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Title/Desc:
PLAN FOR CHARACTERIZATION OF K BASIN SNF & SLUDGE

COMPLETE

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 168165

Proj. ECN

2. ECN Category (mark one) Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	3. Originator's Name, Organization, MSIN, and Telephone No. L. A. Lawrence, ZM71O, L5-01 376-5543	3a. USQ Required? [] Yes [X] No	4. Date October 3, 1995
	5. Project Title/No./Work Order No. Spent Nuclear Fuel Project	6. Bldg./Sys./Fac. No. N/A	7. Approval Designator N/A
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) N/A See below.	9. Related ECN No(s). N/A	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 11b) [X] No (NA Blks. 11b, 11c, 11d)	N/A	N/A Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Updates the plan to concide with the latest Integrated Process Strategy for the SNFP.

WHC-SD-SNF-PLN-007, Rev. 0

13a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

13b. Justification Details

See Item 12 Above.

14. Distribution (include name, MSIN, and no. of copies)

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15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
None		

20. Approvals

	Signature	Date		Signature	Date
OPERATIONS AND ENGINEERING			ARCHITECT-ENGINEER		
Cog. Eng. L.A. Lawrence	L.A. Lawrence	10/3/95	PE		
Cog. Mgr. R. P. Omberg	BJ Makenen for	10/3/95	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

RELEASE AUTHORIZATION

Document Number:	WHC-SD-SNF-PLN-007, Rev. 1
Document Title:	Plan for Characterization of K Basin Spent Nuclear Fuel and Sludge
Release Date:	October 5, 1995

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

T.L. Ontiveros — October 5, 1995

SUPPORTING DOCUMENT	1. Total Pages ~~40~~ 42

2. Title	3. Number	4. Rev No.
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Characterization Plan, 105-K West, Fuel Examinations, SNFP, Sludge	Name: L. A. Lawrence [signature] 9/28/95 Signature Organization/Charge Code 8M710/LD11D

7. Abstract

This plan outlines a Characterization Program that provides the necessary data to support the Integrated Process Strategy scope and schedules for the Spent Nuclear Fuel (SNF) and sludge 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. In order to assure the scope and schedule of the Characterization Program fully supports the Integrated Process Strategy, key project management have approved the plan.

The intent of the program is to provide bounding behavior for the fuel, and acceptability for the transfer of the sludge to the Double Shell Tanks. 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 behavior and properties investigated in the laboratory include physical condition, hydride and oxide content, conditioning testing, oxidation kinetics, and dry storage behavior. These laboratory examinations are expected to provide the necessary data to establish or confirm fuel conditioning process limits and support safety analysis. Sludge laboratory examinations include measurement of quantity and content, measurement of properties for equipment design and recovery processes, tank farm acceptance, 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 August 1995 and on the Multi-Year Program Plan.

8. RELEASE STAMP

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(2) Title

PLAN FOR CHARACTERIZATION OF K BASIN SPENT NUCLEAR FUEL AND SLUDGE

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	Authorized for Release (6) Cog. Mgr. Date
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PLAN FOR CHARACTERIZATION OF K BASIN SPENT NUCLEAR FUEL AND SLUDGE

L. A. Lawrence
S. C. Marschman

September 1995

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

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Date

SUMMARY

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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 Integrated Process Strategy (IPS) (WHC 1995a) scope and U.S. Department of Energy, Richland Office (RL) direction to proceed and implement the strategy (Hansen 1995a). To ensure the Characterization Plan supports the IPS, the current Characterization Plan (Lawrence 1995a) was re-examined and appropriate changes were made to be fully supportive of the new strategy.

The documents which provided input for this Characterization Program are the original accelerated Path Forward Scope and Schedule (Hansen 1995b) the Path Forward Recommendation (PFR) (Fulton 1994), 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 IPS (WHC 1995a). This plan addresses issues identified for the IPS based on several key assumptions concerning the implementation of the IPS, and is focused on obtaining data to address those issues within the schedular constraints of the IPS. These characterization activities must be integrated with the overall K Basin Operations and IPS schedules.

The specific details of the types and numbers 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 IPS and RL stakeholder input and will reflect the expanding understanding being obtained and the data being accumulated. Examinations will be based on the results of the preceding examinations and understanding.

