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7. Abstract

This plan outlines a characterization program that supports the accelerated Path Forward scope and schedules for the Spent Nuclear Fuel (SNF) stored in the Hanford K Basins. The plan is driven by the schedule to begin fuel transfer by December 1997. The program is structured for 4 years (i.e., FY 1995 through FY 1998) and is limited to in-situ and laboratory examinations of the SNF and sludge in the K East and K West Basins.

The program provides bounding behavior for the fuel, and verification and acceptability for the three different sludge disposal pathways. Fuel examinations are based on two shipping campaigns from the K West Basin and one from the K East Basin with coincident sludge sampling campaigns for the associated canister sludge. Sampling of the basin floor and pit sludge will be conducted independent of the fuel and canister sludge shipping activities.

Fuel laboratory examinations include physical condition, hydride and oxide content, conditioning testing, and dry storage behavior. Sludge laboratory examinations include quantity and content, measurement of properties for recovery processes, tank farm and solid waste acceptance, properties for equipment design and simulant development, measurement of corrosion products, and measurements of drying behavior.

The plan is schedule driven and funds have been allocated based on program experience through April 1995. The total program cost is estimated to be $29.5M.

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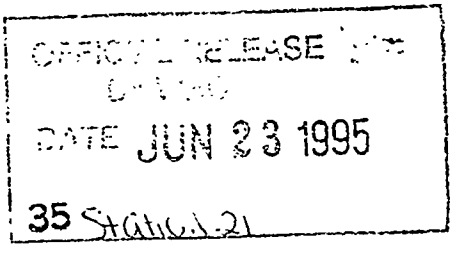

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PLAN FOR CHARACTERIZATION OF K BASIN SPENT NUCLEAR FUEL AND SLUDGE

L. A. Lawrence
S. C. Marschman

June 1995

Document Title: **PLAN FOR CHARACTERIZATION OF K BASIN SPENT NUCLEAR FUEL AND SLUDGE**

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SUMMARY

This plan outlines a characterization program that supports the accelerated Path Forward scope and schedules for the Spent Nuclear Fuel (SNF) stored in the Hanford K Basins. The plan is driven by the schedule to begin fuel transfer by December 1997. The program is structured for 4 years (i.e., FY 1995 through FY 1998) and is limited to in-situ and laboratory examinations of the SNF and sludge in the K East and K West Basins.

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PLAN FOR CHARACTERIZATION OF K BASIN SPENT NUCLEAR FUEL AND SLUDGE

1.0 INTRODUCTION

The Spent Nuclear Fuels (SNF) Characterization Program outlined in this document supports the accelerated Path Forward scope and schedule provided as program planning guidance by RL (Hansen 1995). To ensure this, current characterization plans were re-examined and appropriate changes were made to be fully supportive of the accelerated program.

The documents which provided the basis and rationale for this Characterization program are the accelerated Path Forward Scope and Schedule (Hansen 1995) the Path Forward Recommendation (PFR) (Fulton 1994b), the K Basins Sludge Disposition Strategy (Fulton 1995), the Independent Technical Assessment report (ITA 1994), and the Technology Acquisition Plan (TAP) (Scott 1995). The latter was used because it attempts to define characterization requirements in more detail than either the Path Forward Report or the ITA report. The Characterization Plan (Abrefah 1994) issued earlier provided a general characterization basis for both the PFR and the TAP and so was included in the review.

This plan was prepared to delineate the activities needed to obtain the characterization data necessary to support engineering and design decisions that will be required to support the Path Forward identified by RL (Hansen 1995). This plan addresses project uncertainties, as they are known at the time of its preparation, and is focused on obtaining data to address those uncertainties within the schedular constraints of the accelerated Path Forward. As the Path Forward project matures, it may be necessary to revise this plan to address new engineering and design issues. Subsequent revisions may also be necessary following changes in funding level, changes in costs to complete the identified workscope, and changes in understanding from the examination in progress.

These characterization activities must be integrated with the overall K Basin Operations and accelerated Path Forward schedules. Project concerns may dictate that some of these characterization activities be rescheduled to accommodate higher priority tasks at the basins. These changes will also result in revision to this plan.

The specific details of the number of samples are not provided in this plan. These details will be provided by the individual Data Quality Objectives (DQOs) and Sample Analysis Plans (SAPs) that govern the examinations. The DQOs will be prepared with Path Forward and RL stakeholder input and will reflect the expanding understanding being obtained and the data being accumulated. Examinations will in general after the initial examinations be justified based on the results of the preceding examinations and understanding for any given series of measurements.

There are six general sources of information for the SNF and sludge in the K Basins. These six sources are shown in Table 1 for the 12 information needs for SNF identified in the PNL Characterization Plan for Hanford Spent Nuclear Fuel.

The characterization activities outlined in this plan are driven by the accelerated Path Forward schedule to begin transfer of fuel from the K Basins by December 1997 and begin conditioning by July 1998. The accelerated Path Forward also delineates the specific actions that will be performed in removing the fuel from the K Basins and requires that characterization work be performed in 4 fiscal years (i.e., FY 1995 through 1998). Consequently, this characterization plan must represent the merging of the accelerated Path Forward schedule with the applicable information needs identified in the earlier characterization plan (Abrefah 1994).

Historical data and experience with N Reactor fuels provides the primary basis from which to draw input for modeling and process development activities. Modeling calculations can support several of the information needs exclusive of laboratory examinations (Table 1). In some cases, current modeling capabilities are adequate for the accelerated Path Forward. In others, the codes used for these calculations may not be calibrated or validated for the materials in question, however, those calibrations/ validations are beyond the scope of this plan. Schedule and funding constraints dictate that the characterization activities focus on the areas of greatest uncertainty and risk to the successful completion of the accelerated Path Forward. Based on a review of the literature and from information gathered in technical exchanges, these information needs of greatest uncertainty for the accelerated Path Forward are: material chemical and phase stability, drying/oxidation kinetics, corrosion and degradation, and combustibility/pyrophoricity (Table 1).

Vital characterization data are required early in the program to support schedules. Significant design activities will by necessity be based on literature and foreign data. Unfortunately, foreign data and literature data may be of limited value in several of the information needs because of differences in materials, irradiation histories, storage times, and storage modes. The majority of literature data is for unirradiated uranium or for oxide fuel, therefore it has limited applicability to this program. Process demonstration will not be feasible prior to process selection due to the limited time frame. Process definition will rely on characterization data with confirmatory demonstration a possible future option.

