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Equipment Engineering	Equipment Engineering	Date 04/24/95
Project Title/Work Order		EDT No. 160166
Westinghouse Hanford Company Recommended Strategy for K Basin Sludge Disposition		ECN No. N/A

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Page 1 of 1

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RELEASE AUTHORIZATION

Document Number:	WHC-SD-SNF-SP-001, REV 0
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This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz — May 1, 1995

SUPPORTING DOCUMENT

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5. Key Words	6. Author
K Basin Sludge, canister storage building, multi-canister overpacks, sludge characterization, sludge retrieval, sludge disposition	Name: C. J. Alderman Signature Organization/Charge Code 2C130/LD23A

7. Abstract

The objective of this document is to present the recommended strategy for removal of sludges from the K Basins. This document ties sludge removal activities to the plan for the K Basin spent nuclear fuel and is consistent with follow on direction provided in February 1995. Solutions and processes for resolving sludge removal technical and management issues to meet accelerated K Basin deactivation objectives are described.

8. RELEASE STAMP

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WESTINGHOUSE HANFORD COMPANY
RECOMMENDED STRATEGY FOR K BASIN SLUDGE DISPOSITION

DISCLAIMER

April 21, 1995

CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

1.1 OBJECTIVE

The objective of this document is to present the recommended strategy for removal of sludges from the K Basins. This document ties sludge removal activities to the plan for the K Basin spent nuclear fuel (SNF) described in WHC-EP-0830, *Hanford Spent Nuclear Fuel Project Recommended Path Forward* (Reference 1) and is consistent with follow-on direction provided in February 1995 (Reference 2). Solutions and processes for resolving sludge removal technical and management issues to meet accelerated K Basin deactivation objectives are described.

To arrive at a strategy for sludge retrieval and disposition, several alternatives were evaluated. These evaluations and recommended sludge treatment processes are described in *K-Basin Spent Fuel Sludge Treatment Alternatives Study*, PNL-10398, Vols. 1 and 2 (Reference 3). As a further input to help validate the recommended path forward, an independent expert committee reviewed the preliminary plans for the project and produced a document of recommended approaches, *Independent Review of K-Basin Sludge Disposition Path Forward*, Len Ermold, Chairperson. This report is attached as Appendix A.

1.2 SLUDGE DISPOSITION STRATEGY SUMMARY

Figure 1 shows the general flow for the Westinghouse Hanford Company (WHC) strategy for K Basin sludge disposition. This strategy provides significant improvements over the original plan. It addresses regulatory issues including disposition of the sludges under the Resource Conservation and Recovery Act (RCRA). It also decouples transfer of K Basin sludges from fuel removal activities and allows the potential to remove some sludges prior to initiating fuel removal. Finally, this strategy presents a more cost effective solution to the original plan. Large savings are anticipated by not handling the sludge as fuel. The following outlines the major elements of the recommendation:

1. Manage all sludges as SNF while in the K Basins.

2. Once loose sludges are collected and removed from the facilities, manage them as radioactive or mixed waste consistent with the upcoming characterization results. The preferred sludge path forward alternative sends sludges to the Tank Waste Remediation System (TWRS) and/or the Hanford Solid Waste Disposal as appropriate.

3. Continue to manage sludge within the fuel canisters at the time they are loaded into the multi-canister overpacks as SNF.

The details of the plan are being developed within the Hanford infrastructure. Two options are under consideration: transferring the

sludges to the Hanford double shell tanks (DSTs) and/or placing them into a form appropriate for solid waste disposal. Limited sampling shows that K Basin sludge is not homogenous. Various sludges include differing amounts of fuel fragments, heavy metals, corrosion products from fuel and basin structures, dirt, silicates from the basin walls, and debris. Characterization is the next major step in establishing the actual disposition path. As described below, criteria for waste acceptance and sludge handling equipment will be used to define early characterization requirements. Parallel to the characterization process, ongoing studies are collecting detailed requirements and related costs and schedules associated with solid waste and tank farm disposal. This way, when characterization data are available, the disposition alternatives can be quickly narrowed and the final plan defined.

1.3 SNF PLAN

The SNF plan outlined in Reference 1 describes the basis for removing fuel from the K Basins. Summarized, the plan quickly removes K Basin SNF to a facility where it can be safely staged (10 years or less) until the process is developed to stabilize the material for low-cost interim (up to 40 years) dry storage at Hanford. The staging facility, referred to as the canister storage building (CSB), will become the interim storage facility for the stabilized fuel. Multi-canister overpacks (MCOs) will be used to remove fuel from the basins and will contain the fuel throughout staging, stabilization and interim storage.

At the time the K Basins SNF plan was issued, sludge was assumed to be SNF and was included with all fuel handling processes. However, the plan maintained the sludge path required more evaluation because the recommended fuel stabilization process may be complicated by the presence of sludge. The stabilization facility is envisioned to be relatively simple, with no added means of handling sludges separately from the fuel. For this reason, fuel canister desludging, if required for stabilization, will occur in the K Basins prior to fuel shipping. Therefore the sludge strategy includes handling and disposition of fuel canister sludge as needed. Schedules have been accelerated since the SNF path forward recommendation was issued with some of the details being reassessed in an effort to expedite the K Basin cleanup process.

2.0 SLUDGE DISPOSITION STRATEGY

2.1 PROJECT OBJECTIVES

The objective of the sludge removal project is to manage, remove and disposition K Basins sludges. This must be accomplished while maintaining consistency with budget, schedule and technical requirements for mitigating K Basin vulnerabilities. System and activity functions will be traceable to the SNF primary functions and requirements. All applicable safety and

environmental requirements will be met within the process. Project costs must be minimized wherever possible without compromising these objectives or the expedited schedule for SNF disposition.

2.2 KEY PROJECT MILESTONES

Key Project milestones are:

- Receive DOE direction to pursue managing sludge as waste (Appendix B)
- Complete sludge characterization to meet criteria for transportation, storage and disposition alternative selection (11/95)
- Initiate sludge removal project (12/95)
- Complete bulk sludge removal (12/2000).

These tasks will be planned for completion as early as possible and are dependent upon establishing the overall cleanup priorities in the K Basins as well as budget constraints. Completion of all sludge removal activities remains to be negotiated under the K Basin deactivation plan. Some sludge removal is expected to occur beyond the fuel removal campaign prior to turning the basins over for decontamination and decommissioning. Sections 3.1 through 3.5 of this recommendation provides more detailed discussions about the options and anticipated sludge handling systems. Section 4.3 presents the overall schedule and budgets.

2.3 EVALUATION AND REVIEW OF PATH FORWARD ALTERNATIVES

An alternatives study team evaluated potential sludge treatment processes. The results of that study provided the basis for the sludge path forward described above in section 1.2. Factors evaluated included:

- Technical options
- Regulatory impacts associated with the options
- Cost and schedule impacts
- Use of existing site facilities
- Minimizing worker exposure
- Sludge classification
- Waste form acceptability
- Technical uncertainties.

The various sludge management options showed minor differences in cost and schedule. However, to keep the fuel stabilization facility as simple as possible, the study recommended that sludge disposition could be expedited if the sludges were managed as waste once they were removed from the basin facility. Waste categories the sludges may fit into are low level, mixed (hazardous), and/or transuranic. Each of these categories could be contact or non-contact handled. The actual waste classification is dependent on characterizing sludge constituents. The study team evaluated grouting, calcining, and vitrification waste processes. New facility costs were included in the grouting and calcining options. Vitrification by way of the Hanford tank farms was shown to provide the most advantageous disposition

path. The apparent compatibility of the sludge with material already in DSTs, that the tank farm is a qualified mixed waste facility, and the costs associated with providing new facilities for separately processing the sludge all contributed to this conclusion.