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 (Abrefah 1994)

The characterization activities outlined in this plan are driven by the IPS schedule to begin transfer of fuel from the K Basins by December 1997 and begin conditioning by July 1998. The strategy 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 merges the IPS 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 qualitatively support several of the information needs exclusive of laboratory examinations (Table 1). In some cases, current modeling capabilities are considered to be adequate. 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. Data obtained in this program can be used to support the model and its applicability. Schedule and funding constraints dictate that the characterization activities focus on the areas of greatest uncertainty and risk to the successful completion of the IPS. Based on a review of the literature and from information gathered in technical exchanges, the information needs of greatest uncertainty for the IPS 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 are for unirradiated uranium or for oxide fuel, therefore they have limited applicability to this program. Process demonstration will not be feasible prior to process selection due to the limited time frame. Refinement of initial 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 (Hansen 1995b) showing Multiple Canister Overpack (MCO) loading beginning December 1997, and conditioning beginning July 1998, was the basis for planning the characterization activities. The scope of the characterization testing is to support packaging, transportation, process definition for conditioning, and material behavior under dry storage conditions. The program is structured to provide bounding behavior for the fuel and acceptability for the three different sludge disposal pathways.

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 project. This plan provides data to support the engineering decisions for the IPS (WHC 1995a).

The sludge sampling campaign began 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 original schedule called for disposition of this sludge late in the program (Fulton 1995). Revisions to the schedules for disposition of the K West floor and pit sludge in response to the IPS may dictate changes in these plans for sampling the K West floor and pit sludge.

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 IPS. To the extent possible, 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 THE INTEGRATED PROCESS STRATEGY

The IPS is summarized in Figure 1. The fuel in the open and closed canisters in K East and K West respectively, will be moved to a centralized work location within a confinement zone in the basin pool. Then, the fuel will be removed from the canisters, most likely cleaned, and loaded into a tier basket. Some canisters with highly corroded fuel or degraded canisters will be mechanically separated to remove the elements. Fuel requiring desludging will be subjected to a flushing based desludging operation with limited mechanical desludging as necessary. The tier baskets will be loaded and sealed in an MCO and the basin water will be drained from the MCO.

The second step involves a vacuum drying cycle to remove free water from the MCO. The MCOs will be shipped dry following completion of the vacuum drying process. It is anticipated that the MCO design will require the capability to monitor for hydrogen buildup and may require provisions for pressure relief.

The MCOs would be dry staged at the Container Storage Building (CSB) until the hot vacuum conditioning equipment is available. Cooling of the MCOs would be accomplished by natural convection and they would be monitored and continuously vented for hydrogen management during staging at the CSB.

The hot vacuum conditioning process consists of the following six steps:

1. Heat up to 300 °C while purging with pressurized helium for 24 hours.

2. Evacuate and hold for 48 hours at temperature.

3. Cool down to 150 °C with forced air cooling of the MCO exterior.

4. Oxidize the fuel surface by introducing He-O_2 mixtures for 24 hours.

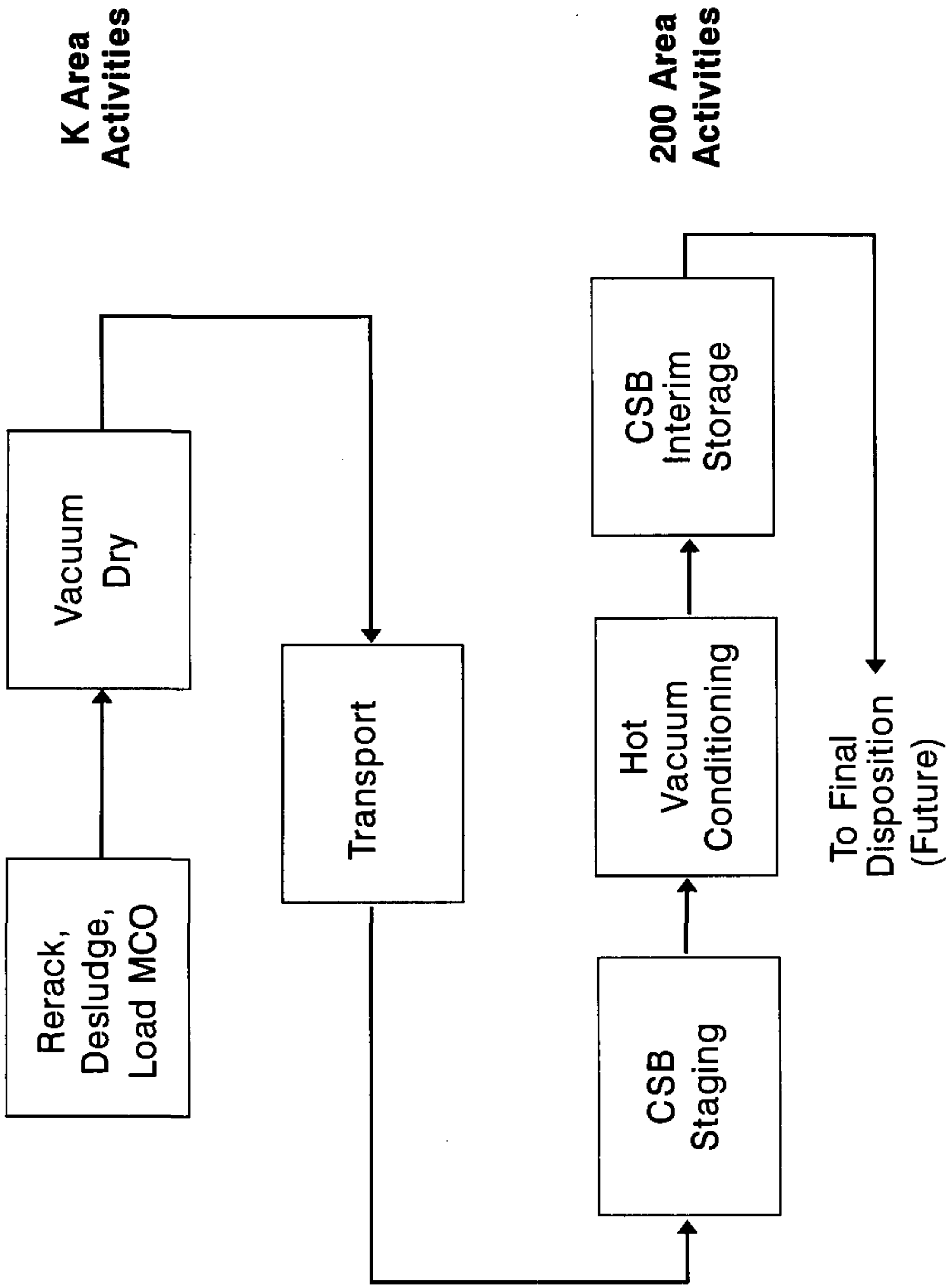
5. Inert with He and cool down to ambient temperatures over 8 to 16 hours.

