of the level of detail and the process used for this work, respectively.

The flowcharts were extensively reviewed and revised during project planning, used as training aids in pre-job briefings, attached to the task instruction as a roadmap for the operation, and revised as the project proceeded. The flowcharts have proved invaluable for tracking progress and making decisions in the field.

Contingency Planning and Changes to the Original Plan Before Starting

The project team recognized early in the planning phase that there were enough unknowns in the project to require a “better than normal” contingency planning effort. First, the project planning included both a remote and a manned excavator for most operations. The choice of equipment would be dependent on dose rates and airborne contamination levels measured in the basin when work was being performed. The second level of contingency planning was in the waste management area. The normal ERDF waste shipping container could be used in some cases, specially prepared open-top boxes could be used for higher activity materials, and shielded boxes or casks would be available for very high activity items.

The entire preparation effort for packaging and shipping SNF was considered a contingency step because there was no hard evidence that the basin actually contained any SNF.

The initial mapping with the ISOCS and GammaCam was completed in January 2001 and revealed a problem: A contingency plan had not been developed if the mapping did not work as proposed. The initial review of the mapping data did not indicate hot spots (i.e., no SNF or high activity waste) in the basin. However, closer review showed that the original premise of these or any other available instruments, being able to locate the target 2.5-cm (1-in.) piece of SNF (1) was not possible with the conditions in the basin. In order to detect the SNF, the background radiation would have to be extremely low; however, the contamination on and in cracks in the stem walls raised the background radiation to a point where the SNF could not be detected under 76.2 cm (30 in.) of soil. With these conditions in the basin, having more than 38.1 cm (15 in.) of soil between the fuel and the detector could effectively mask the target piece of fuel. This forced a re-baseline of Phase II before the project started.