While sludges reside in the basins, classifying them as waste requires managing K Basins as RCRA regulated facilities. This would only serve to increase costs and slow the K Basin deactivation process. Because they are intermixed with fuel, it makes sense to continue managing the sludges as fuel. Sludge remaining in fuel canisters is expected to consist primarily of fuel particles and fuel corrosion products. Therefore the study team concluded this material should continue to be managed as SNF until the value of this material for future use is decided. However, as mentioned above, there may be some canister desludging which could add more material to the waste stream.

These results were combined with a set of other studies directed at implementing these recommendations at Hanford for evaluation by an independent review team (Appendix A). Their results are summarized as follows:

- The proposed plan alternative can be made technically consistent with the Hanford infrastructure. The level of effort required to accomplish this will not be known totally until the sludges are successfully characterized. Some conditioning of sludge from the basin floors may be required to meet TWRS waste acceptance criteria.

- The proposed plan alternative can be made viable from a strategic management perspective. Two areas that could significantly influence viability are the approach to safeguards and accountability and the amount of sludge conditioning that will be necessary for the portions of basin floor sludge that initially do not meet TWRS waste acceptance criteria.

Although firm estimates of the cost savings associated with this plan are not yet completed, major savings are anticipated for managing sludge as SNF. A large reduction is expected in the number of MCOs procured to handle, transfer, stabilize and store sludge.

3.0 ACTIVITIES AND SYSTEMS

3.1 SLUDGE CHARACTERIZATION

Combined with studies on waste acceptance criteria at TWRS and Solid Waste Disposal, characterization will be used to determine the most expeditious waste path for the sludges. Data will be used to assess sludge management and handling techniques such as separations or crushing systems and the feasibility of separating fuel pieces or hazardous waste components. Concepts and associated cost estimates are being developed for the various waste disposition alternatives (TWRS modifications; Solid Waste Disposal costs associated with radioactive, mixed and transuranic contact handled waste forms

qualified for geologic disposal; conditioning costs; unit transport costs and number of transfers for each alternative; etc.). Then, as the characterization data comes in, the number of alternatives will be reduced to those that can be cost effectively implemented within the SNF project integrated schedule.

Characterization activities are initially focused on identifying additional data needed to support equipment design, acceptance of sludge at waste facilities, transportation and regulatory requirements. The sludge characterization process flow is depicted in Figure 2. The data quality objective (DQO) process is applied to ensure collected data are sufficient and of adequate quality and accuracy. Resultant DQOs will be used to develop a characterization plan. This plan will include the sampling plan, analysis requirements, schedule, and reporting requirements.

Many physical characteristics are needed to properly design and test retrieval, treatment and transfer equipment. Treatment alternatives include crushing, separating constituents based on particle size and density, use of flocculents to maintain water clarity, removal of hazardous waste constituents, etc. Sludge characterization data will help define the range of particle size, shape, and densities needed in equipment design and be used to develop improved simulants for testing and demonstrating candidate systems and components.

Characterization activities will also address criteria for sludge acceptance at the disposition facilities: 1) sludge/waste compatibility and 2) sludge transport and receipt. A feasibility study on transferring the sludge to a DST indicated that, based on the data provided thus far, there were no chemical compatibility problems with the waste. The concern that uranium and zirconium could become an ignition source in the tanks if not properly controlled requires more thoroughly characterizing sludge constituents before a definitive acceptance decision can be made. In the case of Solid Waste Disposal, potentially reactive sludge constituents must be stabilized prior to acceptance. The hazardous constituents must be understood to a level required for proper classification and stabilization of the material.

To aid the tank acceptance decision, a waste stream profile sheet will be submitted to TWRS for a determination of waste acceptability for transfer. Waste stream profile sheets are being completed for each K-East (KE) Basin area which has been sampled (the weasel pit, sand filter backwash pit and the basin floor) to determine what data have already been obtained and to show where data are still needed. These profile sheets will also be compared with acceptance criteria required for solid waste disposal and the sampling plan will be adjusted as appropriate.

3.2 SLUDGE DISPOSITION

Ideally, each basin, East and West, will have only one path for sludge. In the K-West (KW) Basin, for example, the sludge can be readily retrieved once enough fuel canisters have been removed to provide access to the floor.

KW Basin sludge is assumed to be relatively benign relative to the sludges in the KE Basin. Visually, it appears to consist primarily of dust that has been deposited on the basin floor since the facility was restarted. Disturbing this material during fuel retrieval is not likely to cause turbidity problems. Therefore, this sludge is expected to be retrieved following fuel removal activities and disposed of as solid waste by grouting. This process will require a minimum of facility modification (if any) and equipment installation and can be performed by an out-sourced contractor.

In the KE Basin, the process will be more complex. Following characterization of the sludge, a decision will be made as to the acceptance of the sludges at tank farms. Processes and requirements are being evaluated to provide a method for transferring the sludges into the tanks. For example, because of the settling nature of the K Basin sludges, the present configuration of the TWRS 204-AR waste unloading facility may need to be modified or bypassed and a process for pumping directly into a tank is being evaluated. A point of contact in the TWRS organization has been assigned to work with the SNF Project to aid in evaluating these proposals and their impact on the existing permits.

If all sludges prove to be acceptable to TWRS, the solid waste option will be dropped from consideration for the KE Basin. The total quantity of sludge in this facility suggests the number of packages required for solid waste disposal and the associated level of effort will lead to unacceptably high costs. In the case where some sludges are not readily acceptable by TWRS, but prove acceptable for solid waste disposal, the quantity of the material in question will be estimated. The costs associated with separating this material and preparing it for solid waste will be balanced against the added costs associated with conditioning it to make it viable for TWRS acceptance. The path providing the most cost effective solution and minimum impact to the basin activities and integrated schedule will be chosen. If the material cannot be put to a form acceptable for either TWRS or solid waste, it will be packaged into a container (such as fuel canisters) that can be inserted into MCOs and will continue to be handled as fuel.

3.3 SLUDGE RETRIEVAL SYSTEM

A major decision for sludge retrieval is whether to operate manually or remotely. Because the sludges are intermixed with basin environs, sludge retrieval will interface and, in some cases, be integrated with activities associated with fuel, debris and water. Potential dose reduction associated with remote operations will be weighed against maintenance dose and the cost/schedule differences between manual and remote operations. Closer inspection will determine if either option has a decided advantage. A manual system will always be retained in the basin. It will act as a backup to a remote system, facilitate general basin cleanup activities as needed, and be used to reach areas a remote system may have difficulty accessing.

3.4 SLUDGE CONDITIONING SYSTEM

Sludges in the basins vary considerably from light flocculent particles to mid range, easily suspendable particles, to heavy granules and chunks of fuel. Debris (paint chips, plastic and metal items, fabric, etc.) is inhomogeneously mixed with these particles. No single path may be viable for all these products. Particle size reduction, separation techniques, and processes to separate hazardous components to minimize the mixed waste stream are all being assessed. Costs, schedules and handling associated with various waste streams (including characterization costs) are being evaluated. The goal is to balance minimizing the waste stream and number of waste streams with cost, schedule and dose commitment.