6. Monitor for H_2 production rate during an initial storage period.

The MCOs will then be placed in interim storage in the CSB awaiting final disposition.

The RL approval of the IPS recommends limited conditioning of undamaged fuel and fully conditioning the degraded fuel in a single step process which would eliminate the need for staging and conditioning at the CSB (Hansen 1995a). The RL recommendation also suggests that active venting as a standard procedure for all the MCOs prior to conditioning may not be necessary.

Figure 1. Integrated Process Strategy for K Basin Fuel Removal.



3.1 BASIC ASSUMPTIONS FOR THE INTEGRATED PROCESS STRATEGY IMPLEMENTATION

The following basic assumptions were made concerning the implementation of the IPS. These assumptions were necessary to establish the basic issues to be addressed by the Characterization Program to support the IPS.

The basic assumptions are:

1. Fuel will be sorted by visual examination into the following three classifications during reracking.

   a. Visibly undamaged fuel with possible incipient failures.

   b. Intact failed fuel with some dimensional distortion and minimal fuel loss.

   c. Grossly failed fuel, fuel chips, and rubble.

2. Desludging is not 100% effective.

3. Independent fuel and sludge laboratory testing is representative of commingling for processing and storage.

4. Basin sludge will be transferred to the Double Shell Tanks (DSTs) for storage.

The first assumption recognizes the opportunity reracking provides for fuel sorting and possible reductions in the number of MCOs or volumes of fuel that needs to be conditioned. The RL approval of the IPS also identifies fuel segregation as an obvious technical consideration (Hansen 1995a).

The IPS recognizes that desludging will not be 100% effective, and has selected a target value of 25 grams of residual sludge or less per assembly as a performance specification (e.g., upper bound) (WHC 1995a).

The bulk of the testing will consider fuel and sludge separately however, some tests with commingled material may be conducted based on results of the independent tests and specific design questions to be answered for the IPS.

Canister and fuel desludging in the basin may eliminate the distinction between canister sludge and floor and pit sludge for the K East basin. The recommended pathway for K East floor, pit, and canister sludge is the DSTs. For K East this does not represent a change in the current strategy (Fulton 1995).

Canister and floor and pit sludge for K West may still be distinct depending upon where and how the desludging is conducted in K West. In the absence of any definition of the engineering for the desludging in K West the sampling and analysis of the K West floor and pit sludge will still be considered separately from the canister sludge or K East sludge. In the event that the IPS becomes more definitive on the disposition of the K West floor and pit sludge this plan may be revised to reflect any changes which may result.