Table 1. Sources of Information for Identified Needs.

(Highlighted Area is the Subject of This Plan)

Information Need	Sources of Information					
	In-Situ Char.	Laboratory Exam.	Modeling Cal.	Foreign Data	Literature Data	Process Demo.
1. Chemical and Isotopic Composition		X*	X			
2. Radionuclide Release Character	X	X				X
3. Chemical and Phase Stability**		X	X		X	X
4. Drying/Oxidation Kinetics**		X	X	X	X	X
5. Corrosion and Degradation**	X	X	X	X	X	
6. Combustibility/ Pyrophoricity**		X	X	X	X	
7. Nuclear Criticality			X			
8. Chemical Toxicity						
9. Size/Weight/Density Characteristics	X	X				
10. Physical Properties		X	X		X	
11. Physical Condition/ Integrity	X	X				
12. Thermal Properties		X	X		X	

*For sludge only.
**Needs of greatest uncertainty for the accelerated Path Forward.

2.0 SCOPE AND OBJECTIVES

2.1 SCOPE

This characterization plan is limited to in-situ and laboratory examinations of the SNF and sludge in the K East and K West Basins. The draft schedule provided by RL on February 14, 1995 showing Multiple Canister Overpack (MCO) loading beginning December 1997, and conditioning beginning July 1998, was the basis for planning the characterization activities to support packaging, transportation, process definition for conditioning, and material behavior under dry storage conditions.

The characterization program is structured to be completed in 4 years (FY 1998) after approximately half the material has been removed from the Basins. One fuel shipping campaign has been completed for the K West Basin and two more are planned for FY 1996, one from the K West Basin and one from the K East Basin.

The program will focus on laboratory examinations for the four information needs identified with the greatest uncertainty and correspondingly the highest risk factors for the successful completion of the accelerated Path Forward.

The sludge sampling campaign will begin with the floor and pit sludge in the K East Basin. K West canister sludge sampling will be concurrent with the second fuel shipping campaign from the Basin. K East canister sludge sampling is scheduled concurrent with the shipping campaign from K East Basin to minimize operator exposure related to characterization. Since it will be necessary to handle and move the canisters for shipping samples it is an excellent opportunity to sample the canister sludge. These activities may be decoupled if the shipping schedule is changed or it becomes necessary to reprioritize the work. K West floor and pit sludge will be sampled and characterized in FY 1997 since the schedule for disposition of this sludge is late in the program (Fulton 1995). The program is structured to provide bounding behavior for the fuel and verification and acceptability for the three different sludge disposal pathways.

This plan provides data to support the engineering decisions for the Path Forward identified by RL (Hansen 1995). As the Path Forward project matures it may be necessary to revise this plan to address new engineering issues. This plan is meant to be a living document.

2.2 OBJECTIVES

The objective of this plan is to define a fuel and sludge characterization program that provides the minimum characterization data necessary to support the Accelerated Path Forward. To the extent possible, consistent with schedule and budget constraints, data will be obtained that directly supports process design, safety, and regulatory needs. Information that cannot be obtained in the time frame provided will be confirmatory in nature.

3.0 PROGRAM SUPPORT FOR PATH FORWARD

The characterization plan is structured to support the decisions necessary to implement the accelerated Path Forward scope and schedule. The relative importance and sources of information to support the Path Forward are summarized in Table 2. The Path Forward decisions were catalogued under the following topics of engineering and design, safety analysis, and Environmental Impact Statement (EIS). The engineering and design decisions are further divided into MCO and transportation, conditioning, and storage. The characterization activities are identified first by the materials to be examined and then by the general information to be obtained from the planned examinations. Five general areas of characterization activities were identified for the fuel: physical characteristics, hydride and oxide content, drying behavior, passivation, and dry storage behavior. Rather than identify the types of examinations, i.e., visual, metallography, etc., the general categories of data collected were listed.

The relative importance of the data collected to program decisions was ranked either as A or B; where A corresponds to required information and B corresponds to confirmation for higher confidence and system validation. The relative importance of the characterization activities represented by Table 2 focuses only on the laboratory measurements. In-situ characterization activities are also providing important information on the conditions of the fuel and sludge in the Basins for process design decisions. Information obtained from the in-situ examinations also support an overall understanding of characterization activities such as physical characteristics.

Schedule constraints enter into the ranking of data for the Path Forward decisions. The EIS will by necessity be completed before significant data are obtained from any fuel examination beyond the initial fuel shipment from K West. Consequently, the bulk of the data collected will only support the EIS in a confirmatory fashion. Also, there are some sludge characterization activities which are not applicable to the MCO and transportation and conditioning (Table 2). It is recognized that this ranking of the importance of the characterization activities to the Path Forward decision is highly subjective and may be revised as additional information is obtained on program definition and from the on-going examinations.

Table 2. Relative Importance of Laboratory Characterization Activities to Path Forward Decisions.

Characterization Activity	Path Forward Support*				
	Engineering and Design			Safety Analysis	EIS**
	MCO	Conditioning	Storage		
1. Fuel (K West)					
Physical Characteristics	A	A	B	B	B
Hydride/Oxide Content	A	A	A	A	B
Drying Behavior	A	A	A	A	B
Passivation	B	B	B	B	--
Dry Storage Behavior	B	--	B	B	--
2. Fuel (K East)					
Physical Characteristics	A	A	B	B	--
Hydride/Oxide Content	A	A	A	A	--
Drying Behavior	A	A	A	A	--
Passivation	B	B	B	B	--
Dry Storage Behavior	B	--	B	B	--
3. Sludge (K East Floor)					
Composition and Quantity	--	--	A	A	--
Transport Behavior	--	--	A	A	--
Tank or Waste Acceptability	--	--	A	A	--
Pyrophoricity	--	--	A	A	--
4. Sludge (K East & K West Canister)					
Removal Characteristics	A	--	--	--	--
Tank Waste Acceptance	--	--	A	A	--
Drying Behavior	A	A	A	A	--
Dry Storage Behavior	B	B	B	B	--
5. Sludge (K West Floor & Pit)					
Composition and Quantity	--	--	A	A	--
Pyrophoricity	--	--	A	A	--
Tank or Waste Acceptance	--	--	A	A	--

*A = Essential--Required input, B = Confirmation--for higher confidence and system validation.
**Environmental Impact Statement for K Basins.