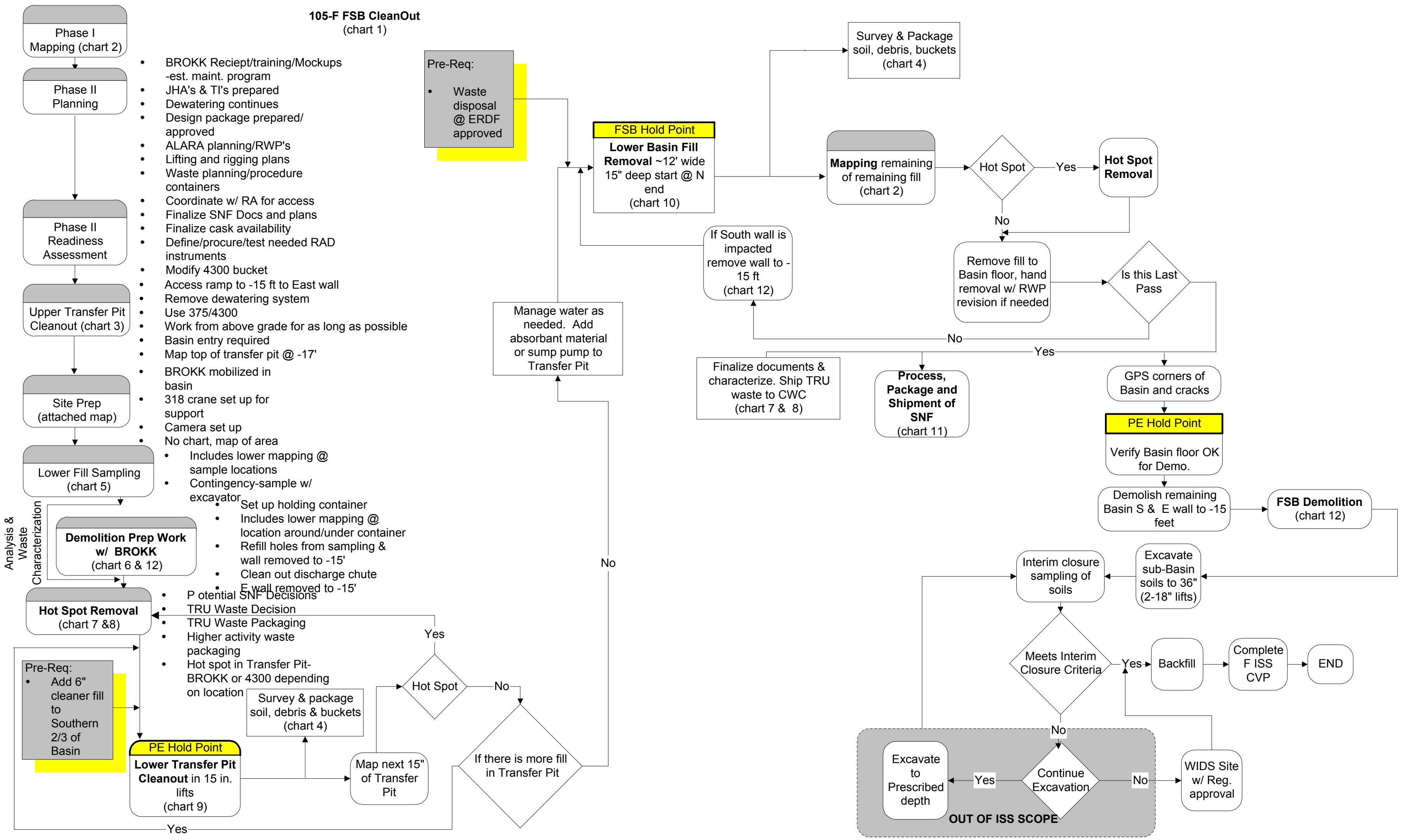

Fig. 1. Flowchart for the overall FSB cleanout process.