3.5 SLUDGE TRANSPORTATION SYSTEM

Packaging options for transporting KE Basin sludge are being identified and evaluated with emphasis being placed on maximizing use of the existing infrastructure. Packages available on site and in the commercial sector will be evaluated relative to package volume and weight capacities, shielding containment, structural integrity, and capital and operational costs. New packages are being developed by other projects for transportation of other materials and fuel on site. The SNF project is assessing the potential for using these systems and will become involved in the acceptance criteria and Safety Analysis Report for Packaging (SARP) if the system appears viable for sludge. Once these options are identified, they will be evaluated for ease of implementing at the K Basins and at the point of disposition.

4.0 MANAGEMENT STRATEGIES

4.1 SAFETY & REGULATORY STRATEGY

By managing the sludges while in the K Basins as SNF, the requirements of the RCRA and the Washington state equivalent Dangerous Waste Regulations are not applicable. The sludges are commingled with recoverable source and special nuclear material. This is similar to the commercial nuclear industry commingled fuel and non-fuel components within spent fuel assemblies. Therefore, considering the sludges as a component of the SNF is consistent with 10 CFR 961.11 which governs the conditions for disposal of the commercial nuclear industry's waste. Once removed from the basins, and therefore separated from the fuel, the sludge will then be classified as waste and appropriately dispositioned.

Packaging and transportation of the sludges will be solely within the public exclusion area of the Hanford site. Therefore it will be governed by the DOE Orders and Westinghouse Hanford Company safety requirements for packaging and transportation of hazardous and/or radioactive materials. The NRC and DOT requirements are referenced as standards with respect to DOE transportation of the sludge. Existing permits will be evaluated for

acceptance of sludge as waste. Changes to permits will be included in the decision process for the disposition path. Allowable changes will be initiated once the final path is determined.

Sludges that have been retrieved and classified as mixed waste will be treated and stored in RCRA permitted facilities. Treatment facilities will be bounded by DOE personnel health and safety requirements, facility safety requirements, environmental protection requirements, and permitting requirements. If the process results in increased air emissions, a notice of construction (NOC) also must be filed with Ecology. Approval of the NOC requires a determination that the facility will be operated in accordance with all applicable federal and state emissions regulations.

4.2 NEPA STRATEGY

The SNF path forward outlined in Reference 1 was chosen to meet technical objectives and to be achievable within the expected constraints of the Record of Decision (ROD) for the Programmatic Environmental Impact Statements (EIS) required by the National Environmental Policy Act (NEPA) and from other regulatory requirements. All potential sludge activities, including its disposition as a waste, will be covered in the K Basins SNF management EIS, which is due to be completed in December 1995. The Notice of Intent for this document was issued in March 1995 (Reference 4).

A concern was raised that the EIS may not be ready in time for the project to send sludge to TWRS or Solid Waste Disposal. Considerable time is required to characterize the sludges and to define, procure and install equipment associated with sludge retrieval, conditioning, packaging and transportation. Therefore, the EIS is expected to be completed by the time the project will be capable of dispositioning the sludge. The existing Environmental Assessment (EA) for TWRS and solid waste will be assessed for covering sludge as waste transfers.

4.3 STAKEHOLDER INVOLVEMENT

As the details of the plan unfold, stakeholders will continue to be informed. During May and June of 1995, briefings will be scheduled with the sovereign nations, local government agencies and interest groups to present this strategy and request feedback prior to finalizing plans. This effort is grounded in the success the SNF Project has maintained with these stakeholders.

4.4 TECHNICAL INTERFACES

The recommended path forward requires interfacing between several functions and facilities on the Hanford Site. Some of the key interfaces are include:

- Acceptance at TWRS

- Off loading at TWRS
- Acceptance at Solid Waste Disposal
- Load out equipment at the K Basins
- Systems associated with debris, water and fuel removal
- General K Basin operation and maintenance activities
- Safeguards and Accountability, and
- N Reactor Fuel Basins.

These interfaces will be managed through constant communications and the SNF project systems engineering process. As questions arise, they will be discussed and documented with representatives of the appropriate interface systems. Initial inquiries have centered on feasibility aspects. As the plan becomes detailed, the interfaces will become more formalized and more carefully managed to ensure all interface requirements are identified. This will minimize issues arising when the path is ready to implement.

Should desludging be required during fuel retrieval, the resultant stream of suspended sludge particles will be transferred to the sludge retrieval system. Any fuel chunks too large to be considered sludge will continue to be handled by the fuel retrieval system. The details of this interface will be developed as fuel handling requirements become better understood. The same is true for the debris cleanup activities. As debris is retrieved, sludge will be disturbed and in some cases produced as large components are segmented for removal. Sludge will be transferred to the sludge retrieval system as needed for disposition. In the case of the water system and during some of the debris retrieval activities, sludge may be collected on cartridge filters. These filters will be dispositioned by the system generating the waste stream. The waste streams from these various systems (including the sludge system) will be evaluated to consolidate waste streams where practical and to establish consistent waste handling processes.

The impacts to K Basin operations and maintenance are also included in evaluating sludge handling processes. The type and placement of equipment, loadout system and associated operations activities are being discussed with K Basin Operations to ensure they can be integrated with all other activities that might be affected.

The overall SNF Project safeguards and accountability approach is being developed and will envelope requirements for sludge transfer. Organizational representatives will be identified to manage the interfaces and aid in establishing acceptable requirements. Material accountability systems will use available technology as necessary to provide accurate transfer assessments within allowable tolerances to account for material transferred in the waste stream. Material estimates within the sludge will be based on characterization data and sludge quantity estimates. Requirements will be established to meet the intent of DOE Order 5633.3B (Reference 5) and approved by the DOE.

Sludge retrieval and dispositioning activities are also being communicated with those involved with N Reactor fuel basin cleanup. Engineering and strategies are being shared to allow each project to take advantage of the other's successes. For example, some of the tools designed

for N Basin cleanup will be incorporated into the set of tools used in K Basins manual sludge retrieval system. The process of transferring the K Basin sludges to TWRS will be evaluated for its applicability to N Basin sludge. This effort at developing common solutions to both cleanup activities is expected to minimize duplication of effort.

4.5 SLUDGE PATH FORWARD SCHEDULE

The accelerated schedule for the SNF plan initiates fuel removal from K Basins December 1997 and has it being completed two years later. This plan for dispositioning sludge allows the schedule for sludge removal to be decoupled from fuel removal. Figure 3 presents two proposed schedules for sludge activities. The schedule shown in white reflects an accelerated case while the grey schedule is budget driven and reflects present planning. Cost estimates for both cases is $33.5M (in 1995 dollars) through FY 2001. Both cases reflect the same schedule associated with KW Basin floor sludge retrieval. This activity is driven functionally by removal of the fuel canisters making the floor accessible to retrieval equipment.

In the accelerated case, initial sludge removal from KE Basin is able to begin in mid FY 1997. This schedule allows all major systems and equipment to be procured by the end of FY 1997. For this case, the funding profile grows from approximately $3.2M in FY 1995 to $6.5 M in 1996, $11.7M for 1997 when major outlays are required for system procurements. The remaining FY costs are focused on operational activities with the procurement for the KW Basin cleanup being placed in FY 1998. Subsequent costs are estimated at $5.2 in FY 1998, $3.2M for both FY 1999 and 2000, with $0.5M in FY 2001.

