BHI-01428
Rev. 0

Transfer Plan for Potential Spent Nuclear Fuel Discovered at the F and H Fuel Storage Basins for Relocation to K Basins

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

Submitted by: Bechtel Hanford, Inc.

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ACRONYMS

AMEW	Office of Assistant Manager for Environmental Restoration and Waste Management
ALARA	as low as reasonably achievable
BHI	Bechtel Hanford, Inc.
DOE	U.S. Department of Energy
ERC	Environmental Restoration Contractor
ERDF	Environmental Restoration Disposal Facility
FH	Fluor Hanford, Inc.
FSB	fuel storage basin
ISOCS	In Situ Object Counting System
ISS	interim safe storage
MOU	memorandum of understanding
NM	nuclear material
PAC TECH	Packaging Technology, Inc.
QA	quality assurance
RL	DOE, Richland Operations Office
SAS	Safeguards and Security
SARP	safety analysis report for packaging
SNF	spent nuclear fuel
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*

1.0 INTRODUCTION

1.1 BACKGROUND

Cleanout of the F and H Reactor Fuel Storage Basins (FSBs) 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 and H Reactors. Following reactor shutdown and in preparation for a deactivation layaway action in 1970, the water levels in the F and H Reactor FSBs were reduced to approximately 0.6 m (2 ft) to 1.5 m (5 ft), respectively, over their floors. Basin components and other miscellaneous items were placed in the FSBs. 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 and H Reactor FSBs were then filled to grade level with 6 m (20 ft) of local surface material (essentially sand and sand/cobble, respectively). The reactor FSB backfill cleanout has the potential of having to remove spent nuclear fuel (SNF) that may have been left unintentionally. Based on previous cleanout of six water-filled FSBs with similar designs (i.e., the B, C, D, and DR FSBs in the 1980's, and the KE and KW FSBs in the 1970's), it is estimated that up to five SNF elements may be discovered in each of the F and H FSBs (UNC 1987).

The F and H Reactor Buildings are Radiological Facilities as defined in *Final Hazard Classification and Auditable Safety Analysis for the 105-F Building Interim Safe Storage Project* (BHI 1998) and the *Final Hazard Classification and Auditable Safety Analysis for the 105-H Facility Interim Safe Storage Project* (BHI 2000).

1.2 SCOPE

This transfer plan defines the process for any SNF that may be discovered during cleanout of the F Reactor and H Reactor FSBs for placement in safe, compliant storage at the 100 Area Interim Storage 105-K Fuel Storage Basins (K Basins). The U.S. Department of Energy, Richland Operations Office (RL) letter of direction (DOE-RL 2000a), dated July 17, 2000 and revised September 28, 2000, defines the roles and responsibilities for management of potential discovery of SNF at the F/H FSBs and the subsequent packaging, transportation, and placement into interim storage at K Basins.

Plans for the removal, packaging, transportation, and receipt of SNF were developed based on historical data (GE 1963, 1965; UNC 1986, 1987). Stage I of the FSB cleanout involves removing the top approximately 5.2 m (17 ft) of fill material, including debris placed in the basin during the 1970 deactivation layaway action. Stage II will remove 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 II, including any SNF, will be characterized with the GammaCam™ and In Situ Object Counting System (ISOCS). Information obtained with these instruments will be used to update the current characterization data.

™ GammaCam is a trademark of AIL Systems, Inc., Deer Park, New York.

To meet retrievability capabilities, SNF is defined as pieces of fuel confirmed in accordance with ERC 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 in situ Germanium-based spectrometry system (i.e., ISOCS) that will be used to provide information on types and amounts of radioactive material will identify irradiated SNF during basin(s) cleanout excavation. 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 (DOE-RL 2000a).

1.2.1 Interfaces

This plan is predicated on completion of the 105-F and 105-H fuel transfer without impact to the K Basins fuel and sludge removal *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) commitment (DOE-RL 2000a). Accordingly, the necessary activities at K Basins to facilitate transfers from the 105-F and 105-H Basins will be delayed until after the start of fuel removal from the K West Basin to enable SNF Project management resources to focus on satisfying the Tri-Party Agreement commitment for initiating fuel removal (November 2000).