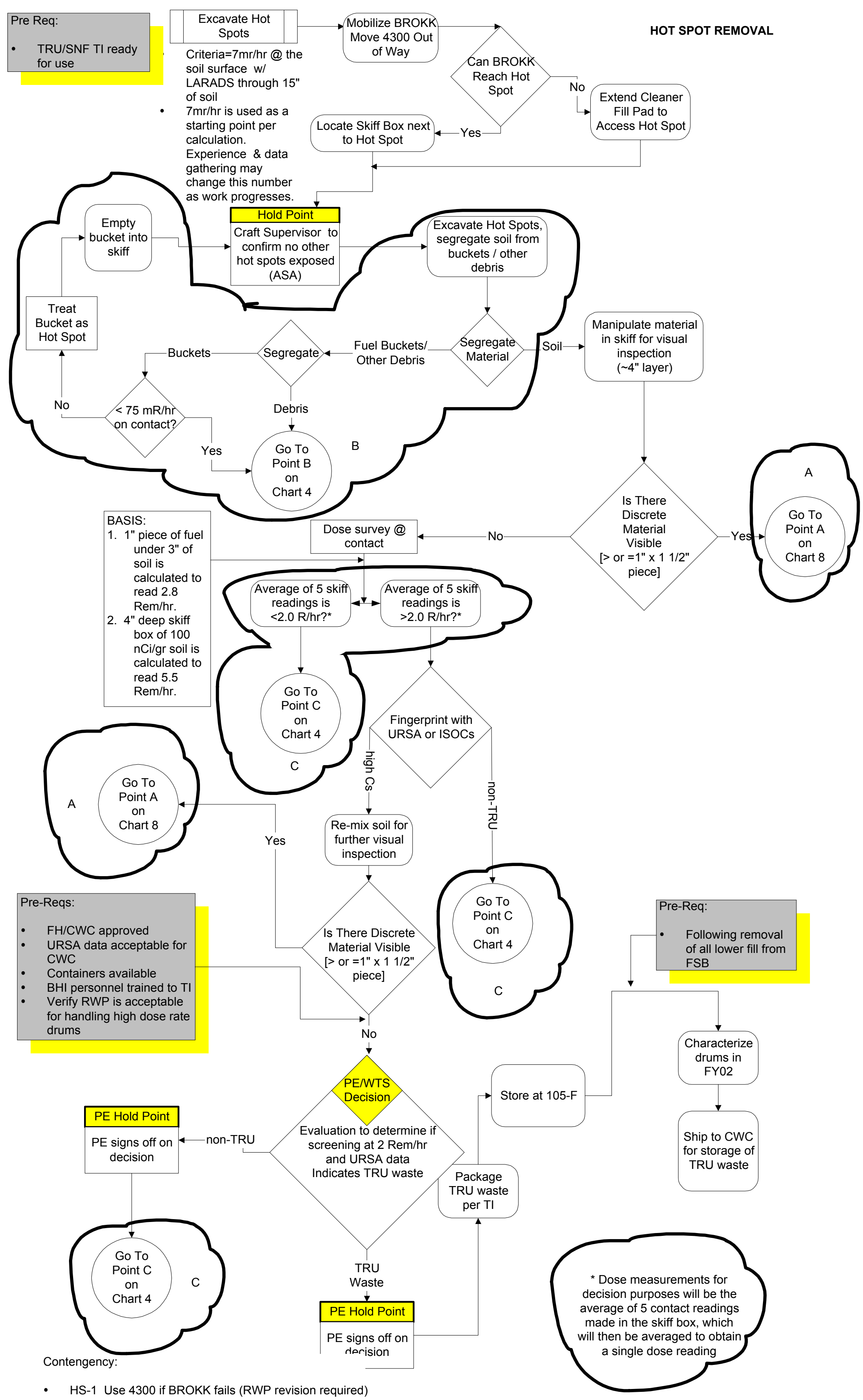

Fig. 2. Flowchart for hot spot removal.

PROGRESS TO DATE

Re-Baseline

After confirmation that the original plan for mapping SNF and hot spots would not work, the project team had to resolve how to proceed with the removal of the fill material when what could be encountered was essentially unknown. The team formed action groups to resolve specific issues and held brainstorming sessions and joint reviews to develop a plan to minimize risk and worker dose, maximizing the use of industrial and radiological safety barriers while allowing the work to be performed in an efficient manner. This plan required that the fill be removed in two lifts of about 38.1 cm (15 in.) each, with mapping of the intermediate layer to determine hot spot locations. The new process consists of the following steps:

- Special precautions and intermediate mapping were planned prior to collecting the waste characterization samples of the bottom sludge materials. These precautions had to be added because the original sampling plan followed SNF removal, but now it was recognized that SNF, hot material, and lower fill removal would have to occur simultaneously. After characterizing the sludge, the top layer of fill could be removed.

- The first 38.1-cm (15-in.) lift would be removed based on the original mapping, showing (as should be expected) that the top layer of the fill material does not contain any high dose, TRU waste, or SNF material. After the first 38.1-cm (15-in.) layer is removed, the remaining 38.1-cm (15-in.) layer is mapped (as was done with the previous lift, except that this effort should be expected to generate hot spots that must be investigated for SNF).

- Remote excavation and processing of hot spots (for suspect SNF items) for confirmation in accordance with project work instructions would then be completed. If a SNF element or fragment is confirmed, it would be stored in a water bath for later packaging. When enough elements are accumulated to trigger a PAS-1 cask shipment or the authorization basis limits are approached, basin fill removal is stopped and shipment to K Basins would be made.

- Following confirmation that no hot spots remain that could contain SNF, the process would shift from SNF retrieval to a more normal waste management operation. This would be accomplished similarly to the hot spot investigation but with bigger, more efficient equipment to remove the remaining fill material and activated/contaminated debris remaining in the bottom of the basin. This material is lifted out of the basin by skiff boxes on a crane and is packaged for disposal at ERDF in a manner similar to the original plan following removal of all suspect SNF.

- Because of equipment reach limitations, the previous three steps would be repeated up to six times to excavate, map, and investigate hot spots and to remove fill from the entire basin.

The repetitive mapping and excavating, as well as the increased as-low-as-reasonably achievable and material-handling issues, added significant time to the project schedule in addition to the time needed to revise the plan.

First Pass of the FSB Lower Fill

The readiness assessment following the re-baseline effort was completed in June 2001, which allowed the first intrusive preparation activities to begin in the basin. The preparatory and setup steps culminated in the collection of the characterization samples in early July 2001 in accordance with the project SAP (4). In parallel with waste designation activities, the first pass (top 38.1 cm [15 in.]) of fill was removed in late August 2001.

The mapping, after the first pass top fill was removed, with the Laser-Assisted Ranging and Data System (LARADS) (an ion chamber detector set up for remote data gathering and computer data collection in a three-dimensional grid system) showed a number of hot spots, in addition to one identified during the sampling effort. The decision to use the LARADS in lieu of the ISOCS or GammaCam was driven by the ease of use in the facility, as it is suspended from a crane hook. In addition, the laser range-finding ability of the LARADS was used to confirm the depth of the remaining soil. By September 6, 2001, the first piece of potential SNF was confirmed and placed in the holding container.

The preparatory work, sampling, and first-pass removal discovered 13 hot spots that were found to contain 10 pieces of potential SNF. After confirmation was made, the SNF was shipped to K Basins in early November 2001, and the first-pass lower fill waste management efforts began in earnest. It had been recognized during the hot spot investigations that the basin contained much more SNF and high activity levels of activated metals. These discovered conditions slowed the waste management activities until a more refined removal and segregation process and relating documents were developed to determine which materials could be put in an ERDF container and which materials had to be packaged in a open-top or shielded box.