4.0 FUEL CHARACTERIZATION

Fuel element characterization activities are divided into three main categories. They are in-situ characterization, laboratory examinations and conditioning, and dry storage testing. The near term activities associated with the categories will first establish the current state of the fuel in the two basins and determine the drying and passivation characteristics to support conditioning process definition. Longer term activities will focus on confirming the design and operating basis for the conditioning process and facility, and establishing the dry storage behavior of the material.

4.1 IN-SITU CHARACTERIZATION

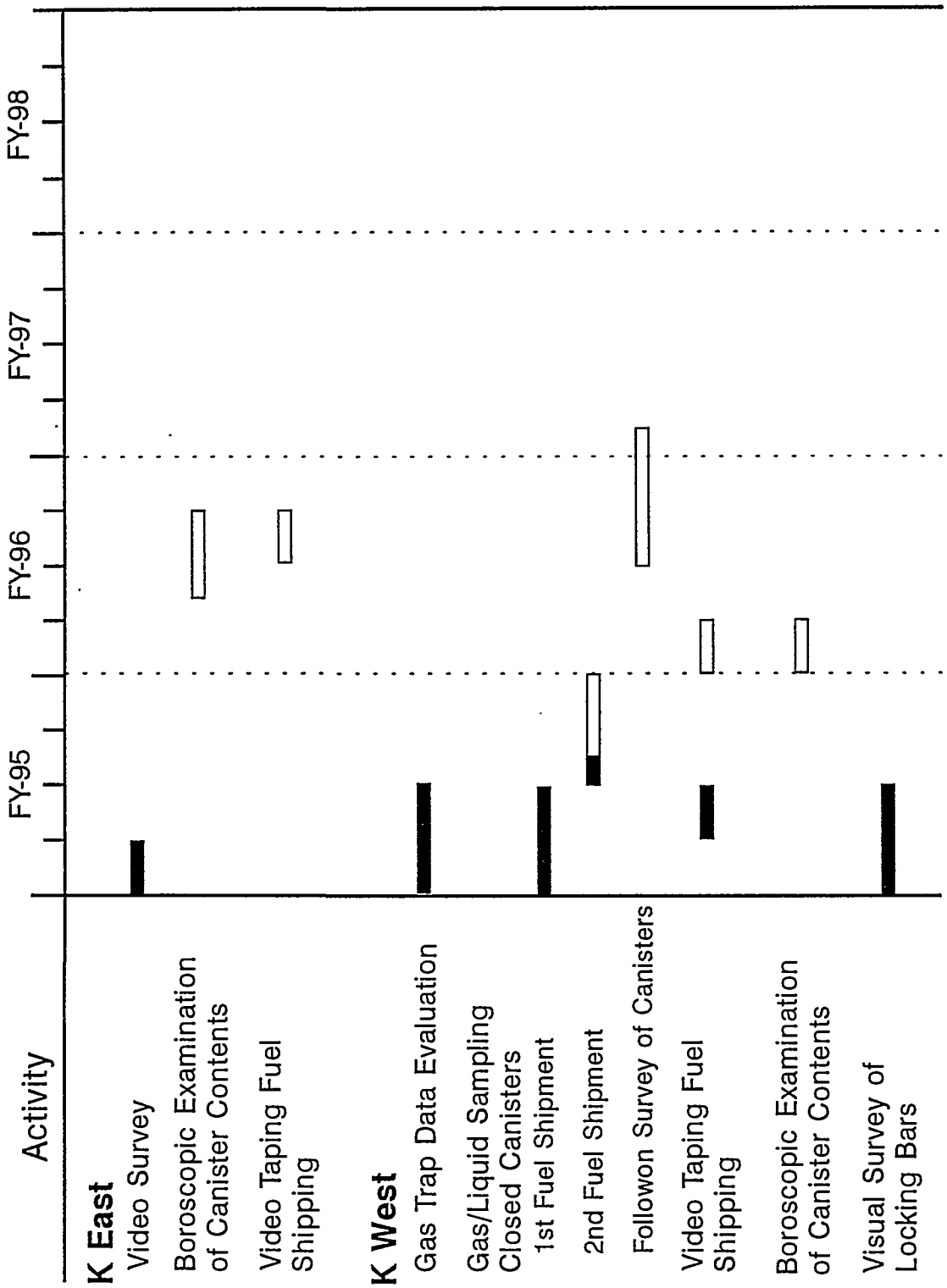
Near term activities to establish the bounding conditions for the fuel in the K West Basin in sealed canisters includes sampling the gases and liquids in selected canisters, evaluating gas trap data for canister seal integrity, visual survey of canister locking bars, and opening selected canisters for shipment of fuel samples to the hot cells for examinations (Figure 1). The in-situ characterization activities in K West generally coincide with the two shipping campaigns which include opening canisters for fuel selection. Gas and liquid sampling is a prerequisite to canister opening for fuel selection. A total of ten canisters were sampled for the first shipment. A total of 30 canisters are planned for gas and liquid sampling for the second shipping campaign from K West. All aspects of the canister opening and sample retrieval will be recorded on video to track material behavior. Detailed boroscopic video examinations will be conducted in conjunction with canister opening for the second shipping campaign in K West to provide additional information on the condition of the fuel and sludge in the closed canisters.

Earlier activities in K East Basin with open canisters included a complete video survey of the fuel condition. The video survey of the open canister tops will be supplemented with detailed boroscopic examinations on the conditions of the material in the canisters.

Boroscopic examinations will extend the range of visual observations to the condition of the lower portion of the fuel elements in the canisters. The assumption has been made in evaluating the recent video survey of K East that there are as many elements with breaches in the lower end as there are visible from the tops of the canisters. These examinations will attempt to test this hypothesis on a limited number of canisters as well as address concerns that have been raised about different or accelerated degradation mechanisms for elements that may be partially submerged in sludge at the bottoms of the canisters. Boroscopic examinations will not be focused on quantifying the amount of sludge that may be in a canister.

A limited gas and liquid sampling campaign is planned for the K West closed canisters in late FY 1996 following the shipment of the second group of samples to the hot cells (Figure 1). The focus of these examinations will be established following a detailed evaluation of the data from the first two sampling activities associated with canister opening and fuel shipping. The intent of the follow-on gas and liquid sampling is to provide additional

Figure 1. Schedule for Spent Nuclear Fuel In-Situ Characterization Activities.



perspectives on the condition of the fuel in the sealed canisters. Gas and liquid sampling may be a cost effective method to ascertain whether fuel in the closed canisters is damaged prior to MCO loading and transport.