An integrated schedule will be established and maintained to ensure adequate coordination of potential transfers from the F and H Basins with planned K Basins operations and construction activities.

If the SNF canister can be shipped dry (preferred method), the package can be completed without being shipping time limited (see Section 2.2). This would make the shipping date more flexible. However, the cask reservation window and security requirements would be affected.

2.0 TECHNICAL WORK DESCRIPTION

2.1 RETRIEVAL

Stage II of the FSB cleanout (bottom 0.9 m [3 ft]) will involve the following:

- Remote mapping of the remaining materials to identify radiological hot spots and possible fuel elements using the GammaCam (to identify hot spots) and the ISOCS unit. The ISOCS unit is used to fingerprint the isotopic mix to identify fuel pieces.

- Remotely excavating and processing suspect SNF items for confirmation in accordance with the approved ERC procedure. When an element or fragment is confirmed as SNF, it will be processed for packaging. The SNF Project will require approval of the safety analysis report for packaging (SARP) to ensure that the loaded canister is compatible with the K Basins safety authorization basis (Sections 3.1.1 and 3.4.3).

- The Bechtel Hanford, Inc. (BHI) Project Manager will notify the BHI Safeguards and Security Representative and the Fluor Hanford, Inc. (FH) Manager of Safeguards in accordance with the Safeguards and Security Memorandum of Understanding (MOU) (BHI 1996) (see Section 3.5) if suspect nuclear material (NM) is located.
- Remotely moving fuel items and loading into a fuel canister/cask for shipment to K Basins.
- Remotely excavating other high dose material, packaging for disposal, and disposing of at the Environmental Restoration Disposal Facility (ERDF) or other approved facility.
- Removing the remaining fill material and trash in the bottom of the basin, and packaging and disposing of at an approved facility.
- Demolishing the basin concrete, size reducing the rubble, and packaging and disposing of the material at the ERDF.

2.2 PACKAGING

The approved SARP commitments shall not be modified, deleted, or otherwise altered without the revision of the appropriate SARP documents.

Prior to loading the canisters and shipping cask, K Basins personnel shall be notified to oversee the loading operations.

SNF element(s) will be remotely washed to remove any foreign or chemical substance, dried (drain-rack for air drying or by other acceptable surface liquid removal means), weighed within an accurate range of a calibrated scale, and then loaded into a canister. When the canister is filled with five or less SNF elements as determined by dose levels, fissile material quantity, and other SARP requirements (Appendices A, B, and C), it will be prepared for closure. The canister will be filled with water if required for SNF recovery at K Basins. A nonvented water-filled canister may require shipping that will allow for opening within a specified time to prevent hydrogen buildup. If the canister can be shipped dry (i.e., not submerged in water), then the package can be completed without its shipping time being limited. When the canister is ready (see Section 3.2.1) and all approved records are in place, it will then be placed into a shipping cask by crane for transport to interim storage at K Basins.

2.3 SHIPMENT

The loaded and secured shipping cask will be transported by ERC or DynCorp Tri-Cities Services, Inc. transportation to K Basins for interim storage in the 100-K Area. As currently planned, no special highway route controls, escorting, or heavy-load shipment approval will be required. The shipping cask will be loaded and secured on a tractor/trailer as described in the SARP for this packaging system. Based on current projections, the loaded shipping cask should not create a radiation area. Actual exposure rates will be verified by a radiation control technician survey before departure from the FSB area.

2.4 RECEIPT AND STORAGE AT K BASINS

The fuel will be received at the K Basins in a PAS-1 shipping cask. The fuel will be received at the K East Basin South Loadout Pit, the K East Basin Dummy Elevator Pit, or the K West Basin Dummy Elevator Pit, dependent on the results of the integrated scheduling activity. Upgrades will be performed to enable fuel receipt at the applicable pit. If the K East Basin Dummy Elevator Pit is used, preparations will include cleanout of accumulated waste and debris from the pit.

The cask system will be decontaminated, consistent with SARP requirements, and provided to the ERC or DynCorp Tri-Cities Services, Inc. for return to the F Basin, H Basin, or assigned storage custodian location.