The work at the FSB was temporarily stopped twice during the first-pass fill removal process to update the authorization basis (9) and the air permit based on the fuel that was found. The original documents were based on 5 elements, which was initially raised to 10 when the fifth element was found (i.e., the first stoppage of work). The documents authorizing work with up to 10 elements exposed in the basin allowed the project to proceed for about 14 days of work before the tenth element was found. At this point, it was clear that the historic documents were not accurate, and the current project plans and safety documentation were updated to address up to 50 potential elements in the basin. The basin remained a radiological facility because these "new" elements were buried and only accessible as a source term once excavated.

On December 11, 2001, the first-pass lower fill was completely removed and second-pass removal began within a few days.

Waste Management Challenges

Any fill material or debris removed during SNF investigations, as well as all materials remaining after the determination is made that no additional SNF or TRU designated waste exists in an area, must be segregated and packaged for proper disposal, as described in Table II. This is generally done using an excavator in the basin, filling a skiff box that is used to fill an ERDF container or an open-top box.

Table II. Waste Segregation Strategy

Measured Dose Rate	Packaging/Transportation/Disposal or Storage
19 to 102 R/hr spent fuel	PAS-1 cask/dedicated trailer/K Basins
0 to 200 mr/hr fill material and activated metal	ERDF can/roll-off truck/ERDF
200 mr to 400 mr/hr fill material and activated metal	Open-top box with poly-foam lining/tractor trailer/grouted at ERDF
400 mr to about 2R/hr fill material and activated metal	Shielded container/tractor trailer/ERDF
> 2 R/hr activated metal	Investigate further for greater than Class C Waste considerations (Central Waste Complex [CWC] if yes, ERDF in shielded container if no)
> 2 R/hr fill	Investigate further for TRU waste considerations (CWC if yes, ERDF in shielded container if no)

The ERDF containers are used to accept sludge and activated metals at less than about 200 mrem/hr during in process surveys of the skiff boxes. If the skiff box exceeds 200 mrem/hr but is less than 400 mrem/hr, this material is placed in an open-top box that is lined with about 15.2 cm (6 in.) of poly-foam. The foam allows a greater distance between waste and contact dose readings measured at container skin (shipping/handling requirement), which allows a payload of higher dose materials in the box.

Minor amounts of material are currently being stored in a shielded container for later disposal. This material has been segregated during hot spot investigations and is some of the most activated material found in the basin. It is anticipated that this material will meet the ERDF waste acceptance criteria and will be documented and shipped accordingly when all of this type of material has been collected.

SNF Location, Retrieval, Packaging, and Shipment

Radiological mapping of a basin area is performed to identify where high-dose items may be present in the fill materials. This effort uses the LARADS system (an ion chamber detector set up for remote data gathering and computer data collection in a three-dimensional grid system) and is designed to show the high-dose area(s) that must be investigated to retrieve SNF, high-dose, or TRU waste materials.

Hot spot excavation for retrieval of the suspect SNF piece is performed in a very controlled manner with a BROKK 330N remotely operated excavator. Careful excavation of an identified hot spot is performed to determine the cause of the high radiation levels. As each bucket of sludge, debris, and fill material is placed in a skiff box, an RO7 ion chamber probe, operated from a man lift 7.6 m (25 ft) above, is used to determine if and where the hot material was in the deposited material. When an area in the skiff box is identified as containing radioactive material, the BROKK bucket is used to slowly uncover the item of concern (see Figure 3). Manned entries into the area with long-handled rakes have at times been needed to uncover an item. When located, the item is visually inspected using BROKK cameras or binoculars to determine if the item looks like fuel. Highly irradiated traveling wire flux monitor wire, fuel spacers, and process tubes are eliminated from further SNF consideration at this point. If the item looks like fuel, or the visual determination is inconclusive, a shielded URSA 2x2 sodium iodide probe is used to determine the relative cesium-137 ratio to other radionuclides as the final step in determining if the item is suspect SNF versus an irradiated piece of metal. Upon determination, the item is placed in a water-filled holding container until final SNF determination is made and shipment to K Basins is warranted.

Fig. 3. BROKK 330N in the FSB.