4.2 LABORATORY EXAMINATIONS

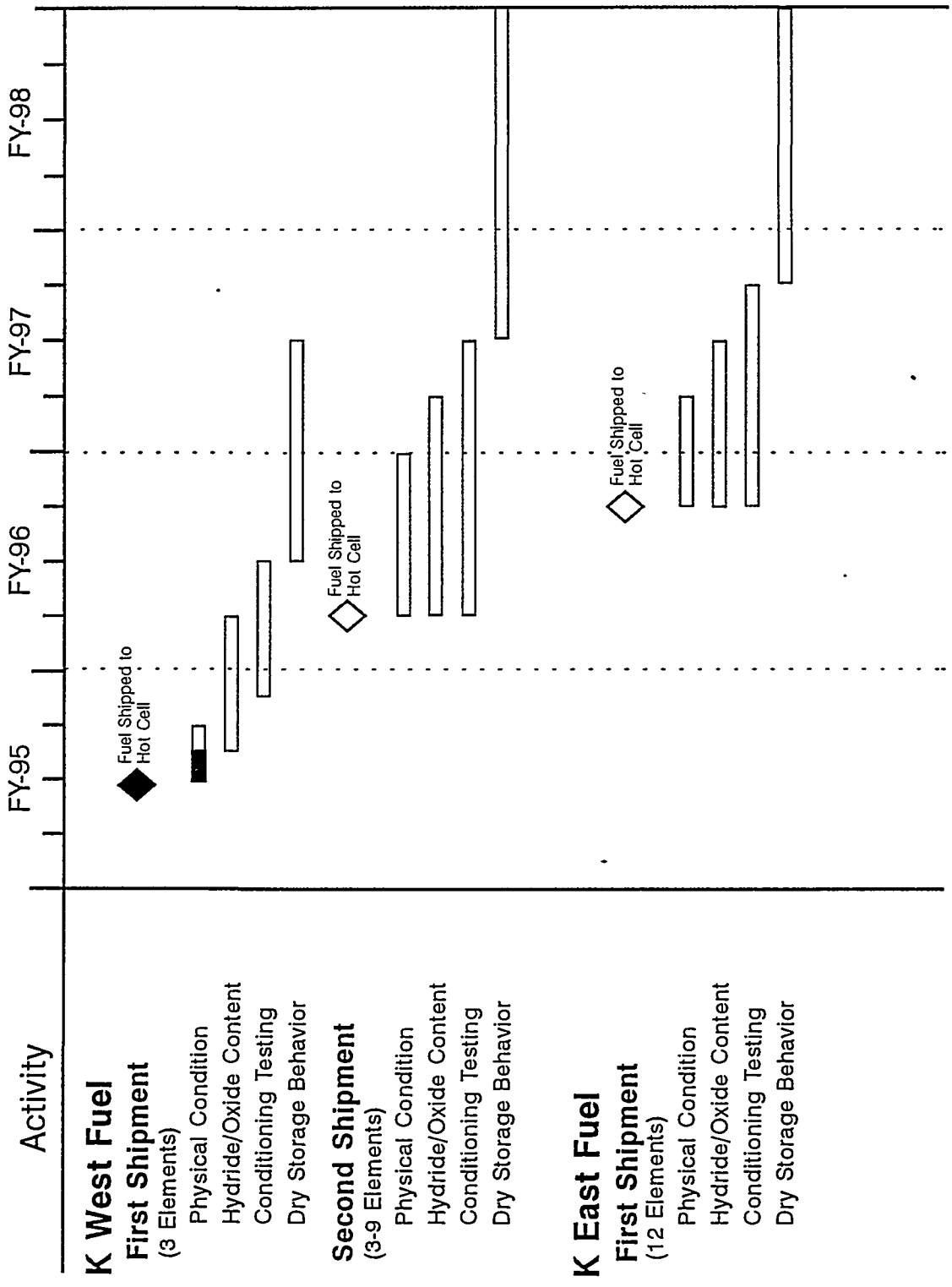
Fuel was selected from the K West closed canisters to provide information to confirm bounding conditions on the fuel state for MCO packaging, transportation, and to confirm process definition for conditioning. Fuel was selected from the K West Basin first because shipping to the hot cells could be expedited from K West Basin in early 1995 and because of the uncertainties and speculations as to the condition of the fuel after extended storage in the closed canisters. The fuel variable expected to have the largest impact on the initial state of the material for conditioning is breached cladding. Cladding breaches provide a pathway for uranium/water corrosion and fuel/cladding degradation. An as-discharged fuel element (no visible damage), a damaged and a badly damaged fuel element were selected for the initial fuel shipment. The three samples were selected to be representative of the visible fuel damage expected in the K West canisters inventory and help bound the expected behavior of the material. A second shipment is planned to provide additional information for bounding and confirmation of conditioning behavior. It may also be desirable to sample fuel that has been subjected to additional variables known to influence the initial fuel state. These include storage mode, irradiation history, galvanic effects of dissimilar metals, water quality, and storage time. Sample requirements for a second shipment will be based on the results of the initial fuel sampling and examinations. Details for the fuel samples to select for the second shipment from K West will be developed as part of the DQO for the shipment.

Fuel selection from K East will similarly provide information to establish bounding conditions on the fuel state. The complete video survey of K East and the planned supplemental boroscopic examinations of selected canisters will be the basis for fuel selection. A single shipping campaign is planned for K East beginning in late FY 1996 similar to the sampling in progress for K West. Fuel selection and examinations will focus on defining the fuel states which are different for K East compared to the K West data being obtained. In this way duplication can be eliminated where the data shows similar bounding behavior for the two fuel populations.

The schedule for Fuel Characterization activities is summarized in (Figure 2). A total of three cask shipments are projected for the second shipping campaign from K West and up to four from K East. These numbers of cask shipments from the two basins may be changed as more information becomes available from the canister opening in K West and overall fuel behavior in K East.

Laboratory examinations were divided into physical condition, hydride and oxide content, conditioning testing, and dry storage behavior (Figure 2) consistent with the Path Forward decisions identified in Table 2. The physical condition of the fuel will be established through detailed examinations during all the in-basin activities associated with sample selection and shipment and visual examinations and photography in the hot

Figure 2. Schedule for Spent Nuclear Fuel Characterization Activities.



cells. Critical activities in the hot cells such as the initial removal from the water and exposure to cell atmosphere which will generally be air will be recorded on video. Sample dimensions, weight, and density will also be measured to establish the physical condition of the fuel as feed material for MCO loading, transportation, and conditioning.