3.0 REQUIRED ACTIONS

3.1 CANISTER ACQUISITION

The plan is to reserve one of the PAS-1 shipping casks (as soon as the SARP permits) that are currently stored at the 222-S Laboratory in the 200 West Area. The cask reservation window will narrow as the SNF transfer plans are finalized. Two of the six sludge canisters stored in the 100-K Area have been reserved by FH for ERC use. The additional shielding in tall sample canisters with a short sample canister lid to increase cavity size for full SNF element may be necessary for as low as reasonably achievable (ALARA) concerns pending SARP approval. The canister assembly racks for the PAS-1 cask are different for the sludge and sample canisters. The rack assembly for the sludge canister rack will hold two canisters. The rack assembly for the tall sample canister will hold four canisters.

3.1.1 Canister Design Criteria, Review, and Approval

As currently planned, the canister design criteria and design review and approval are based on the following projections.

The FSB SNF transfer packaging being evaluated for this transfer plan is used for the K Basins sludge (WHC 1995, WMFS 1999), sample canisters (DOE 1999), and the PAS-1 shipping cask. Before use of this packaging system (canister and cask), the K Basins receipt personnel shall review and concur with the proposed packaging. A SARP is required for the SNF using this packaging because of the radionuclide inventory, dose rate levels, and because of the onsite transfer of this packaging. A SARP evaluation is necessary to demonstrate that the packaging meets the requirements of BHI-EE-10, *Waste Management Plan*, Part I, Section 3.0, “Waste

Storage and Handling," and Section 4.0, "Shipping and Documentation," and BHI-EE-12, *ERC Transportation Manual*, for SNF by meeting the applicable performance requirements for normal conditions of transport.

The SARP will be prepared by the Packaging and Engineering Department of either GTS Duratek, Packaging Technology, Inc. (PAC TECH), or other qualified firms. This transfer plan may require future revision, pending comparison with SARP limitations.

3.1.2 Roles and Responsibilities for Fabrication/Quality Assurance

As currently planned, no fabrication is anticipated. However, if fabrication of packaging container items becomes necessary, the organization will obtain BHI Decommissioning Project funding approval for its engineering, quality assurance (QA), and other fabrication support. Possible fabrication tasks include the following:

- Prepare and submit for approval the project schedule showing detailed steps and milestones for all major fabrication, procurement, and delivery of equipment or machinery.

- Prepare detailed shop drawings that translate the detail design engineering drawings into complete details and instructions regarding the fabrication. Submit shop drawings to the contractor for review and approval.

- Furnish and procure all materials necessary to fabricate equipment or machinery in accordance with the contractor-approved schedule and specification(s). Submit applicable material mill certificate of compliance to the contractor as required.

- Fabricate components in accordance with prepared applicable specifications and as detailed in the final shop drawings approved by the contractor. The item shall be fabricated in such a fashion that it can be safely transported to the Hanford Site's 100 Area without significant field modifications.

- Shop paint in accordance with prepared specification and as approved by the contractor.

- During the fabrication period, provide safe and unrestricted access during normal working hours to a third party designated by the contractor for in-plant inspection of shop-supplied material and workmanship.

The shop shall have an established QA program that prescribes the QA management policies, organizational structure, and procedures for all aspects of work performed by the shop. The shop's QA program shall comply with DOE Order 5700.6C, *Quality Assurance*, and 10 CFR 830.120, "Quality Assurance," and be submitted to the contractor for review and concurrence. The shop shall perform all work in accordance with its approved QA program.

3.2 F AND H PREPARATIONS

3.2.1 Canister Loading Procedures

The SARP will specify loading restrictions and the Field Support work package will include hold point for the QA and witness (FH) for the weighing loading requirements.

FH shall review and concur with ERC packaging and shipping procedures and documents that affect the path forward for SNF, including the plan for fuel transfer to K Basins (DOE-RL 2000a). FH shall establish and approve canister loading procedures and documents, with the exception of F Reactor and H Reactor FSB internal procedures and documents that do not affect fuel acceptance at the K Basins.

3.2.2 Maximum Enrichment Verification

Documentation was reviewed to verify that the F and H FSB SNF inventory met the K Basin SNF requirement of a maximum of 1.25 weight % uranium-235 enrichment. The SNF in the F and H Reactor Buildings identified in BHI (1998), BHI (2000), and GE (1963) is predominantly natural uranium. The enriched uranium fuel used was 0.947 weight % uranium-235 to provide excess reactivity and power flattening (GE 1963, Vol. 3).