The second schedule reflects the flattening of the costs to meet present planned budget for all SNF Project activities. Fiscal year funding for 1995 is reduced to $2.1M with FY 1996 costs rising to $4.2M and to $6.7M and $6.9M for FYs 1997 and 1998, respectively. In FY 1999 operations related activities drives the cost estimate to $8.2M with FYs 2000 and 2001 dropping to $3.1M and $1.9M. In this budget driven case, added scope is incurred because the sludge conditioning system is not expected to be in place in the KW Basin by the time fuel removal is scheduled to begin. Therefore, a sludge staging system must be developed to store the sludge if desludging is required in the KW Basin until conditioning and removal systems can be installed. The earliest sludge can be removed from the KE Basin in this case is in FY 1998.

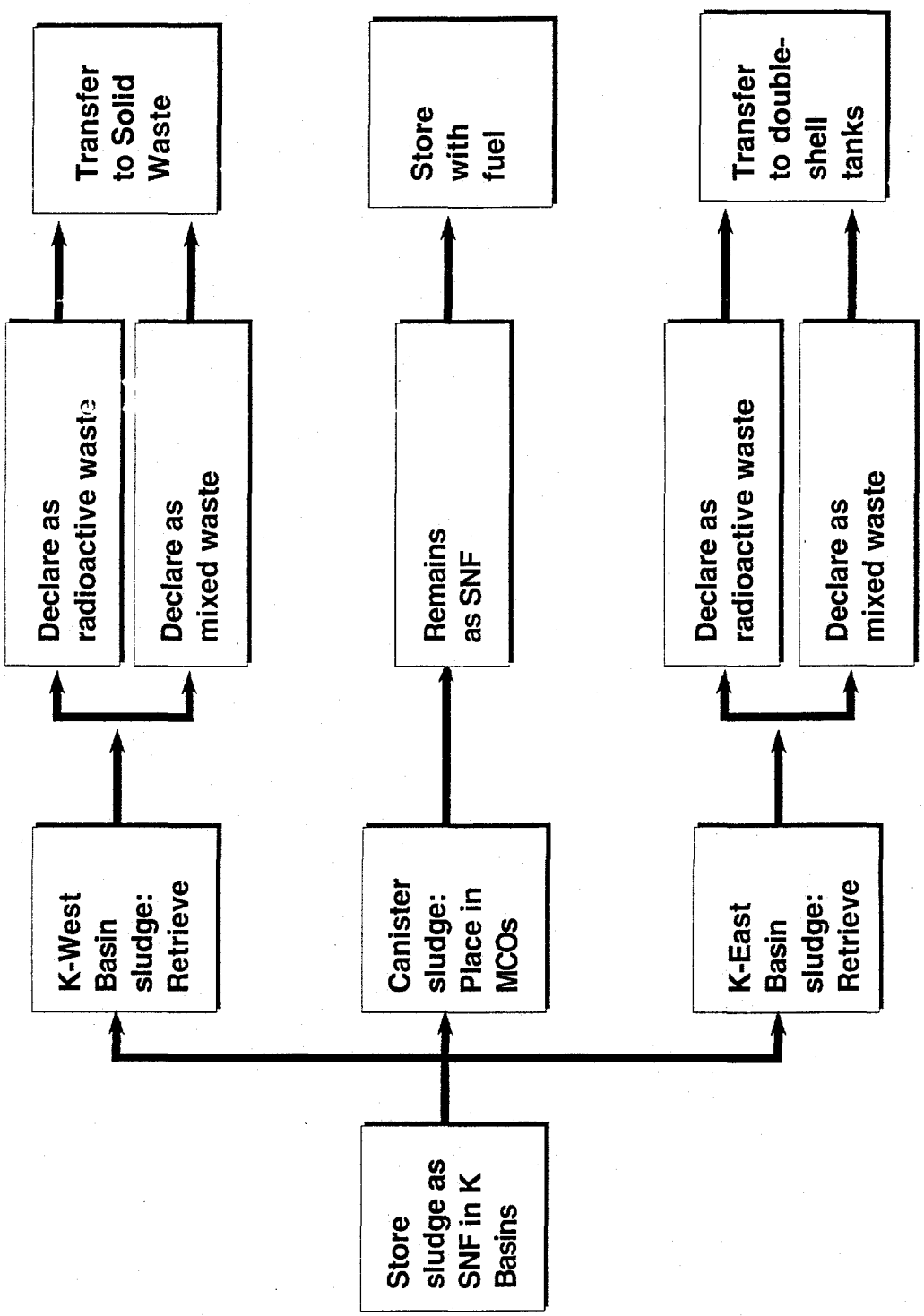


Figure 1, Recommended K Basin Sludge Disposition Strategy

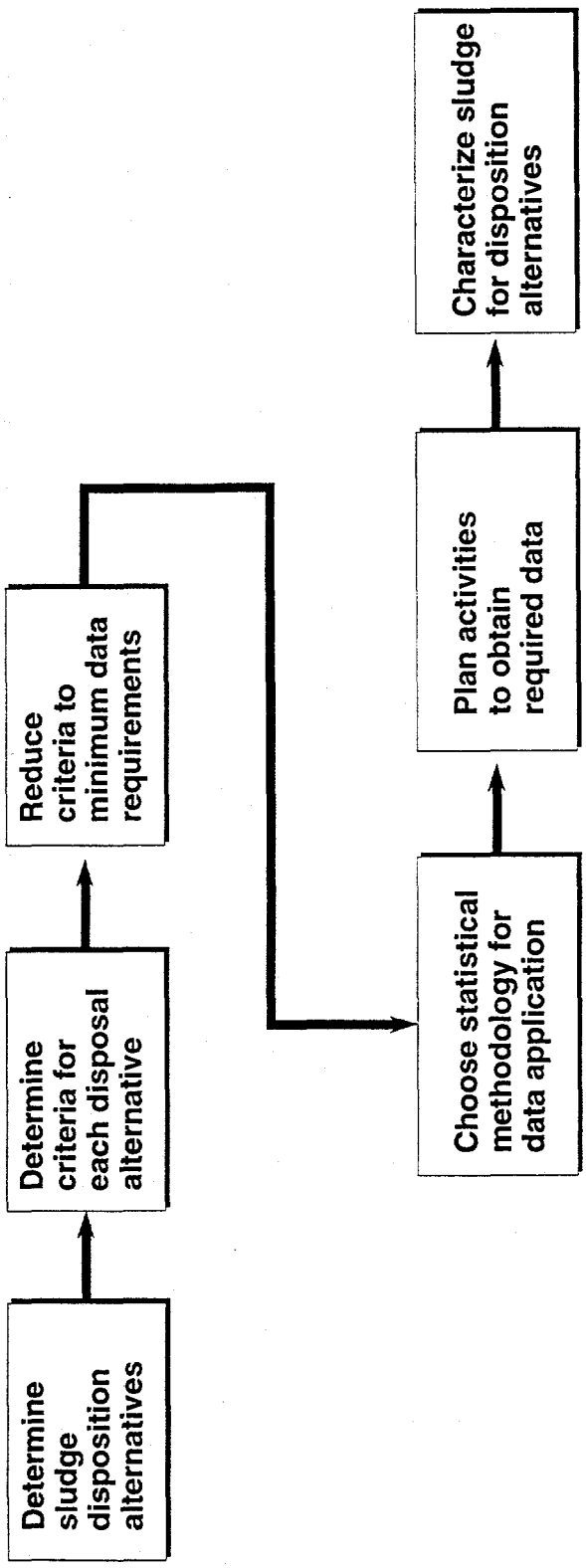
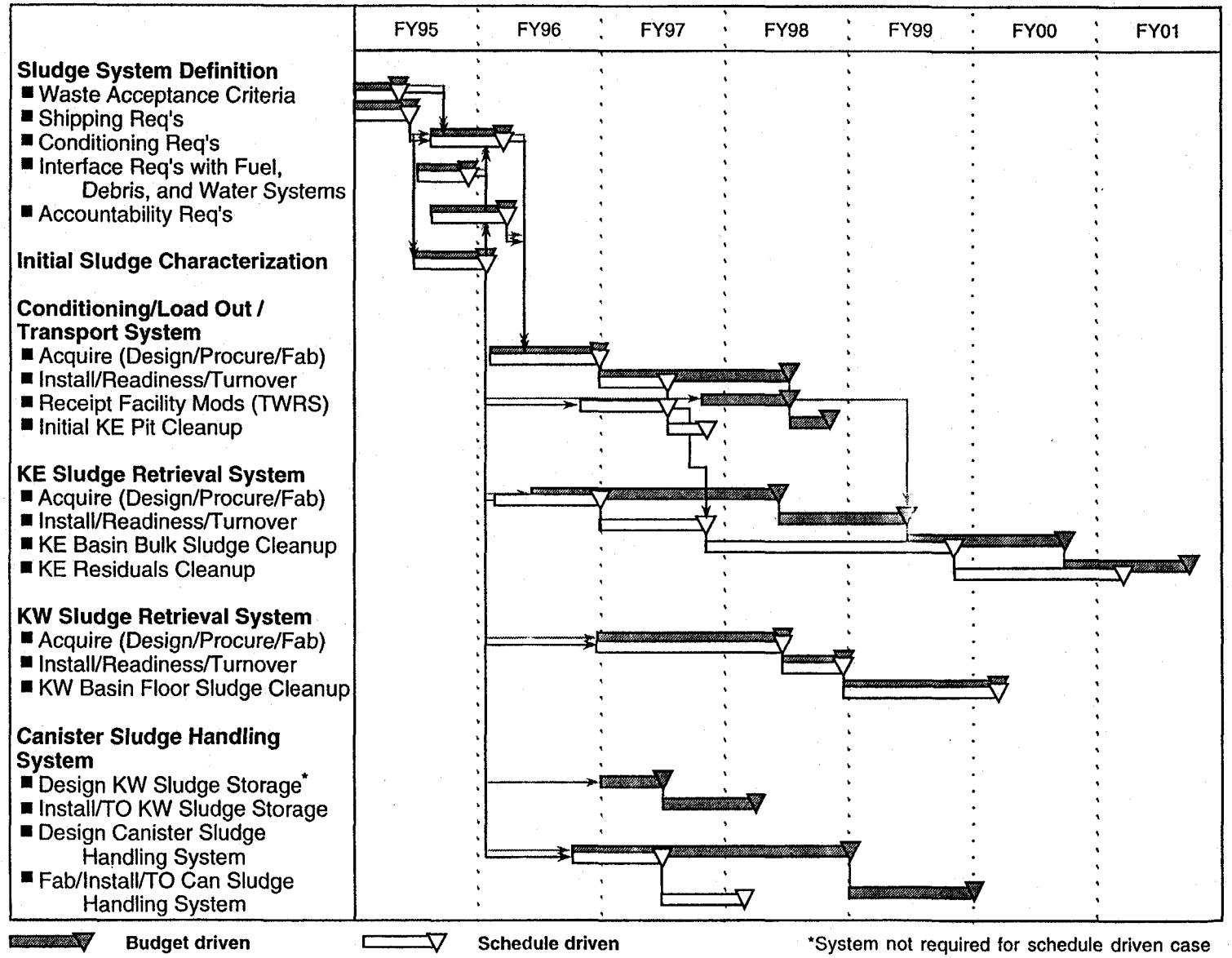


Figure 2, Sludge Characterization Process Flow

Figure 3, Recommended K-Basin Sludge Disposition Schedule



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1) Fulton, J. C., *Hanford Spent Nuclear Fuel Project Recommended Path Forward*, WHC-EP-0830, Volume I, Rev. 0, Westinghouse Hanford Company, October 1994.

2) Letter, C. A. Hansen, U.S. Department of Energy-Richland Operations Office to A. L. Trego, Westinghouse Hanford Company, "Approval of Spent Nuclear Fuel (SNF) Path Forward Recommendation," February 14, 1995.

3) PNL, *K-Basin Spent Fuel Sludge Treatment Alternatives Study*, PNL-10398, Vols. 1 and 2, January 1995.

4) DOE, 1995n, *Notice of Intent to Prepare an Environmental Impact Statement for the Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, Richland, WA*; Federal Register, Vol. 60, No.59.

5) DOE Order 5633.3B, *Guide of Implementation Instruction for Nuclear Material Management and Safeguards System Reporting and Data Submission.*

APPENDIX A

INDEPENDENT REVIEW OF K BASIN SLUDGE DISPOSITION

Consisting of 18 pages,
including cover page

From: Sludge Disposition Review Team
Phone: 373-1978 S7-84
Date: March 8, 1995
Subject: REVIEW OF K BASIN SLUDGE DISPOSITION PATH FORWARD

To: E. W. Gerber R3-86

cc: C. J. Alderman N1-21
W. T. Alumkal S7-85
J. G. Field G2-02
C. K. Girres T3-05
W. C. Moffitt B3-02
J. P. Sloughter H5-27
A. L. Trego B3-01
M. J. Wiemers R3-86
Sludge Project File N1-32