The hydride and oxide content of the fuel will be established with optical metallography. These two chemical characteristics of the fuel are of most interest to the Path Forward decision process. Samples will be selected from the degraded areas of the fuel to maximize the opportunity to determine hydride content and extent of fuel oxide formation on the surfaces exposed to the storage water and sealed canister gas environment.

Metallographic examinations of the fuel samples will be in parallel rather than in a series from one shipment to the next. This provides a pool of samples from which to select the samples with the highest priority for project decisions and support of conditioning testing. Pre- and post-conditioning metallography on sibling samples will be utilized to establish the effects of conditioning as well as establish the pre-conditioning state of the material.

4.3 CONDITIONING AND DRY STORAGE TESTING

Conditioning testing of the K Basin fuel is being considered separately from the laboratory examinations due to its direct support to process definitions for the Path Forward.

One of the main areas of technical uncertainty identified by the ITA team is the fuel and corrosion product drying and passivation behavior as a function of time, temperature, gas composition, and possibly pressure. The accelerated Path Forward schedule calls for the conditioning process specification by the end of FY 1995 with process validation by the end of FY 1996 and design completed by mid FY 1997. Initial conditioning testing will be conducted at one atmosphere pressure in a controlled temperature and gas composition furnace with some off-gas analysis capabilities and data will be provided to support conditioning process decisions.

Modifications to the ITA proposed conditioning process will be considered for the second series of tests to be conducted. Parameters of interest from the second series of tests include time and temperature, and gas composition. The second series of tests will also be at one atmosphere pressure. Vacuum drying and elevated pressure testing of the conditioning process will be conducted after the materials response to one atmosphere is established and sufficient experience has been obtained with the system and the in-cell testing.

Testing will be in parallel for the fuel samples from the different shipments. Initial testing will be with small samples selected from the degraded portions of the fuel elements and could then proceed to full ring sections of the damaged ends of the fuel elements. Multiple samples could be tested under similar conditions to provide some assurance behavior is consistent for a given degree of fuel element degradation. Selection of

samples for repeat testing will be a trade-off between the number of samples available, the overall conditions of the samples selected, and the program priority for test data. These issues will be addressed in the DQOs for the particular group of samples tested.

Longer term fuel characterization activities include completion of conditioning process testing for the fuel materials and studies of the dry storage behavior of the materials. The dry storage behavior testing will utilize samples prepared as part of the drying behavior studies. Tests will be conducted to envelope the Container Storage Building (CSB) parameters. Detail testing parameters will be defined consistent with the completion of the conditioning process and the storage facility design. Initial data on dry storage behavior will be obtained on limited samples before beginning loading of the MCOs and validation testing is expected to be completed by the end of the program in FY 1998.

5.0 SLUDGE CHARACTERIZATION

Sludge characterization is divided into three main categories which reflect the major types of sludge represented. The main types of sludge are K East floor and pit sludge, K East and K West canister sludge, and K West floor and pit sludge. K West floor and pit sludge is assumed to be relatively benign compared to the sludge in K East, and in the canisters. It appears to consist primarily of dust that has been deposited on the basin floor since the facility was refurbished and restored but may also contain some fuel from the fuel segregation campaigns.

Different pathways have been tentatively identified for the disposal of the materials (Fulton 1995). K East floor sludge will be removed and forwarded to the Double Shell Tanks (DSTs) for storage and ultimate disposal. K West floor sludge due to its expected composition and content is to be removed and handled as radioactive solid waste. The sludge in the closed canisters in K West and the open canisters in K East may be partly or completely removed from the fuel and sent to the conditioning facility. Sludge which does not accompany the fuel will most likely follow the DST pathway. Characterization activities were identified which support these three proposed pathways for the sludge material. The sludge characterization activities are summarized in (Figure 3).

Sludge characterization activities will be conducted in the followings areas: quantity, transport properties, drying behavior, pyrophoricity, dry storage behavior, and composition. The near term activities focus on the sludge chemical constituents, how much is present to be processed, acceptability of the sludge for the different disposal pathways and drying characteristics for the material that must be dried as part of the material inventory in a MCO.

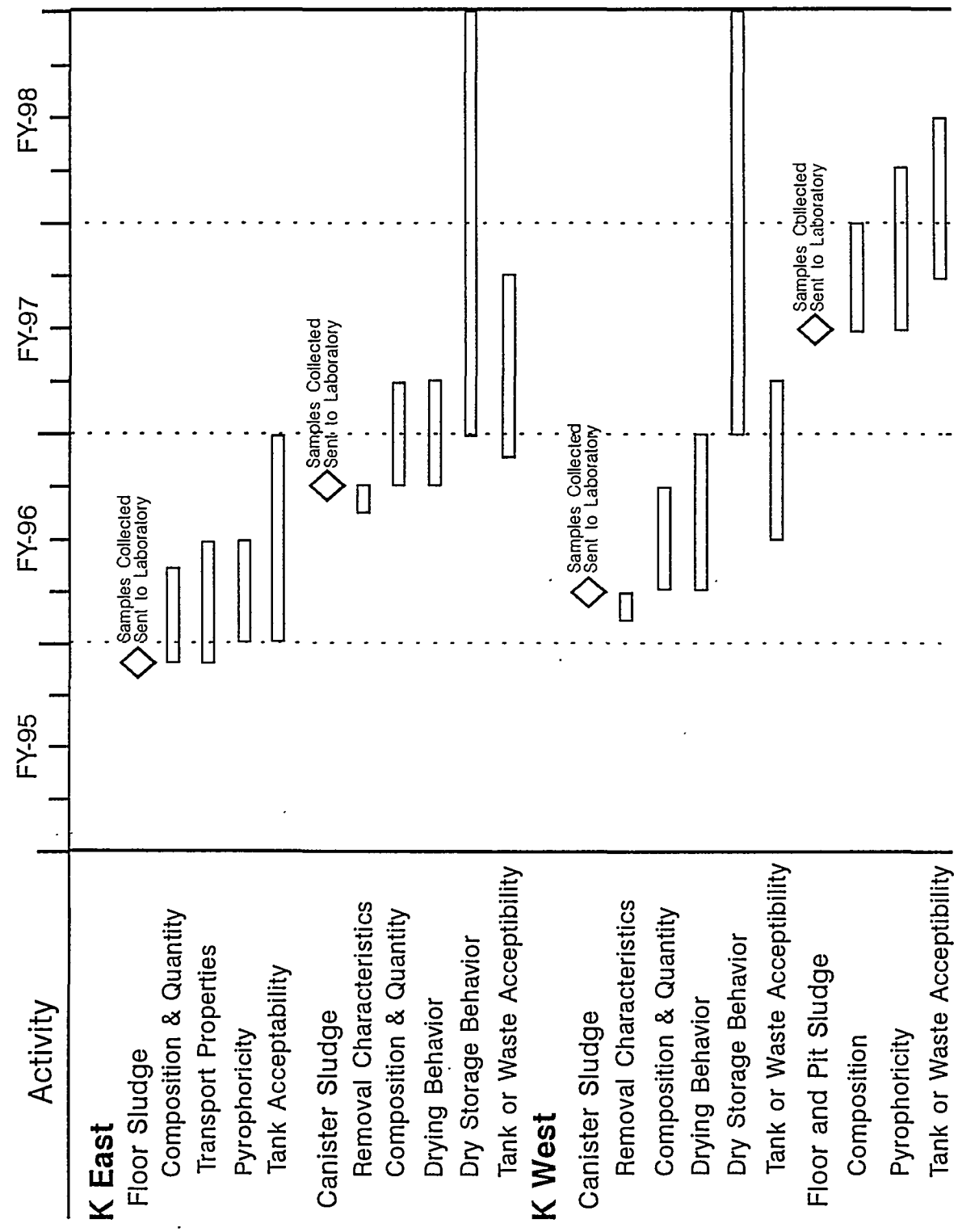
Again examinations are expected to occur in parallel rather than in series due to the schedule constraints of the program (Figure 3). Examinations may be conducted in the same facility as the fuel, i.e., Postirradiation Testing Laboratory hot cells, or in other chemistry laboratories, i.e., 325 Building and 222-S, which are capable of handling and examining the particular material.