3.2 BASIC ISSUES FOR THE INTEGRATED PROCESS STRATEGY IMPLEMENTATION

The following basic issues were identified for the implementation of the IPS based on the process strategy and the assumptions identified (Section 3.1). The basic issues identified to be addressed by this Characterization Plan are:

1. What are the criteria for classification of fuel condition during reracking?

2. What are the criteria on acceptable fuel condition for safe long term dry storage of the fuel in sealed containers?

3. What are the performance criteria for the fuel desludging process?

4. What are the acceptable methods to retrieve, process, and transport sludge?

5. What are the acceptance criteria for transfer of sludge to the DSTs?

If fuel is to be sorted during the reracking then it may be necessary to develop criteria based on the extent of damage, potential pyrophoric behavior, Cold Vacuum Drying (CVD) behavior, conditioning behavior, oxidation characteristics, and dry storage behavior. Results of selected examinations and experiments will be used to develop a criteria that can be implemented during sorting to assure that behavior during the various IPS process steps is within the safety bounds established.

In the case of long term dry storage the issues relate primarily to pressurization of the MCO and the need for venting. The thermal behavior of the material, and the resultant corrosive behavior, corresponding hydrogen evolution, release of moisture, and pyrophoricity are the specific issues of concern identified for long term dry storage. Radiolysis of the water present in the MCO will also contribute to the pressurization and hydrogen content.

For fuel desludging the main issue is the behavior of the sludge that will accompany the fuel in the MCO. The performance issues are essentially the same as for the first issue which dealt with fuel with the inclusion of moisture content of the sludge and its drying characteristics.

In the case of sludge retrieval and transport the issues are quantity of material to be physically handled, properties for equipment design and process development, radiological properties for operation and shielding consideration, radionuclide content for accountability, pyrophoricity, and data to support development of a representative simulant.

Issues for the acceptance of the sludge for transfer to the DSTs are very similar to those for retrieval and transport with the addition of the chemical constituents, and the potential for reactions which may be outside the safety envelope for the DSTs. The overriding issue for transfer of sludge to the DSTs is the pyrophoric potential of the material.

These five issues and the specific concerns of each are summarized in Table 2 along with the testing program constructed to address the issues. Places where the examinations provide essential or required input and areas where the examinations provide confirmation for a higher confidence level or system validation are identified on the table.

Each portion of the testing program will be discussed in detail in the following sections of this plan. What is planned or has already been completed, and how the data will be used to address the identified issues will be discussed for each series of measurements.

In addition to describing the overall and individual logistics of the plan, specific details of the measurements and how they relate to the engineering decisions to be made will be discussed in as much detail as possible. The plan is, however, somewhat evolutionary in that what is learned in the initial measurements in a specific part of the program will be used to focus the follow-on measurements and tests to support the parallel developments in the IPS engineering.

Technology issues were identified for the IPS as part of establishing the status of the technology (Puigh 1995). Eight general issues for resolution were defined. These eight issues shown in Table 3 are correlated with the five issues identified in this plan to be addressed by the characterization activities.

The Characterization Program outlined in this plan provides strong support for the first four issues identified for the IPS and provides limited data on criticality and materials accountability for the sludge and some information on canister particulate behavior. This plan does not provide data to address the issue of the MCO structural stability. This topic is outside the scope of this Characterization Plan. Similarly the Characterization Plan does not provide data to support the thermal performance analysis. Specific data could be provided to support the thermal performance code prediction that are within the scope and capabilities of the laboratory facilities. If specific tests are identified, they could be incorporated into the ongoing laboratory physical property measurements.

Table 2. Characterization Program and Issues for Integrated Process Strategy.

CHARACTERIZATION PROGRAM AND ISSUES FOR INTEGRATED PROCESS STRATEGY

TESTING PROGRAM	Classification of Fuel During Repacking					Safe Long Term Dry Storage				Fuel Desludging					Sludge Retrieval & Transport					Sludge Acceptance for Transfer to DST's				
	Fuel Damage in Intact Element	Energetic Reactions/ Pyrophoric Behavior	CVD Behavior	Conditioning Behavior	Dry Storage Behavior	Pyrophoric Behavior	Oxidation Behavior & H2 Evolution	Moisture Content	Thermal Behavior	Sludge Energetic Reactions	Sludge H2O Content	Sludge CVD Behavior	Sludge Conditioning Behavior	Sludge Dry Storage Behavior	Quantity	Physical Properties	Radiological/Radionuclides	Energetic Reactions/ Pyrophoricity	Simulant Development	Physical Properties	Radiological/Radionuclides	Endo & Exo Thermic Reactions	Pyrophoricity	Chemical Constituents
1. IN-SITU EXAMINATIONS																								
a. Boroscopic Exams	A														A									
b. Video During Fuel Selction, Handling	A														B	A								
c. Gas/Liquid Sampling	A																							
d. Sludge Volume	A														A	A	B			A	B			
2. FUEL LABORATORY EXAMINATIONS																								
a. Physical Condition	A					B																		
b. Hydride/Oxide Content	A	A	B	B	A	A	A	B	B	B														
c. Ignition Testing		A		A	A	A			A															
d. Conditioning Testing		A	A	A	A	B	B	A	B	B	A	A	A	B										
e. Oxidation Kentics		A	A	A	A	A	A	A	B															
f. Dry Storage Simulation		B	B	A	A	B	A	A	B				A	B										
3. SLUDGE LABORATORY EXAMINATIONS																								
a. Quantity/Composition	A						B	A			A				A	A	A		A	A	A	A		A
b. Physical Properties												A				A			A	A				A
c. Pyrophoricity						A	A	A		A			A	A				A					A	
d. Radiochemistry																	A				A			A
e. Conditioning Testing						A	B	A			A	A	A	A				A					A	
f. Dry Storage Simulation						A	A	A			A		A	A				A					A	