Attached for your information is the report providing a review of the recommended K Basin sludge disposition path forward as developed by an independent review team. The report has been prepared, at your request, with the defined objective of focusing on two major areas associated with the feasibility of the proposed path forward. The two major areas evaluated by the review were:

1. Technical consistency of the proposed path forward alternative with the existing Hanford infrastructure.

2. Viability of the proposed path forward alternative from a strategic management perspective.

The report conclusions are:

- The proposed path forward alternative can be made technically consistent with the Hanford infrastructure. The level of effort required to accomplish this will not be known totally until the sludges are successfully characterized. Some sludge conditioning may be required to meet TWRS waste acceptance criteria. The ability of the TWRS waste acceptance facility, 204-AR, to physically handle some of the heavier sludges, and the treatment of pyrophoric constituents are two areas of concern.

- The proposed path forward alternative can be made viable from a strategic management perspective. Two areas that could significantly influence viability are the approach to accountability and the amount of sludge conditioning that will be necessary for the portions of sludge that initially do not meet TWRS waste acceptance criteria.

The committee also developed the following recommendations:

- A consistent and easily understood definition should be developed that articulates when and under what conditions sludges become waste as opposed to spent nuclear fuel.
- Alternatives for addressing the heavy sludge particles, chips, and chunks should include segregating them and managing them as co-mingled material that follows the spent nuclear fuel.
- The functions of pursuing the recommended path forward, preparation of a sludge-specific Environmental Assessment, and preparation of the Environmental Impact Statement on the management of spent nuclear fuel from the K Basins at the Hanford site in Richland, Washington, should proceed in parallel to accommodate the desired schedule and possibility that significant sludge conditioning may be required prior to acceptance by TWRS.
- The characterization effort should be accelerated.
- Consideration should be given to expedited retrieval and processing of the lighter flocculent sludges while disposition of the heavier sludges is being pursued.
- The SNF Project should become active participants in the double shell rail car and the LR-56H development activities.