In preparation for this sludge characterization activity, all available historic data on the sampling and characterization of the basin sludge was collected and a summary document was prepared (Baker 1995).

5.1 K EAST FLOOR SLUDGE

A major floor sludge sampling activity for K East is scheduled for late FY 1995 to obtain representative samples (Figure 3). Sampling equipment is being developed and sample analysis will be focused on equipment design parameters and verification of the acceptability of the material for transfer to the DSTs for storage and ultimate disposal. Sludge will be removed from the Basin floor, and from the Basin pits for analysis. The specific sample

Figure 3. Schedule for Spent Nuclear Fuel Sludge Characterization Activities.



locations and numbers and laboratory analyses will be developed in the DQOs and SAPs for the sampling activities. Sampling of floor sludge in the K East Basin can be independent of the fuel shipping campaigns. However, sampling must be scheduled with ongoing basin activities and must be in accordance with an ALARA plan developed to keep operator exposure to a minimum.

The K East floor and pit sludge has been sampled in the past (Baker 1995). These samples provided very limited chemical and physical property data and were taken in only a few locations with severe restrictions on sample quantity.

The central problem to be addressed by the characterization efforts for K East floor and pit sludge is "what is an acceptable way to retrieve sludge from K East and to process, transport, and store the material." Equipment must be designed or commercial services procured to retrieve, transport, and process the material. Physical properties such as fluid viscosity, particle size, chemical constituents, etc., are necessary to determine pathway acceptability and to design the equipment or place a services contract for sludge processing.

Sludge may be either stored in the DSTs until it can be disposed of or stored as solid waste. In either case the characteristics of the sludge must be determined to assure compatibility and acceptability for the disposal path.

5.2 CANISTER SLUDGE

The sludge present in the canisters is expected to contain large quantities of corroded fuel particles. Sampling at K West will be coincidental with the second fuel shipping campaign from the K West Basin in early FY 1996. The level of sampling will be dependent upon the quantities of sludge present in the closed canisters that are opened for examination and fuel element retrieval for the laboratory examinations.

The K East canister sludge is currently scheduled to be collected from selected canisters during the fuel shipping campaign, however, if there are schedule constraints with shipping, sludge samples from K West will have to be used for process decisions until the K East samples are available.

The actual characterization will be focused on the verification and acceptability for the recommended Path Forward for the sludge material (Fulton 1995). If the material is to accompany the fuel elements in the MCOs then drying and conditioning testing will be most important. If however, the material is to be removed from the canisters before they are transferred to the storage or conditioning facility, the packaging and drying requirements for the material may be as important as the material behavior characteristics necessary to establish the characterization activities to support this particular disposition strategy. Some sludge will accompany the fuel since desludging is not expected to be 100% effective. Canister sludge may be removed at the basin and packaged separate from the fuel for disposal in an MCO. Drying and conditioning testing of canister sludge within the package selected will be important for process definition if this pathway is chosen for the canister sludge.

If canister sludge accompanies the fuel in the MCOs then furnace testing activities with the fuel described previously must be expanded in scope to include both degraded fuel sections and representative sludge in the same furnace cycle.

5.3 K WEST FLOOR AND PIT SLUDGE

Characterization of the floor and pit sludge in K West will be focused on establishing acceptance for disposal as radioactive solid waste. Current sludge characterization efforts will first look at the K East floor sludge followed by the K East and West canister sludge. Characterization of the K West floor and pit sludge will occur late in the program. This may be revised if programmatic decisions dictate early removal of some or all of this material.

6.0 DOCUMENT HIERARCHY FOR CHARACTERIZATION

The WHC and PNL document hierarchy for the SNF Characterization activities is summarized in Table 3. A Program Management Plan jointly authored by WHC and PNL defines the roles and responsibilities for Characterization. The initial Program Management Plan is being revised to reflect the program and roles for the two organizations (Fulton 1994a). The Characterization Plan prepared by PNL at the beginning of the program identified the sufficient characterization data and analysis to support acceptability and licensing of the disposition strategy (Abrefah 1994).

Data Quality objectives and corresponding Sample Analysis Plans (SAPs) where applicable are prepared by WHC for a specific characterization activity. The DQO process follows a logical progression of data requirements definition and identification through proposed data collection, analysis, and evaluation approaches (Lawrence 1994). All data requirements are based upon a particular problem definition and on identification of SNF project disposal decisions the characterization data is intended to support.