Key: A = Essential/Required Input
B = Confirmation -- for Higher Confidence Level and System Validation

CPIPS.WK3 26-Sep

Table 3. Connection of the Issues in this Characterization Plan to the Issues Identified for the Integrated Process Strategy.

IPS Technology Status Issues	Characterization Program Issues*				
	Classification of Fuel During Reracking	Safe Long Term Dry Storage	Fuel Desludging	Sludge Retrieval and Transport	Sludge Acceptance for Transfer to DSTs
Hydride Issues and Ignition	X	X	X	X	X
Chemical Corrosion	X	X	X	X	--
Hydrogen Generation	--	X	X	--	X
Vacuum Drying and Conditioning	X	X	X	X	--
Thermal Performance	--	--	--	--	--
Criticality Materials Accountability	--	--	--	X	X
Canister/Particulate Behavior	--	X	X	--	--
MCO Structural Integrity	--	--	--	--	--

*X = Characterization Program provides data to support the corresponding IPS issue.

4.0 FUEL CHARACTERIZATION

Fuel element characterization activities are divided into two main categories. They are in-situ characterization and laboratory examinations. 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 conditioning characteristics and oxidation kinetics to support 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

In-situ examinations include boroscopic examinations of the fuel elements in the basins, video recording during fuel selection and handling, sampling the gases and liquids in selected canisters, measuring canister sludge depth in the canisters, and measurements to estimate sludge volumes.

4.1.1 Boroscopic Examinations

Earlier activities in K East Basin with open canisters included a complete video survey of the fuel condition (Pitner 1995). 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 provide only qualitative information on the amount of sludge that may be in a canister (Section 4.1.4).

Examinations of both the open and closed canisters will be conducted in conjunction with the planned fuel shipments from the two basins to the hot cells for examinations.

The data from the boroscopic examinations combined with the video survey will define the extent of fuel damage in the K East basin and provide information on the extent of fuel damage. This information will be used in conjunction with laboratory visual examination to help establish criteria for classification of fuel during the repackaging.

4.1.2 Video During Fuel Selection and Handling

All operations during the fuel selection and handling operations for shipment of elements to the hot cells for examination will be recorded on video. Similarly all the sample collection activities for sludge are being recorded on video. In addition to providing an initial visual record of the appearance of the samples the video record provides data on such things as the water turbidity during the handling and movement.

Development of criteria for sorting of the fuel during the reracking operation will require information on the observable condition of the elements. The video operation provides operational data to support the development of the sorting criteria. The video also provides data on the physical properties of the sludge such as settling rates and indirectly sludge quantity.

4.1.3 Gas and Liquid Sampling Closed Canisters

Gas and liquid sampling of the closed canisters in K West is a prerequisite to canister selection and opening for fuel selection. A total of ten canisters were sampled for the first shipment from K West. The DQO prepared for the examinations identified the issues and decisions to be addressed by these measurements (Makenas 1995a).

1. Shipping for Examination: Several issues are connected with the shipping of fuel to the hot cells. Is the contamination level inside of closed canisters sufficient to cause unacceptable levels of radioactive species in the basin pool or adjacent air space when a limited number of specific canisters are opened for examination and shipping of fuel to Hanford hot cells? Will additional ion-exchange capacity be needed to mitigate the effects of the canister opening? Thus, liquid and possibly gas sampling will take place in conjunction with shipment of fuel to hot cells for examination. Sampling to address these issues will be for quantification of radioactive contaminants in the liquid (primarily) and gas (secondarily) of particular canisters with a decision made on which canisters will be opened to yield the best fuel specimens for hot cell examination.

2. Interim Storage and Associated Processing: How much fission gas, hydrogen, dissolved nuclides and sludge must be dealt with in the eventual shipping and processing of the K West Basin fuel when it is removed from the basin? Gas inventory may not be a problem for storage if the MCOs are vented. Another way to phrase this question is "how much corrosion of damaged fuel has taken place in the closed canisters?" since it is the corrosive process which gives rise to the release of fission products, the production of some hydrogen and the production of a nonadherent oxide (i.e., sludge). Both the gas and liquid samples will contribute understanding here.