The attached report has been reviewed and concurred with by review team members. The review team would like to extend our thanks to you and your staff for logistical support and accommodations associated with the review and preparation of the report. Efforts of Carol Alderman and Bev Garvey were particularly noteworthy.

L. F. Ermold, Chairperson
Sludge Disposition Review Team

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Attachment

INDEPENDENT REVIEW OF K BASIN SLUDGE DISPOSITION

PATH FORWARD

February 1995

REVIEW TEAM

Len Ermold, Chairperson
Greg Field
Cindy Girres
Kathleen Niesen
Jim Sloughter
Thornton Waite

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1.0 EXECUTIVE SUMMARY

A recommended path forward for disposition of K Basins sludge has been developed which considers the impact of related regulatory and permit requirements as evaluated by a team comprised of WHC, Pacific Northwest Laboratory, and Scientific Applications International Corporation. The recommended path forward concludes that disposition is dependent on the classification of the sludge and that the sludge on the basin floor and sludge within the canisters should be dealt with separately. The specific recommendations are:

1. Sludges should be managed as spent nuclear fuel (SNF) while in the K Basins.

2. Once loose sludges are collected and removed, they should be managed as radioactive or mixed waste consistent with the final characterization results. The proposed sludge path forward alternative would send sludges to the Tank Waste Remediation System tank farm and/or the Hanford Solid Waste Facilities.

3. The sludge that remains within the fuel canisters at the time they are loaded into the multi-canister overpacks should continue to be managed as spent nuclear fuel.

An independent review team was assembled with the defined objective of focusing on two major areas associated with the feasibility of the proposed path forward. The two major areas evaluated by the review team were: (1) technical consistency of the proposed path forward alternative with the existing Hanford infrastructure, and (2) viability of the proposed path forward alternative from a strategic management perspective.

The review team reached the following conclusions:

- The proposed path forward alternative can be made technically consistent with the Hanford infrastructure. The level of effort required to accomplish this will not be known totally until the sludges are successfully characterized. Some conditioning of sludge from the basin floors may be required to meet Tank Waste Remediation System (TWRS) waste acceptance criteria. The ability of the TWRS waste acceptance facility, 204-AR, to physically handle some of the heavier sludges, and the treatment of pyrophoric constituents are two areas of concern.

- The proposed path forward alternative can be made viable from a strategic management perspective. Two areas that could significantly influence viability are the approach to accountability and the amount of sludge conditioning that will be necessary for the portions of basin floor sludge that initially do not meet TWRS waste acceptance criteria.

The review team also developed the following recommendations:

- A consistent and easily understood definition should be developed that articulates when and under what conditions sludges become waste as opposed to spent nuclear fuel.
- Alternatives for addressing the heavy sludge particles, chips, and chunks should include segregating it and managing it as co-mingled material that follows the spent nuclear fuel.
- The functions of pursuing the recommended path forward, preparation of a sludge-specific Environmental Assessment, and preparation of the Environmental Impact Statement on the management of spent nuclear fuel from the K Basins at the Hanford site in Richland, Washington should proceed in parallel to accommodate the desired schedule and possibility that significant sludge conditioning may be required prior to acceptance by TWRS.
- The characterization effort should be accelerated.
- Consideration should be given to expedited retrieval and processing of the lighter flocculent sludges while disposition of the heavier sludges is being pursued.
- The SNF Project should become active participants in the double shell rail car and the LR-56H development activities.

2.0 INTRODUCTION

Approximately 2100 metric tons of irradiated reactor fuel are stored in the K-East (KE) and K-West (KW) Basins at the Hanford Site, Richland, Washington. Corrosion of the fuel, basic components and infiltration of sand and dirt have led to the accumulation of sludges, both inside the fuel canisters and on the basin floors. Due to the deteriorating condition of the fuel, the age of the K Basins, and the potential for leakage from the basins, which are within 1/2 mile of the Columbia River, DOE has committed to remove the fuel and sludges by December 2002 as part of the Tri-Party Agreement (TPA).

There are three waste classification options for sludges in the K Basins. The sludges can be considered to be spent nuclear fuel, mixed (radioactive/hazardous including transuranic) waste, or radioactive (including transuranic) waste. The sludges in the basins are considered to be spent nuclear fuel until they are removed from the basins. The characteristics of the sludges being removed will determine whether they are a mixed waste or radioactive waste when it is removed from the basin. The disposal alternatives were assessed on the basis of cost, schedule, acceptability of the final waste form, pyrophoric concerns, technical uncertainties, and long term implications of the work being performed.

The fuel canisters in the KW Basin are sealed, and the sludges on the KW Basin floor consist mostly of dirt and debris. The storage canisters in the KE Basin are not sealed, allowing the fuel elements to corrode and dirt to collect in the fuel canisters. Since some of the fuel canisters have screens on the bottom, fuel particulates as well as dirt are on the KE Basin floor. Based on a limited sampling of the KE Basin, both transuranic materials and hazardous constituents are present in the sludges, so that the sludges must be conditioned as a mixed waste. It is possible, however, that additional sampling will indicate that not all of the sludges in the basins will have to be conditioned in the same manner.

In order to plan and prepare for this work on an expedited basis, the Spent Nuclear Fuel Project has proposed an initiative to remove the sludges from the K Basins. The sludge path forward removal effort held a meeting on February 22 through 23, 1995, for an independent review of their proposed approach to the work to be performed. This report summarizes the review team findings and conclusions regarding the proposed approach to removal and management of the sludges.

3.0 SLUDGE RETRIEVAL

It is proposed that the sludges be removed from the K Basins with a vacuum system, using a vacuum head, hoses, and pumps. A 1/4-inch screen on the vacuum head will limit the size of particulates that can be removed. This provision will prevent large fuel particles and other large pieces from being removed, minimizing the radiation fields of the sludges when they are removed. Any large particles of spent fuel or other debris will be collected and handled separately. The sludges will be removed from the basin floor and racks, but the system is not presently required to retrieve sludges from the storage canisters. The sludge in the storage canisters will be packaged and transported with the fuel.

Prior to removing the sludges, they will be characterized so that the radiation fields and constituents are known. This characterization will be used to determine the conditioning and disposition requirements. This is necessary so that the conditioning equipment is ready to process the sludges as they are removed from the basins. If any dewatering of the sludges is performed in the K Basins building, excess water will be returned to the K Basins.

The sludge retrieval system will handle the sludge in a wet condition. As the sludges are removed from the basins, the sludge retrieval system will deliver the sludges to a load-out system for transport for further conditioning or storage. Disturbance of the water in the basins shall be minimized so that the airborne release of sludge particulates is within the air permit requirements and so that the visibility in the basins is maximized for operator efficiency. The system will require only minimal modifications to the existing building. It will be designed to minimize exposure to the operating personnel as well as to minimize the generation of waste materials that must be handled. The sludge retrieval system shall not preclude any disposal alternatives. Chemical modifiers shall only be used if necessary, and they shall not prevent any subsequent management options.

The sludge removal will be performed more than one time. The first sludge removal operation may be performed after the large contaminated items have been removed from the basins, and prior to removal of the fuel canisters. Following removal of the canisters, the sludge removal process will be repeated, since there will be improved access to the basin floors and the rack structures.

4.0 SLUDGE CHARACTERIZATION

Characterization of the K Basin sludges is a key element in establishing the viability of the sludge path forward recommendation. Data are needed to support decisions for sludge conditioning, transportation, and double-shell tank storage. The need for characterization is recognized, as evidenced in documents, briefings, and planning activities reviewed by the team.