3.2.3 Method of Performance

The BHI work force will be used exclusively for fuel removal and canister loading, but supplemental work force resources from FH may be required. BHI and FH shall budget and pay for costs consistent with responsibilities noted in the RL letter of direction (DOE-RL 2000a). If specific activities are accomplished on the behalf of another party, work and/or purchase/task orders shall be mutually developed to support activities, including appropriate funding.

3.3 ONSITE SHIPMENT PREPARATIONS

3.3.1 Safety Analysis Report for Packaging/Package Design Criteria

As currently planned, the canister design criteria and design review and approval are based on the following projections.

The FSB SNF transfer packaging being evaluated for this transfer plan is used for the K Basins sludge (WHC 1995, WMFS 1999), sample canisters (DOE 1999), and the PAS-1 shipping cask. Before use of this and/or other packaging systems (canister and cask), the K Basins receipt personnel shall review and concur with the proposed packaging. A SARP is required for the SNF using this packaging because of the radionuclide inventory, dose rate levels, and because of the onsite transfer of this and/or other packaging. A SARP evaluation is necessary to demonstrate that the packaging meets the requirements of BHI-EE-10, *Waste Management Plan*, Part I, Sections 3.0 and 4.0, and BHI-EE-12, *ERC Transportation Manual*, for SNF by meeting the applicable performance requirements for normal conditions of transport.

The SARP will be prepared by the Packaging and Engineering Department of either GTS Duratek, PAC TECH, or other qualified firms. This transfer plan may require future revision, pending comparison with SARP limitations.

3.3.2 Cask Acquisition

Responsibilities for cask lease/modification/decontamination/return will be an ERC-coordinated action.

The ERC plan is to reserve one of the PAS-1 shipping casks (as soon as the SARP permits) that are currently stored at 222-S in the 200 West Area. The cask reservation window will narrow as the SNF transfer plans are finalized. Two of the six sludge canisters stored in the 100-K Area have been reserved by FH for ERC use. The additional shielding in tall sample canisters with a short lid to increase cavity size for full SNF element may be necessary for ALARA pending SARP approval. The canister assembly racks for the PAS-1 cask are different for the sludge and sample canisters. The rack assembly for the sludge canister rack will hold two canisters. The rack assembly for the tall sample canister will hold four canisters.

3.4 K BASINS PREPARATIONS

The K Basin preparations will be performed based on the assumption that a maximum of 68.04 kg (150 lbs)[1] of single-pass production reactor fuel will be recovered from the F and H Basins. Additionally, documentation identified in Section 3.3.2 that establishes that the maximum uranium-235 enrichment within the inventory does not exceed 0.947% must be provided for SNF Project review and acceptance prior to implementation of this plan.

3.4.1 Safety Analysis Report/Technical Safety Requirements Modification

FH will revise the K Basins safety analysis report as needed to support introduction of a maximum 68.04 kg (150 lbs) of additional fuel inventory from the 105-F and 105-H Basins via the South Loadout Pit or the Dummy Elevator Pit.

3.4.2 Physical Modifications

The scope of the physical modifications at the K Basins is dependent on whether the transfer path via the South Loadout Pit is available. Therefore, the scope of the modifications will be established in conjunction with development of the integrated schedule.

[1] The 10-element quantity is calculated on the largest fuel element type listed in the GE report, which is over twice the canned factor weight of all the other 18 types of fuel element. The auditable safety analysis and this report use the largest fuel element data for worst-case calculation bases (GE 1963).

3.4.3 Operating Documents

K Basin operating documents will be revised to support receipt and storage of the fuel from the 105-F and 105-H Basins consistent with requirements established by the SARP and the modified K Basins safety analysis report.

3.4.4 Training

A training plan will be developed to address receipt and storage operations at the K Basins. Training will be completed consistent with requirements identified in the training plan.

3.4.5 Air Permit/Notice of Construction

FH will provide required notification and documentation for State of Washington Department of Health review for activities at the K Basins. Existing K Basins air permit documentation will be revised to reflect the additional source term and supplemental work activities, as necessary.