Therefore, the primary use of the data from the gas and liquid sampling is to support the fuel selection for shipment to the hot cells, however, this along with the subsequent hot cell data will support the development of the criteria for classification of fuel during reracking.

4.1.4 Sludge Volume

The sludge volume in the basins is being estimated using depth measurements in the basin floor, pits, and canisters as well as estimates based on the volume of sludge collected during the sampling campaigns. Sludge depths were measured in the sand filter backwash pit and on the basin floor in K East using a ruler and a video camera (Baker 1995). Some measurements of sludge depth were also made in the K East Weasel Pit. Sludge volumes were estimated by curve fitting to the discrete points and integrating the area under the curves in these two areas. The sandfilter backwash pit in K West has been characterized for sludge depth.

An ultrasonic probe has been developed to measure the depth of the sludge in the canisters. The probe will be utilized during the fuel sampling campaigns in both K East and K West to measure sludge depth in the canisters selected for fuel sampling. There has been significant speculation as to the amount of sludge in the canisters since it is expected to contain a large percentage of corroded fuel compared to the sludge in the basin proper.

The K East floor and pit sludge sampling campaign also provides data on the volume of sludge within the basin. Sample locations were selected to be representative of the K East basin inventory.

The volume of sludge within the basins provides important data on the extent of fuel damage in the basins as well as the quantities and physical properties of the sludge to be retrieved, transported, and accepted at the DSTs for storage (Table 2). The sludge volume also provides data, to a lesser degree, on the radiological and radionuclide inventories.

4.2 LABORATORY EXAMINATIONS

Fuel was selected from the K West closed canisters to provide information on bounding conditions on the fuel state for MCO packaging and 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 drying and conditioning is breached cladding. Cladding breaches provide a pathway for uranium/water corrosion. 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 (Lawrence 1995b). 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 irradiation history, storage mode, 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 IPS decisions identified in Table 2.

4.2.1 Physical Condition

Visual examinations, photography, dimensional characterization, and density will establish the physical condition of the material transferred to the hot cells for detailed examinations and testing. The initial removal from the water and exposure to cell atmosphere, which will generally be air, and sample sectioning will be recorded on video.

All fuel samples transferred to the hot cells will be visually examined and photographed to record their as received physical condition. Dimensional and density measurements will be utilized where appropriate to provide further characterization of the sample as needed.

Laboratory examinations will provide the detail of the physical conditions which, when combined with the behavior of these fuel elements in terms of pyrophoricity, CVD, conditioning, and dry storage, will be the basis for the development of a sorting criteria for the fuel during reracking. The sorting criteria will most likely be based on the operators under water visual observation of each element and an understanding of how the particular fuel behaves under the IPS process conditions.