The review team recommends initiating characterization as soon as possible to reduce costs and risks with the path forward recommendation. The team's understanding is that the earliest date sampling could begin is June 1995. Key data needs would not be satisfied until sampling and laboratory data are available which could be in the September, October, November 1995 timeframe, which is one-fourth to one-third the way into the sludge retrieval schedule.

Design, development, and modifications to sludge retrieval/processing, transportation, and receiving systems are dependent on the characterization information. Particle sizes, chemical compositions, particle densities, pyrophoricity, and radiation levels are key characteristics that have significant potential to affect system design and modifications.

Characterization of the sludges, particularly in the KE Basin, will be a difficult task. The approach the team reviewed includes the key elements of a successful effort. Sampling, physical measurement, and historical information are coupled together into a sound plan. A rational Data Quality Objectives (DQO) process that includes equipment design/simulant development, double-shell tank waste acceptance criteria, solid waste disposal acceptance, transportation, and regulatory requirements is underway. Sampling equipment needs to be tested with simulants, and statistics are needed to provide valid characterization information.

5.0 TANK WASTE REMEDIATION SYSTEM ACCEPTANCE CRITERIA

Acceptance criteria for storage in TWRS must be met for the sludge path forward option to be implemented. Initial reviews based on limited sludge characterization data reveal two issues:

1. Sludges contain some solids that may be incompatible with the current 204-AR Waste Unloading Facility.

2. Sludges contain some fuel fragments composed of uranium and zirconium metal that may be pyrophoric and could be a potential ignition source in the tank waste.

Initial reviews do not indicate any other compatibility problems with tank storage or vitrification. However, the characterization data are very limited, have considerable variability and, at present, do not provide a firm technical basis for establishing compatibility. Additional characterization data are necessary to satisfy the TWRS criteria. These criteria have been provided and are being used as a part of the Data Quality Objectives process for the sludge characterization.

6.0 SOLID WASTE ACCEPTANCE CRITERIA

The recommended path forward for the KW sludge appears to be technically consistent with the infrastructure within the Hanford Solid Waste facilities. However, all decisions will ultimately be based on the characterization data. The characterization effort must provide the detailed information to meet the acceptance criteria. Based on the preliminary characterization data available from the KE Basin, hazardous constituents such as lead, cadmium, and chromium could also be found in the KW basins.

If the KW sludges are managed as mixed waste, the option of grouting the waste is feasible. However, it must be done in accordance with the Resource Conservation and Recovery Act (RCRA) Land Disposal Restriction regulations so the waste can be placed in a mixed waste landfill and not require further treatment. The characterization efforts should include these requirements.

Strategically, the Hanford Solid Waste facilities are equipped to handle the KW sludge regardless of whether it is low-level or mixed waste. The mixed waste landfill will be operational before the sludge is ready to be moved. Also, other waste that is generated, such as debris, can be handled at the Solid Waste facilities provided the acceptance criteria are met.

7.0 TRANSPORTATION AND PACKAGING

The sludge path forward recommendation leads to three distinct sludge paths. Sludge in fuel canisters would be transported from KE and KW Basins to the Canister Storage Building with the fuel; the KE Basin sludge would be shipped to double shell tanks; and the KW Basin sludge would be sent to the Hanford Solid Waste facilities. The transportation system for each path is being selected to interface with the specific sludge retrieval and disposition system. The existing transportation recommendations focus on the KE Basin sludge. A study is being performed to guide the selection of the transportation system. A system is not presently approved for bulk sludge shipments.

The sludge-in-canister path is strategically linked with the fuel path forward, and will be included in the development of the new Multi-Canister Overpack transportation system. There are no unique transportation issues associated with this path.

The KW Basin sludge transportation system has not been selected. If necessary, KW Basin sludge could be handled in a manner similar to KE Basin sludge, but the preferred alternative is to send the KW Basin sludge to the Hanford Solid Waste facilities. The transportation system for this path needs to be developed consistent with the solid waste acceptance criteria. There is adequate time to develop this path with little risk to the project.

The KE Basin sludge path is essentially a bulk transfer. Two new onsite bulk transportation systems that are scheduled to be in service in early calendar year 1996 are likely alternatives. It is not obvious which system should be selected, but both appear viable and appropriately use existing site infrastructure. Loading and unloading system interfaces and bounding source term characterizations need to be developed. However, these would be required regardless of the selected transportation system. This system should be chosen early to ensure operational readiness.

The selected alternative is technically consistent with the hazardous material transportation infrastructure that is planned to be in place when shipments begin. Rail and highway services are available from K Basins to 204-AR, the general loading station for waste tanks. The new Double Shell Rail Car (DSRC), and the LR-56H tanker truck which are among the packaging systems being evaluated as potential sludge transfer systems are being developed to unload at 204-AR. Neither system is being specifically developed to handle K Basin sludges. Therefore, the use of either system for K Basins sludges must be evaluated. The effort to validate the transportation system is worthwhile.

The selected alternative is very consistent from a strategic management perspective. It uses existing infrastructure, provides efficiency and cost savings by utilizing capital hardware developed by other programs, and matches the operational and schedule needs. It also provides good flexibility.

It appears that the KE Basin sludge could be transported in two stages. The first stage would involve pumping out the more dispersible, light sludge, and the second stage would involve the heavier, harder to pump material. It is more likely that the lighter sludge will be transportable in the bulk transportation systems available, whereas the heavier material may contain more fuel particles and be more difficult to pump and transport. Since the lighter material could be transported first, there is ample time to test the system and, if necessary, find alternatives for the heavier sludge.

There is risk associated with the assumption that the DSRC or LR-56H systems will be available. The DSRC development is being funded by T Plant as a replacement for an existing system. The design is behind the original schedule, and the Safety Analysis Report for Packaging (SARP) is not fully funded. Actions should be taken as soon as possible to ensure this system is in place by calendar year 1996. Funding may be needed to ensure KE Basin sludge can be transported.

The LR-56H development has proceeded rapidly, is fully funded, and supports a TPA milestone. TWRS should be contacted to ensure development continues as scheduled. Funding to include authorization to transport KE Basin sludge should be provided as soon as possible.

8.0 REGULATORY ISSUES

The Review Board identified three regulatory recommendations for the Sludge Path Forward. These recommendations are:

- Completion of the Environmental Impact Statement (EIS) (Management of the spent nuclear fuel from the K Basins at the Hanford Site, Richland, Wa.) process for the SNF Project Path Forward is necessary in order to finalize management decisions and complete the design of the Sludge Path Forward Project. However, one or more separate and specific EAs may be appropriate for portions of sludge. A likely candidate is readily pumpable, lighter sludge which is not in the canisters. Due to the nature of this sludge fraction, it may lend itself to early removal, transportation, and management within TWRS without the need for additional facilities or facility improvement. If this portion of the sludge can be removed and managed in an expedited fashion, it may allow better characterization and management of the remaining sludges, which have different chemical and physical characteristics.

- The sludges in the K Basins may not be appropriately designated as a single uniform material. The regulatory designation of the sludges within the K Basins as either waste (hazardous/dangerous, radioactive, or mixed) or spent nuclear fuel may vary within the sludges depending on physical, chemical, radiological, and location factors. Various portions of the sludges (some in fuel canisters) may be of sufficiently dissimilar character to justify different designation and thereby different paths. As an example; loose, light, pumpable sludge without pyrophoric properties, and containing leachable heavy metals may be appropriately designated mixed waste, and best be managed in the TWRS. However, loose heavy sludge, with pyrophoric properties, containing leachable metals may be most appropriately designated as spent nuclear fuel and processed for long term storage.