The SNF elements are stored until a sufficient quantity is available for shipment or the authorization basis limit is approached in the holding container. The elements are individually and remotely washed to remove foreign or chemical substances and are dried, weighed, and loaded into a canister. When the canister is filled, as determined by dose levels, fissile material quantity, and other authorization basis (9) and SARP (8) requirements, the canister is prepared for closure. Experience has shown that the elements have little or no fuel exposed (cladding is intact); therefore, the canister can be shipped dry. Because the package is shipped dry, gas generation is not a concern and packaging can be completed without limited shipping time. When the canister is closed and all approval records are in place, the canister will then be placed into a shipping cask by crane for transport to interim storage at K Basins.

Project Documentation

The project team actively manages the following documents as SNF and other items are found in the basin. This effort requires close coordination between the field and engineering staff to ensure that work is performed in accordance with regulatory and nuclear safety requirements. The needed revisions are requested, produced, and approved in a timely manner to eliminate (or at least minimize) any impact to field work.

- Authorization basis and air permit management are constant challenges because these two documents are the most susceptible to increase number of fuel elements in the basin. Based on previous experience, both documents could be revised in about one week and the air permit could receive regulatory approval in a few more days.

- Criticality evaluations were revised to account for increased number of fuel elements; however, due to the lack of significant enrichment of the SNF, no impact has been encountered.

- Work instructions were written to support the readiness assessment at the start of the project and were accurate for what was known at the time. The various packages have required revisions to incorporate changing work process flowcharts, lessons learned, and changes in the waste management/packaging criteria.

- Characterization and waste management documentation were revised to reflect the following:

    1. Results of the characterization sampling
    2. Method of measuring radiological conditions on the loaded skiff boxes for waste segregation purposes
    3. Waste profiles and shipping information to reflect the amount and radiological condition of the activated metal.

LESSONS LEARNED

Production Rates and Project Schedule

The project team's original estimate of full production rate was overly optimistic for removal of the lower fill material. Even with the most optimum loadout achieved after trying to achieve the best waste packaging scenario, actual removal rates are controlled by radiological considerations such as the following:

1. Removing high airborne controls after the packages are sealed

2. Surveying, swiping, and monitoring trucks and containers into and out of high radiation and high contamination areas

3. Hot particle controls

4. Counting radiological swipes using onsite equipment.

The project schedule, however, was built on estimated removal rates without sufficient consideration given to the logistics of moving the filled containers into and out of loading positions next to the basin.

Records – Quality of Information

The planning for the 105-F FSB cleanout was based on available deactivation records from the 1965 to 1970 timeframe. These records indicated that all SNF and high-activity materials were removed from the basin. This information was tempered with previous decommissioning experience and documentation from the mid-1980s where a few elements or pieces of SNF (two or three per basin) were discovered buried in the sludge layer. With this additional information, planning proceeded with the expectation that five SNF elements would be found. In fact, through the first 25% of the 105-F FSB cleanout work, more SNF was found (i.e., ten elements) than the combined total in three basins previously cleaned out in the mid-1980s. Some of the 1970 data has proven to be very accurate regarding fuel bucket locations and contents. A significant shortcoming of this documented inventory is that while most of the identified spacers are in the expected locations, some of these spacers are actually SNF elements.

The mid-1980s decommissioning documents indicated that some activated hardware should be expected. However, ongoing work is finding more and higher activity materials than were indicated in the historic documents.

The net result is that more fuel and more activated metal are being encountered than had been indicated in any of the historic documentation.

Technology Application – Laboratory Versus Field Application

The initial project plan relied heavily on the application of an integrated suite of radiological measuring devices to determine what was buried in the fill material prior to excavation. The ISOCS and GammaCam instruments were chosen for their ability to detect and map the location of high-activity materials through the soil and then differentiate between activated metal (expected to be primarily cobalt-60) and SNF (primarily cesium-137). This effort failed, not because of the instruments performance, but because the conditions in the field prevented either instrument from detecting at low enough sensitivities to identify material on the basin floor. The instruments were somewhat difficult to use when suspended from a crane hook, but an issue regarding instrument sensitivity caused the real problem. The minor amounts of contamination on or in cracks of the stem walls produced readings similar to those expected from very high-dose-rate material under 76.2 cm (30 in.) of soil. The differentiation of the stem walls from items buried in the soil was very difficult, when this was solved and we were able to focus only on the soil, the background from the stemwalls prevented very low readings in the soil to be differentiated.