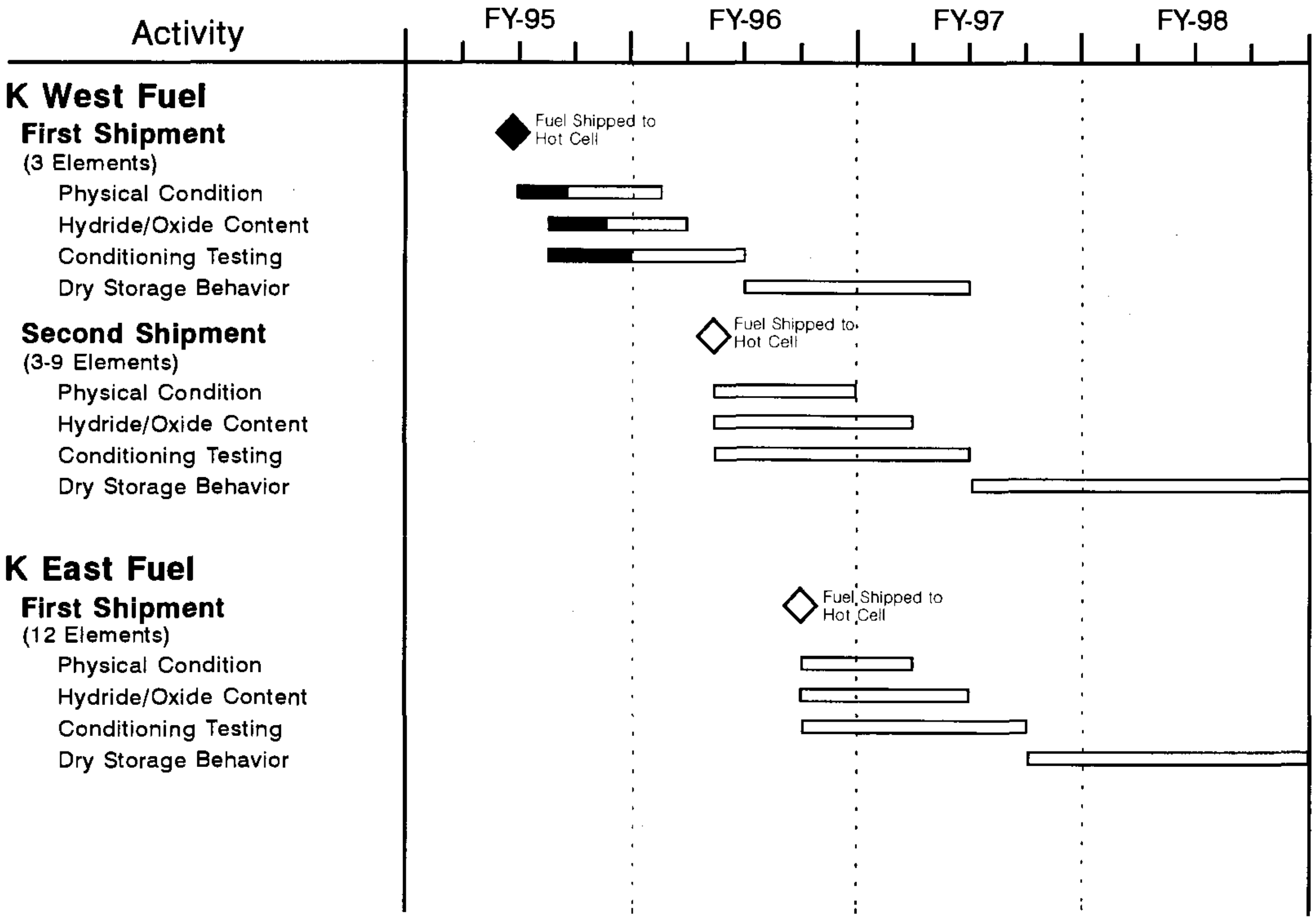


Figure 2. Schedule for Spent Nuclear Fuel Characterization Activities.

4.2.2 Hydride and Oxide Content

The hydride content and oxide on the exposed fuel surfaces and cracks will be established with optical metallography. These two chemical characteristics of the fuel are of most interest to the IPS 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.

Samples will be selected for metallographic examinations from the complete inventory rather than from each element examined 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.

4.2.3 Ignition Testing

Fuel samples will be exposed to temperatures in excess of 300 °C under oxidizing atmospheres to determine the sets of conditions for which the N Reactor fuel will ignite. The initial testing will be with samples from the undegraded fuel matrix to establish a baseline for the bulk of the material stored within the basins. Samples which have been subjected to the IPS drying and conditioning cycle will be tested to establish the effects of the conditioning process.

Samples for ignition testing will also be selected from the complete inventory. This provides a pool of samples from which to select the samples with the highest priority for the project decisions as well as support for characterization testing efforts.

Ignition testing provides direct data on the pyrophoric behavior of the material as well as the effects of the conditioning and projected dry storage behavior. Ignition testing also supports the determinations of thermal behavior for the material for safe long term dry storage and safety analysis (Table 2).

4.2.4 Conditioning Testing

Fuel samples will be subjected to the CVD and Hot Vacuum Conditioning (HVC) to establish the materials response to the proposed conditioning process. One of the main technical uncertainties for the IPS is the fuel and corrosion product drying and conditioning behavior as a function of time, temperature, gas composition, and pressure. The test matrix summarized in Table 4 identifies the general testing strategy for the samples in support of the IPS. Initial testing with the ITA process with fuel samples from the undamaged portion of the first fuel element examined will be discontinued and all future testing will focus on the IPS process.

Table 4. Testing Matrix for Conditioning.

Test Series	Sample Configuration	Test Conditions	Issues Addressed
I	Undamaged interior fuel samples	IPS process	Baseline data on bulk fuel behavior
II	Small samples from degraded end of K West fuel (1st shipment)	IPS process	Drying/conditioning degraded fuel
III	Small samples from degraded ends of K West fuel (2nd shipment)	IPS process - Parametric tests of time, temperature pressure, gas composition	Optimizing fuel response end product for dry storage
IV	Large samples (whole ends) from degraded K West fuel (2nd shipment)	IPS process - Selected process parameters	Large samples response to selected process
V	Small and large samples from degraded ends K East fuel	IPS process - Selected process parameters	Possible differences in population behavior between basins
VI	Large samples from degraded ends K East and K West fuel	IPS process	Process design confirmation

The initial test series with undamaged internal fuel samples from the first shipment from K West is nearing completion and testing of small samples from the degraded ends of the elements from the first shipment from K West are scheduled to begin in the first quarter of FY 1996 (Figure 2). The testing is planned to proceed through a series of tests to select or define the process parameters of time, temperature, gas composition, and pressure with samples from the second K West fuel shipment. The three elements from the first shipment are insufficient to conduct any meaningful parametric tests.