  Designation precedents must be considered, and consistent policies are necessary in designation decisions even when these decisions occur years apart. However, the primary considerations when making all designation and management decisions must be the primary objective of protecting the Columbia River and accomplishing safe, cost effective sludge management on an expedited basis.

- The determination that the K Basins are not RCRA regulated waste management units and yet contain material which may be designated hazardous/dangerous waste has precedent within the RCRA and Washington Dangerous Waste programs. Because the U.S. Department of Energy (DOE) has defined spent nuclear fuel as a commodity integral to its operations, and not a waste product requiring disposal, spent nuclear fuel is functionally equivalent to a product, not a waste. The SNF storage and processing operations

are integral to the safe and appropriate management of that product.

RCRA regulations and the Washington Dangerous Waste Management regulations apply to solid wastes that are also hazardous/dangerous. It has long been a tenet of the RCRA and state programs that it is not the chemical character of a material alone that causes it to be regulated. The "generation" of the regulated material as a waste, separate from its non-regulated production process, is also required for it to come under regulation. Therefore the determination that the K Basins are not RCRA-regulated storage units is consistent with regulatory precedent. As an example, when leaded gasoline is in a tank prior to sale or trade, sludge develops in the bottom of the tank over time. The gasoline storage tank is <u>not</u> considered a RCRA-regulated waste management unit prior to the removal of the tank bottoms. This sludge, when removed from the tank for disposal, treatment, or processing, is a hazardous/dangerous waste and must be managed in accordance with the applicable hazardous/dangerous waste regulations. The sludge has the same chemical and physical characteristics when it is in the gasoline tank as it does when it is removed. However, it only becomes as solid waste and, thereby, a hazardous/dangerous waste after it is removed from the gasoline tank.

In addition to the above "product" rationale, there is also a basis to exclude the basin sludges from regulation as solid waste. The sludge in the K Basins is currently part of a spent nuclear fuel reclamation scheme. Under WAC 173-303-016 (Table 1), if a sludge or by-product exhibiting a characteristic or criteria is reclaimed, it is not a solid waste and therefore not subject to regulation as a dangerous waste. If the sludge or by-product is disposed, however, it is considered a solid waste and is subject to regulation under WAC 173-303.

9.0 PUBLIC INVOLVEMENT

The public participation efforts to date on the Sludge Path Forward have been admirable and successful. The unanimous vote of approval from the Hanford Advisory Board represents a stakeholder level of trust and confidence in program representatives as well as technical, safety, and regulatory decisions made thus far.

Since the recommendations of the team include consideration of paths for sludge management beyond those previously communicated to stakeholders and because National Environmental Policy Act evaluation work on the Sludge Path Forward is not yet complete, it is important that candid and timely stakeholder involvement be continued. The infrastructure limiting factors, technical unknowns, and policy options regarding embarking on one or more of the previously identified paths forward or including new paths forward should be communicated to stakeholders at the earliest opportunity. Their participation in all NEPA processes, including the full SNF Sludge EIS and any supporting EA work, should be invited and encouraged. It is important that stakeholders recognize that the Sludge Path Forward Project is continuing to evolve and that details of implementing a final Path or Paths Forward requires refinement based on improving knowledge and may vary slightly from the previously outlined approach.

10.0 CONCLUSIONS/RECOMMENDATIONS

The review team reached the following conclusions concerning the two focus areas it was requested to consider:

- The proposed path forward alternative can be made technically consistent with the Hanford infrastructure. The level of effort required to accomplish this will not be known totally until the sludges are successfully characterized. Some sludge conditioning may be required to meet TWRS waste acceptance criteria. The ability of the TWRS waste acceptance facility, 204-AR, to physically handle some of the heavier sludges, and the treatment of pyrophoric constituents are two areas of concern.

- The proposed path forward alternative can be made viable from a strategic management perspective. Two areas that could significantly influence viability are the approach to accountability and the amount of sludge conditioning that will be necessary for the portions of sludge that initially do not meet TWRS waste acceptance criteria.

The committee also developed the following recommendations:

- A consistent and easily understood definition should be developed that articulates when and under what conditions sludges become waste as opposed to spent nuclear fuel.

- Alternatives for addressing the heavy sludge particles, chips, and chunks should include segregating them and managing them as co-mingled material that follows the spent nuclear fuel.

- The functions of pursuing the recommended path forward, preparation of a sludge-specific Environmental Assessment, and preparation of the EIS on the management of spent nuclear fuel from the K Basins at the Hanford Site in Richland, Washington, should proceed in parallel to accommodate the desired schedule and possibility that significant sludge conditioning may be required prior to acceptance by TWRS.

- The characterization effort should be accelerated.

- Consideration should be given to expedited retrieval and processing of the lighter flocculent sludges from the basin floors while disposition of the heavier sludge is being pursued.

- The SNF Project should become active participants in the double shell rail car and the LR-56H development activities.

APPENDIX B

CONCURRENCE ON K BASIN SLUDGE CLASSIFICATION

Consisting of 3 pages,
including cover page

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

MAR 15 1995

95-NMD-023

Dr. A. L. Trego, President
Westinghouse Hanford Company
Richland, Washington

Dear Dr. Trego:

CONCURRENCE ON K BASIN SLUDGE CLASSIFICATION

References: (1) WHC ltr. to R. A. Holten, RL, from J. C. Fulton, "K Basin Sludge Classification Recommendation" (Ltr. No. 9550053), dtd. January 5, 1995.

(2) PNL-10398, Volumes 1 and 2, "K Basin Spent Fuel Sludge Treatment Alternatives Study," prepared by Science Applications International Corporation, dtd. January 1995.

In response to Reference (1), the U.S. Department of Energy (DOE), Headquarters (HQ) and the Richland Operations Office (RL) have reviewed Reference (2) and concur with the approach to develop a path-forward recommendation for classifying the K Basin sludge, subject to the following conditions:

- Westinghouse Hanford Company (WHC) should maximize compatibility of the stabilized material (i.e., multi-canister overpacks and contents) with anticipated criteria for emplacement of spent nuclear fuel into a geological repository, such that the potential for repackaging and additional processing will be minimized. This includes addressing the impacts of sludge quantity, form, and conditions on repository acceptance.

- If other sludge constituents are later found to be hazardous, as defined under the Resource Conservation Recovery Act (RCRA), then consideration should be made to render the waste non-hazardous (non-RCRA), where feasible, by application of the Best Available Control Technology (BACT).

The comments above were raised by John J. Jicha, EM-37, during a teleconference on January 26, 1995, between HQ, RL, and WHC.

Please note that the classification and disposition of the K Basin sludge cannot be made until the sludge characterization results have been evaluated. The disposition should also consider the option of desludging the canisters in one of the basins. This in-situ desludging offers potential for substantial savings in project cost.

No response is required of WHC on this letter but should you have any comments or questions, please call Oscar M. Holgado, of the Nuclear Materials Division, on (509) 373-0589.

Sincerely,

C. A. Hansen, Assistant Manager
for Waste Management

NMD:OMH

CONCURRED BY:

John J. Jicha, EM-37

for James V. Antizzo, EM-36

cc: J. C. Fulton, WHC
E. W. Gerber, WHC
T. B. Veneziano, WHC