The SAPs provide the detailed instructions to the laboratories conducting the measurements consistent with the corresponding DQO. Detailed Test Plans and Test Instructions are prepared by PNL for corresponding hot cell and laboratory examinations within their area of responsibility again in support of the appropriate DQO.

Data reports, evaluations, and interpretation of the data will likewise be prepared by WHC and PNL for that which they have primary responsibility. Joint reports will be issued where applicable.

Table 3. Document Hierarchy for Characterization.

Title	Scope	Authorship
Program Management Plan	Defines roles and responsibilities for characterization	WHC and PNL
Characterization Plan	General examination requirements for material being sent to a repository	PNL
Plan for Characterization of K Basin SNF and Sludge (this document)	Specific plans to support accelerated Path Forward	WHC and PNL
Data Quality Objectives	Documents DQO process for specific characterization activities	WHC
Test Plans and Test Instructions	Detailed testing requirements and plans to implement the corresponding DQO	PNL
Reports	Data reports and evaluations and interpretation of the data	WHC, PNL*

*Dependent upon the scope and primary responsibility for the data reported.

7.0 QUALITY ASSURANCE

A comprehensive Quality Assurance (QA) program for WHC has been developed and implemented. The QA program is documented in WHC-CM-4-2, "Quality Assurance Manual." This program is utilizing WHC-CM-4-2 as the governing WHC QA requirements for the Characterization of K Basin Spent Nuclear Fuels and Sludge.

Pacific Northwest Laboratories (PNL) is responsible for a portion of the laboratory characterization activities. Characterization activities performed by PNL will comply with a project-specific QA plan which ensures compliance with the criteria of NQA-1 and other related requirements.

The Office of Spent Nuclear Fuels Management has decided to use the applicable portions of the Office of Civilian Radioactive Waste Management (OCRWMs), "Quality Assurance Requirements and Description (QARD)," DOE/RW 0333P as the baseline requirements. These requirements, at a minimum, apply to the characterization for data collection that facilitates interim storage or future disposal, conditioning for interim storage, or in final form for disposal, and handling and packaging for interim storage or disposal.

SNF Project Quality Assurance conducted a review of the WHC QA program against DOE/RW 0333P for the fuel characterization activities (Smith 1995). The WHC QA Program was found to provide an equivalent system of management controls to those of DOE/RW 0333P except for two rated areas. These were: the responsibility for sample tracking through analysis and procedures or plans for data validation. Sample tracking and protocol is specified in the SAPs for characterization and a plan is being developed for data validation. A Quality Assurance plan is being developed for the SNF Project. Certain SNF activities will require implementation of DOE/RW 0333P as the baseline requirement document.

The QA requirement for the PNL portion of the characterization activities have been identified in PNL QA Plan ETC-011, current revision (PNL 1994). This plan is in compliance with the requirements of DOE/RW 0333P.

8.0 SCHEDULE DELIVERABLES AND BUDGET

8.1 SCHEDULE

The overall characterization schedule for fuel and sludge is summarized in (Figure 4). Path Forward decisions related to conditioning and the initiation of fuel removal are the schedule drivers and are included as references to the accelerated plan.

If the Path Forward schedules for fuel conditioning are revised and or the recommended Path Forward for the sludge is changed, then the program workscope and schedules must be adjusted to accommodate the differences.

Detailed schedules are being and will be developed for each of the main characterization activities to coordinate all performing organizations to assure the program milestones in this plan are met. Particular attention will be given to coordinating these schedules with the K Basin Operations staff and with the hot cells and laboratories conducting the measurements.

In-situ visual examinations will be completed in FY 1996 following detailed boroscopic examinations of canisters opened during the corresponding shipping campaigns from K West. A limited gas and liquid sampling campaign will be conducted in K West following an evaluation of the sampling data obtained FY 1995. Sample shipping from both basins to the hot cells for examinations will be completed in FY 1996 to support the accelerated schedule to begin loading the MCOs by the end of 1997 (Figure 2).

WHC efforts will focus on understanding fuel behavior in FY 1996 after sufficient samples have been sent to the hot cells. Efforts in the area of technical support, fuel behavior analysis, and documentation will reach a maximum in FY 1997 to support the design validation and confirmation and will be focused on dry storage behavior in FY 1998.

8.2 DELIVERABLES

Deliverables were identified for the in-situ characterization and the fuel and sludge examinations outlined in this plan (Table 4). The schedules and content of these milestones may change as the characterization activities are integrated with the overall K Basin Operations and the accelerated Path Forward schedules.

8.3 BUDGET

Characterization program costs through April 1995 were obtained and used as the basis for projecting future costs consistent with the outlined work scope and program schedules. The proposed characterization program budget for a projected 4 year program is summarized in Table 5.