3.5 SAFEGUARDS AND SECURITY

The safeguards and security MOU (BHI 1996) defines the responsibilities and commitment of BHI and FH in determining if quantities of NM that present safeguards and security concerns are discovered during ERC activities and ensuring storage, protection, and accountability of this NM are in compliance with DOE requirements.

3.5.1 FSB Material Custody Transfer Logistics (Responsibilities, Timing)

The Office of Assistant Manager for Environmental Restoration and Waste Management (AMEW) shall direct BHI to maintain SNF, pursuant to the MOU (BHI 1996) between BHI and FH, at the F and H FSBs until acceptance by the Office of Spent Nuclear Fuels at K Basins.

3.5.2 Procedure for Establishing Material Inventory

The BHI portable in situ Germanium-based spectrometry system (i.e., ISOCS) that is to be used to provide information on types and amounts of radioactive material will identify irradiated SNF during basin(s) cleanout excavation.

FH will confirm if the discovered material is NM. If the evaluation concludes that the material is NM, FH will define the appropriate NM protection requirements, and establish a Material Balance Area for accountability of the inventory.

3.5.3 Physical Security

If FH security services are needed to implement NM protection requirements, FH will provide these services.

3.6 NATIONAL ENVIRONMENTAL POLICY ACT REVIEW

The *Engineering Evaluation/Cost Analysis for the 105-DR and F Reactor Facility and Ancillary Facilities* (DOE-RL 1998) and the *Engineering Evaluation/Cost Analysis for the 105-H Reactor Facility and Ancillary Facilities* (DOE-RL 2000b) present the results of an engineering evaluation/cost analysis that was conducted to evaluate alternatives to address implementation of ISS of the F Reactor Building, including the FSB. The reactor blocks will remain in a safe storage mode for up to 75 years as identified in the Record of Decision (58 FR 48509) issued following the environmental impact statement, *Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington* (DOE 1992). The *Removal Action Work Plan for 105-DR and 105-F Building Interim Safe Storage Projects and Ancillary Buildings* (DOE-RL 2000d) and the *Removal Action Work Plan for 105-D and 105-H Building Interim Safe Storage Projects and Ancillary Buildings* (DOE-RL 2000c) present the methods and activities to perform the removal action to modify structures as necessary and construct ISS enclosures for the reactor buildings.

3.7 RCRA/CERCLA/TSCA

Documentation certifying that no regulated materials are being transferred to K Basins will be provided by the ERC. The *Sampling and Analysis Plan for the 105-Phase IV Fuel Storage Basin* (DOE-RL 2000e) addresses the interim closure of the F FSB complex and the soils underlying and adjacent to the F FSB, including dispositioning the backfill soils in the F FSB. Phase IV is divided into two stages: Stage I focuses on the upper portion of the fill material in the FSB for possible reuse, and Stage II addresses the fill material, debris, concrete, and underlying soil in the lower portion of the FSB. Stage I may provide early identification of any FSB regulated materials prior to fiscal year 2001. Both Stage I and Stage II will provide data for verification that no regulated materials are in contact with SNF, or will identify the need to develop a means of removing foreign or chemical substances.

3.8 READINESS

3.8.1 Readiness Determinations/Plans of Action

An ERC readiness assessment will be accomplished and completed prior to the start of each excavation stage of the FSB backfill cleanout: Stage I from grade level to approximately 5.9 m (17 ft) below grade level, and Stage II from approximately 5.9 m (17 ft) below grade level and below (see Section 2.1).

All of the FSB cleanout activities have been evaluated as "Radiological," including the activities for any SNF that may be discovered during cleanout of the FSB for placement in safe, compliant storage at the K Basins. Therefore, BHI as the approval authority is the appropriate level based on BHI-MA-02, *ERC Project Procedures*, Procedure 8.2, "Readiness Assessments." This procedure also assigns the project manager responsibility to verify the type of review that is required. The review type has been set at Level I Readiness Assessment based on the table in Appendix 1 of BHI-MA-02, Procedure 8.2.

3.8.2 Integration of F/H and K Readiness Activities

Regulatory Services will be notified that fuel shipment will occur, prior to the loaded cask being removed from the FSB area. The work package shall include a Field Superintendent verification hold point for the notification being performed.