When the decision was made to perform the cleanout in two lifts, the three-dimensional locating capabilities of the LARADS made it a better choice than the GammaCam. The laser mapping capability of the LARADS was modified to accurately indicate how much actual fill material remains after removal of the first lift (approximately the top 38.1 cm [15 in.]). Because the fuel buckets are removed in the first lift, the remaining soil level can range from 38.1 cm (15 in.) to as little as 5.1 to 7.6 cm (2 to 3 in.). This causes large variations in the instrument readings, but knowing the actual depth of soil at any given location allows proper adjustments to the raw data so only areas that could actually contain the target size piece of SNF are called out as hot spots.

FUTURE APPLICATIONS AND CONCLUSIONS

105-H Basin Application

The scope of work and conditions at the 105-H FSB are similar, and the effort is planned to be moved to the H Reactor's FSB when the 105-F FSB is complete. The lessons learned at the 105-F FSB will be applied to the final planning for the 105-H FSB. The main difference is that the 105-H FSB has large, softball-size cobble in the fill material, and the 105-F FSB fill consisted of fine sand. This will introduce different challenges to the radiological instruments and the BROKK 330N remote excavating equipment. Work at the 105-H FSB is scheduled to start in October 2002.

Burial Ground Excavations

At Hanford, other sites in the DOE complex, and other commercial or government locations, environmental restoration work involves excavating previous burial grounds and disposal cells. The lessons learned and experiences gained in looking for SNF in soil and packaging large volumes of highly variable radiological waste has direct application to the challenges of burial ground restoration.

CONCLUSION

The 105-F FSB offered many unique challenges, but the work is proceeding in a safe manner. The level of unknown condition is being reduced each day as additional experience is gained in the search for and recovery of SNF and the segregation and packaging of the activated metal and sludge that remains. This project exemplifies the need for good planning and the ability to make several rapid mid-course corrections while the work proceeds. Flowcharting the various steps and decision-making processes may be the biggest single item that has contributed to the success of communicating, training, approving, and performing this complex workscope.

REFERENCES

1. *Radionuclide Inventory and Source Terms for the Surplus Production Reactors at Hanford*, UNI-3714, Rev. 1, UNC Nuclear Industries, Richland, Washington (1987).

2. Contract No. DE-AC06-93RL12367 – *Roles and Responsibilities for Management of Potential Discovery of Spent Nuclear Fuel (SNF) at F and H Reactor Fuel Storage Basins*, DOE-RL Letter of Direction 00-ERD-115, dated July 17, 2000, and revised DOE-RL Letter of Direction 01-ERD-180, Contract No. DE-AC06-93RL12367 – *Revised Roles and Responsibilities for Management of Potential Discovery of Spent Nuclear Fuel (SNF) at 105-F And 105-H Reactor Fuel Storage Basins*, December 21, 2000, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

3. *Summary Report Reactor Plant Deactivation Test F & H Storage Basin Layaway*, GE-RL-REA-2689, General Electric, Hanford Atomic Products Operation, Richland, Washington (1965).

4. *Sampling and Analysis Plan for the 105-Phase IV Fuel Storage Basin,* DOE/RL-2000-54, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington (2000).

5. *Description of the 100-B, 100-C, 100-D, 100-DR, 100-F and 100-H Production Reactor Plants*, *Hazards Summary Report*, GE-HW-74094, Vol. 3, General Electric, Hanford Atomic Products Operation, Richland, Washington (1963).

6. *Fuel Storage Basins Cleanup and Stabilization Project Report*, UNI-3958, UNC Nuclear Industries, Richland, Washington (1986).

7. *Transfer Plan for Potential Spent Nuclear Fuel Discovered at the F&H Fuel Storage Basins for Relocation to K Basins*, BHI-01428, Rev. 0, Bechtel Hanford, Inc., Richland, Washington (2001).

8. *PAS-1 Cask Onsite Safety Analysis Report for Packaging (SARP) for the 105-F/H Fuel Storage Basin Spent Nuclear Fuel*, BHI-01476, Rev. 0, Bechtel Hanford, Inc., Richland, Washington (2001).

9. *Final Hazard Classification and Auditable Safety Analysis for the 105-F Building Interim Safe Storage Project*, BHI-01151, Rev. 1, Bechtel Hanford, Inc., Richland, Washington (2001).

FOOTNOTES

[a] Universal Radiation Spectrum Analyzer (URSA) is a registered trademark of Radiation Safety Associates, Inc., Hebron, CT.
[b] GammaCam is a trademark of AIL Systems, Inc., Deer Park, NY.
[c] BROKK 330N is a registered trademark of Brokk AB, Skellefteá, Sweden.