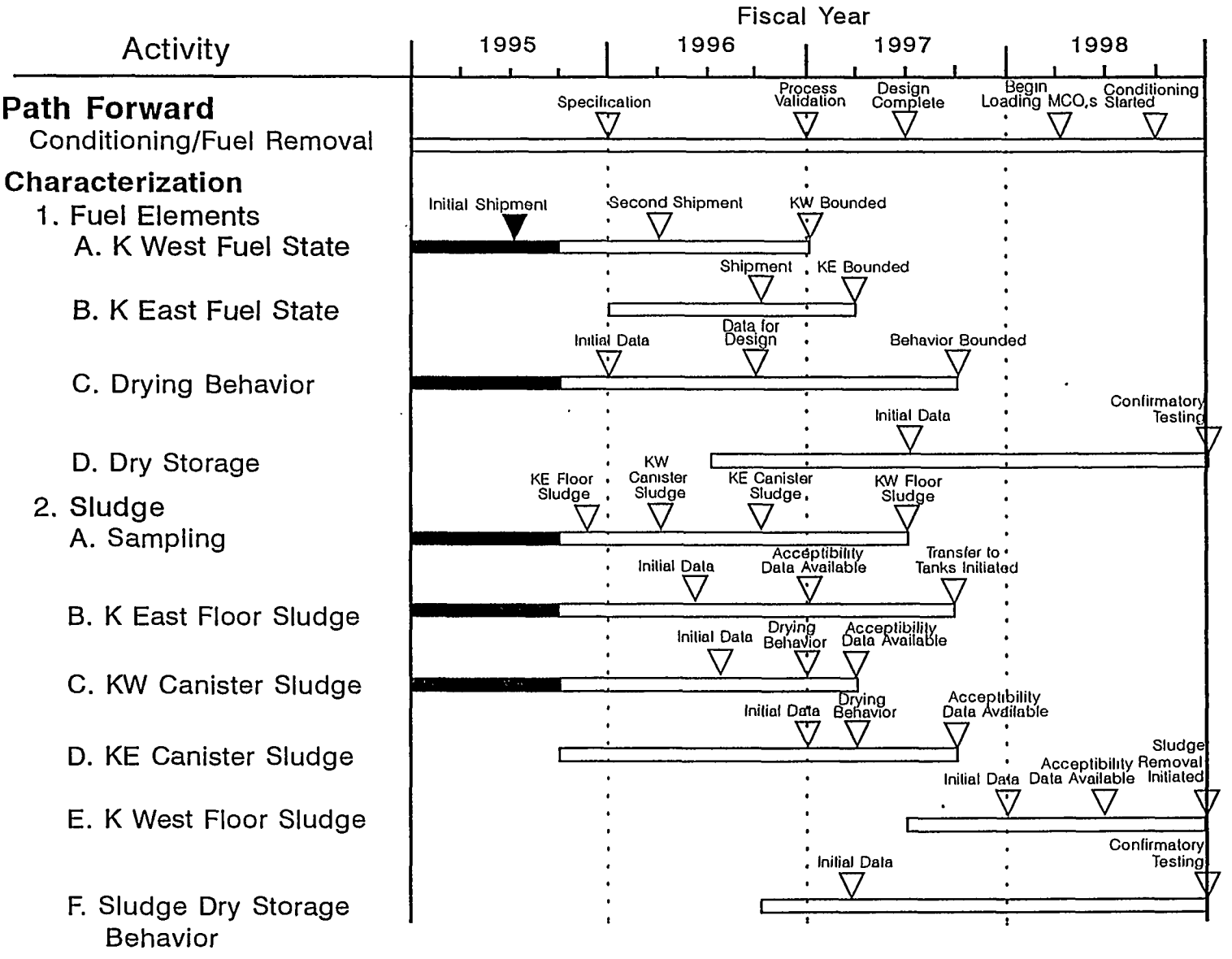


Figure 4. Overall Characterization Schedule for K Basin Fuel and Sludge Supporting the Accelerated Path Forward.

Table 4. Spent Nuclear Fuels Characterization Program Deliverables.

Activity	Deliverable	Estimated Date
1. In-Situ Characterization	1.1 Complete video and boroscopic examination of K West	January 1996
	1.2 Complete video and boroscopic examination of K East	June 1996
	1.3 Perspective on fuel degradation in canister bottoms	August 1996
	1.4 Complete canister gas/liquid sampling for second K West shipment	September 1995
	1.5 Complete follow-on gas/liquid survey of K West canisters	November 1996
2. Fuel Examinations	2.1 Establish hydride/oxide content of first K West samples	December 1995
	2.2 Complete second K West fuel shipment	January 1996
	2.3 Establish K West fuel response to conditioning process (1st shipment)	March 1996
	2.4 Complete K East fuel shipment	June 1996
	2.5 Drying data for process definition	June 1996
	2.6 Establish physical condition of K West fuel	September 1996
	2.7 Establish hydride/oxide content for K West fuel	December 1996
	2.8 Establish K East fuel response to conditioning process	June 1997
	2.9 Complete dry storage behavior testing	September 1998
3. Sludge Examinations	3.1 K East floor/pit sludge sent to laboratory	September 1995
	3.2 K West canister sludge samples sent to laboratory	February 1996
	3.3 Complete K East floor/pit sample laboratory examinations	March 1996
	3.4 K East canister sludge samples sent to laboratory	July 1996
	3.5 K East floor/pit sludge tanks or waste acceptability established*	September 1996
	3.6 Establish K West canister sludge drying characteristics	September 1996
	3.7 K West canister sludge tank or waste acceptance established*	December 1996
	3.8 K East canister sludge tank or waste acceptance established*	March 1997
	3.9 K West floor/pit sludge sent to laboratory	July 1997
	3.10 Complete K West floor/pit sludge laboratory examinations	December 1997
	3.11 K West floor/pit sludge tank or waste acceptability*	March 1998

*Subject to TWRS or solid waste schedules for review and approval.

Table 5. Spent Nuclear Fuel Characterization Program Budget.

Activity	Funding Requirement ($1,000)*			
	FY 1995	FY 1996	FY 1997	FY 1998
WHC				
In-situ visual	275	150	0	0
Gas/liquid sampling	725	350	0	0
Shipping	1,800	750	0	0
DQOs and program direction	500	500	500	500
Sludge	800	1,200	1,500	1,000
Technical support, analysis, and documentation	500	1,500	2,000	1,500
Subtotal	4,600	4,450	4,000	3,000
PNL				
Hot cell preparation	1,735	750**	0	0
Hot cell examinations	950	1,950	2,000	1,500
Technical support	1,110	1,200	1,250	1,000
Subtotal	3,795	3,650	3,500	2,500
TOTAL	8,395	8,350	7,500	5,500

*Constant FY 1995 dollars.
**Includes $50K capital expenses.

The WHC technical support includes interfacing with PNL on the hot cell examinations, providing interaction and data interpretations to the Path Forward tasks, and providing a central repository for the data collected. All data will be validated and verified before being placed in the data library for SNF Project use.

The PNL hot cell preparation in FY 1995 is supporting installation of equipment and procedures for testing in support of the conditioning process. Hot cell preparations in FY 1996 include development of the dry storage testing capability, installation of the TGA system and improvements to the visual examinations equipment and upgrades to the transfer cell for fuel receipt and waste disposal. The level of funding for the hot cell examination and technical support will remain fairly constant for the life of the program. The increase in hot cell examination funding requirements for FY 1996 and beyond compared to FY 1995 reflects that samples have arrived at the hot cells at the beginning of the second half of FY 1995 for examinations.

The plan is schedule driven and funds have been allocated based on program experience through April 1995. If the data projected to be available within the schedule of this plan is considered to be too limited to support Path Forward decisions it may be possible to accelerate the accumulation of design and process support data if additional funds were made available. However, facility and support function limitations for processing additional samples, such as K Basin Operations and the hot cells and laboratories scheduling for corresponding examinations may limit the ability to expand the program scope. Conducting hot cell and laboratory examinations in parallel rather than series for different fuel and sludge shipments will maximize the ability to obtain high priority data within program schedule and funding constraints.

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