A K Basin readiness assessment on the fuel transfer process will be completed prior to removing the loaded cask from the FSB area. The work package shall include a Field Superintendent verification hold point that this has been performed.

4.0 SCHEDULE

4.1 PROPOSED SCHEDULE

An integrated schedule will be established and maintained to ensure adequate coordination of potential transfers from the F and H Basins with planned K Basins operations and construction activities.

Key activity dates are as follows:

- F FSB Stage II cleanout readiness assessment: March 9, 2001
- F FSB SNF removal: May 31- June 19, 2001 (date assumes full funding December 1, 2000)
- H FSB Stage II cleanout readiness assessment: March 8, 2002 (tentative date)
- H FSB SNF removal: June 21 – July 11, 2002 (tentative date).

4.2 SCHEDULE APPROVAL AND CHANGE

Schedule approval and change control will be performed by the ERC Decommissioning Project Control group.

5.0 FUNDING

5.1 FUNDING METHOD

As identified in the RL letter of direction (DOE-RL 2000a), the AMEW is responsible for funding all activities for retrieval, transfer, and placement of this fuel into storage at the K Basins. The Office of Spent Nuclear Fuels will provide two storage canisters from existing excess for AMEW use, and is responsible for funding activities after the fuel is successfully emplaced within approved storage locations at K Basins.

If specific activities are accomplished on the behalf of another party, work and/or purchase/task orders shall be mutually developed to support activities, including appropriate funding.

5.2 COST PERFORMANCE TRACKING AND STATUS

The ERC Decommissioning Project Control group will track the cost and schedule status in weekly meetings. Cost performance will be measured using the earned value method, with schedule and cost variance included. Cost performance is documented and trended until project completion.

6.0 REFERENCES

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58 FR 48509, 1993, "Record of Decision: Decommissioning of Eight Surplus Production Reactors at the Hanford Site," Final Rule, *Federal Register*, Vol. 58, pp. 48509, September 16, 1993.

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DOE, 1999, *Safety Evaluation Report NuPac PAS-1 Packaging with Payload B, Certification of Compliance,* DOE/USA/9184/B (U) (DOE), Docket 94-22-9184, Rev. 1, January 25, 1999, U.S. Department of Energy, Washington, D.C.

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APPENDIX A

RADIONUCLIDE INVENTORY FOR ONE SPENT NUCLEAR FUEL ELEMENT

APPENDIX A

RADIONUCLIDE INVENTORY FOR ONE SPENT NUCLEAR FUEL ELEMENT

Complete radionuclide inventory data for one spent nuclear fuel element (Table A-1) are provided by Nuclear Safety Engineering from the auditable safety analysis[1].

Table A-1. One Spent Nuclear Fuel Element Radionuclide Inventory.

Isotope	Inventory (Ci)
Am-241	7.83E-02
Ba-137m	5.61E+00
Cd-113	4.00E-04
Cs-137	5.93E+00
Eu-152	3.03E-05
Kr-85	1.72E-01
Nb-94	1.60E-04
Pd-107	4.00E-06
Pu-238	3.61E-03
Pu-239	2.40E-01
Pu-240	6.00E-02
Pu-241	1.07E+00
Se-79	4.00E-05
Sm-151	7.21E-02
Sr-90	5.85E+00
Tc-99	2.00E-01
U-238	1.20E-03
Y-90	5.85E+00
Zr-93	4.00E-04

Note: Table A-1 evaluates in-growth of americium-241 but was not included in the inventory because americium –241 did not contribute any direct dose. However, Table C-1, Appendix C, takes americium-241 in-growth into consideration for fissile material calculations.

[1] BHI-01151, Rev. 0, *Final Hazard Classification and Auditable Safety Analysis for the 105-F Building Interim Safe Storage Project*, 1998, Bechtel Hanford, Inc., Richland, Washington, and Management of Change (MOC) MOC-2000-0002. This MOC excludes uranium-235 in the fuel element inventory and therefore will be excluded in the dose calculations.

APPENDIX B

SPENT NUCLEAR FUEL DOSE RATE EVALUATION

APPENDIX B

SPENT NUCLEAR FUEL DOSE RATE EVALUATION

The worst-case dose level uses (Table A-1, Appendix A) fuel values from the auditable safety analysis (ASA) (BHI 1998) as the database. Cask calculation will show dose rates that could be expected for handling those canisters for the on-site K Basin sludge and sample canisters that go in the PAS-1 cask. The expected spent nuclear fuel dose levels are evaluated based on (1) the report on fuel storage basin dose survey readings prior to backfill (GE 1965); (2) the FSB cleanout report for the D, DR, B, and C basins (UNC 1986); and (3) BHI FSB cleanout survey data at the N Reactor. The MicroShield™ results (BHI 2000a), and the results are summarized below.

Based on the fuel element constituents (Table A-1), the MicroShield calculations were performed to determine potential conditions for two different canisters (Section 3.1.1) and a bare element. However, these results do not match operational data. During the cleanout of the B, C, D, DR, and N basins in the 1980's–1990's, fuel elements rarely exceeded 25 R/hr at contact. Based on this empirical evidence, revised exposure rates were calculated. The results for a measurement obtained at the center of the sidewall are shown in Table B-1.

Table B-1. Exposure Rates (mR/h) for a Single Fuel Element.

	ASA Databased Results[a,b]			Empirically–Adjusted Results[c]		
	Sludge Canister[d]	Sample Canister[e]	Bare Element[f]	Sludge Canister	Sample Canister	Bare Element
Contact (1 in.)	647	79.4	120,000 (120 R/h)	135	16.5	2.5 E4 (25 R/h)
1 ft	101	12.8	5,500 (5.51 R/h)	21	2.67	1,150 1.15 R/h
100 cm	14.5	1.77	577	3.02	0.37	120.2

[a] BHI 1998.
[b] BHI 2000b. The Management of Change excludes uranium-235 in the fuel element inventory and therefore is excluded in the dose calculations.
[c] GE 1965, UNC 1986.
[d] Attachment A of BHI (2000a) shows the assumptions, model used, and results using Microshield.
[e] Attachment B of BHI (2000a) shows the assumptions, model used, and results using Microshield.
[f] Attachment C of BHI (2000a) shows the assumptions, model used, and results using Microshield.

™ MicroShield is a trademark of Grove Engineering, Rockville, Maryland.

While the exposure rate for five fuel elements will vary slightly based on geometry, the exposure is roughly five times higher. Fractional fuel elements will similarly emit fractions of the exposure rate.

REFERENCES

BHI, 2000a, *Fuel Dose Rate Calculations*, Calculation No. 0100F-CA-N0012, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2000b, *Management of Change – 105-F Fuel Storage Basin Sediment Concentrations,* MOC-2000-0002, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

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GE, 1965, *Summary Report Reactor Plant Deactivation Test 105-F & H Storage Basin Layaway*, GE-RL-REA-2689, General Electric, Hanford Atomic Products Operation, Richland, Washington.

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APPENDIX C

SPENT NUCLEAR FUEL
FISSILE MATERIAL EVALUATION

APPENDIX C

SPENT NUCLEAR FUEL FISSILE MATERIAL EVALUATION

Based on the fuel element constituents (Table A-1, Appendix A), the fissile material calculations were performed to determine potential number of spent nuclear fuel elements (fissile material gram quantities) for estimating canister-loading limitation. The worst-case fissile material gram quantity estimate uses Table A-1 fuel values as the database. However, the portable in situ Germanium-based spectrometry system (In Situ Object Counting System [ISOCS]) will be used to provide information on types and amounts of radioactive material identified as spent nuclear fuel during basin(s) cleanout excavation. Information obtained with this instrument will be used to provide actual data for the packaging.

Table C-1. Fissile Material for Spent Nuclear Fuel.

Per Fuel Element Table A-1 Note: Table C-1 takes Am-241 in-growth inventory into consideration.			**Number of Grams of Fissile Material**						
			# of Fuel Elements	**1**	**2**	**3**	**4**	**5**	**6**
Fissile Isotopes	**Inventory (Ci)/ Fuel Element**	**Inventory (g)/ Fuel Element**							
Pu-239	0.24	3.8229405		3.822941	7.645881	11.46882	15.29176	19.1147	22.93764
Pu-241	1.068	0.01025		0.01025	0.0205	0.03075	0.041	0.05125	0.0615
			Sum	3.83319	7.666381	11.49957	15.33276	19.16595	22.99914

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