The final three series of tests will involve complete ends of the degraded elements in the controlled atmosphere furnace. In Series V with K East fuel smaller samples may be tested in the furnace and the TGA system to evaluate differences in response which may be traced to different storage histories or other fuel parameters not adequately addressed in the fuel samples from the second shipment from K West. 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.

Conditioning testing provides required input for most of the categories for the three issues identified for the IPS that involve fuel (Table 2). The fuel materials response to the proposed drying and conditioning processes initially proposed by the ITA and now modified for the IPS has been a major uncertainty and design issue in the program.

4.2.5 Oxidation Kinetics

Oxidation rate data will be obtained for the irradiated N Reactor material using a Thermo Gravimetric Analysis/Differential Scanning Caliometer/Mass Spectrometer (TGA/DSC/MS) System in a special shielded glove box facility in the laboratory. The rate constants will be established for selected small fuel samples as a function of temperature and combinations of air and moisture content.

The rate constants are central to conditioning process definition and safety analysis. Currently literature data for unirradiated uranium metal is being used for the calculations multiplied by a conservative factor of 10X to 100X to account for the uncertainties in actual irradiated N Reactor fuel behavior (Puigh 1995). The TGA/DSC/MS System measurements will compliment and augment the conditioning testing in the controlled temperature and atmosphere furnace with large samples in the hot cell.

Reductions in the factors applied to the rate constants for the process design and safety analysis can result in significant benefits in process times and system capabilities in case of postulated air ingress accidents.

Testing will be closely coupled to the sample preparation schedule for the conditioning furnace since samples will be prepared for the TGA/DSC/MS System concurrent with sectioning for condition tests and metallography samples.

Sample throughput for the TGA/DSC/MS System will be faster then the conditioning furnace due to the duration of the test cycle, i.e., hours for the TGA compared to days for the conditioning furnace, and the ease of operations in a glove box compared to the hot cell.

4.2.6 Dry Storage Simulation

The dry storage simulation tests will envelope the CSB parameters and will utilize samples prepared as part of the conditioning testing. Large whole end samples from Series IV, V, and VI will be utilized for the testing to represent the conditions with a MCO as much as possible (Table 4).

Development of the testing capability and initiation of testing is scheduled to begin in FY 1997 (Figure 2). It may be possible to prepare a test environment capable of containing more than one of the large conditioned samples thereby providing a large volume of material to monitor. The dry storage simulation will generally provide confirmatory data for the MCO, process, and CSB designs due to the program schedules. However, testing may provide data to support modifications to the storage conditions possible within the CSB design parameters. The specific questions to be addressed by the dry storage simulation will be developed in the DQOs for the specific test series.

5.0 SLUDGE CHARACTERIZATION

Sludge characterization (exclusive of overall volume definition) is divided into sampling and laboratory examinations. Sampling is divided into three main categories which reflect the major types of sludge present. 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 sludge in the canisters. K West floor sludge is likely to consist primarily of dust, insects, and sand that has been deposited on the basin floor since the facility was refurbished and restored.

Different pathways have been tentatively identified for the disposal of the materials (Fulton 1995). K East floor and pit sludge will be removed and shipped to the Double Shell Tanks (DSTs) for storage and ultimate disposal. The sludge in the closed canisters in K West and the open canisters in K East will likewise be separated from the fuel and sent to the DSTs for storage. K West floor and pit sludge due to its expected composition, content, and volume was to be removed and handled as radioactive solid waste. The IPS plans to desludge the fuel in the basins may change this strategy for the K West floor and pit sludge. However, in the absence of detailed engineering for the K West sludge, the floor and pit sludge sampling will be considered separately from the canister sludge consistent with the initial version of the Characterization Plan. Characterization activities were identified which support these three proposed pathways for the sludge material. The sludge characterization activities are summarized in (Figure 3).

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 SLUDGE SAMPLING

5.1.1 K East Floor and Pit Sludge

A major floor and pit sludge sampling activity for K East was conducted in late FY 1995 to obtain representative samples (Figure 3). Sample analysis will focus on equipment design parameters and verification of the acceptability of the material for transfer to the DSTs for storage and ultimate disposal. Sludge was removed from the Basin floor, and from the Basin Weasel Pit for analysis. The specific sample locations and numbers and laboratory analyses are in the DQO (Makenas 1995b) and SAP (Welsh 1995) for the sampling activities. Sampling of floor sludge in the K East Basin was independent of the fuel shipping campaigns.

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.

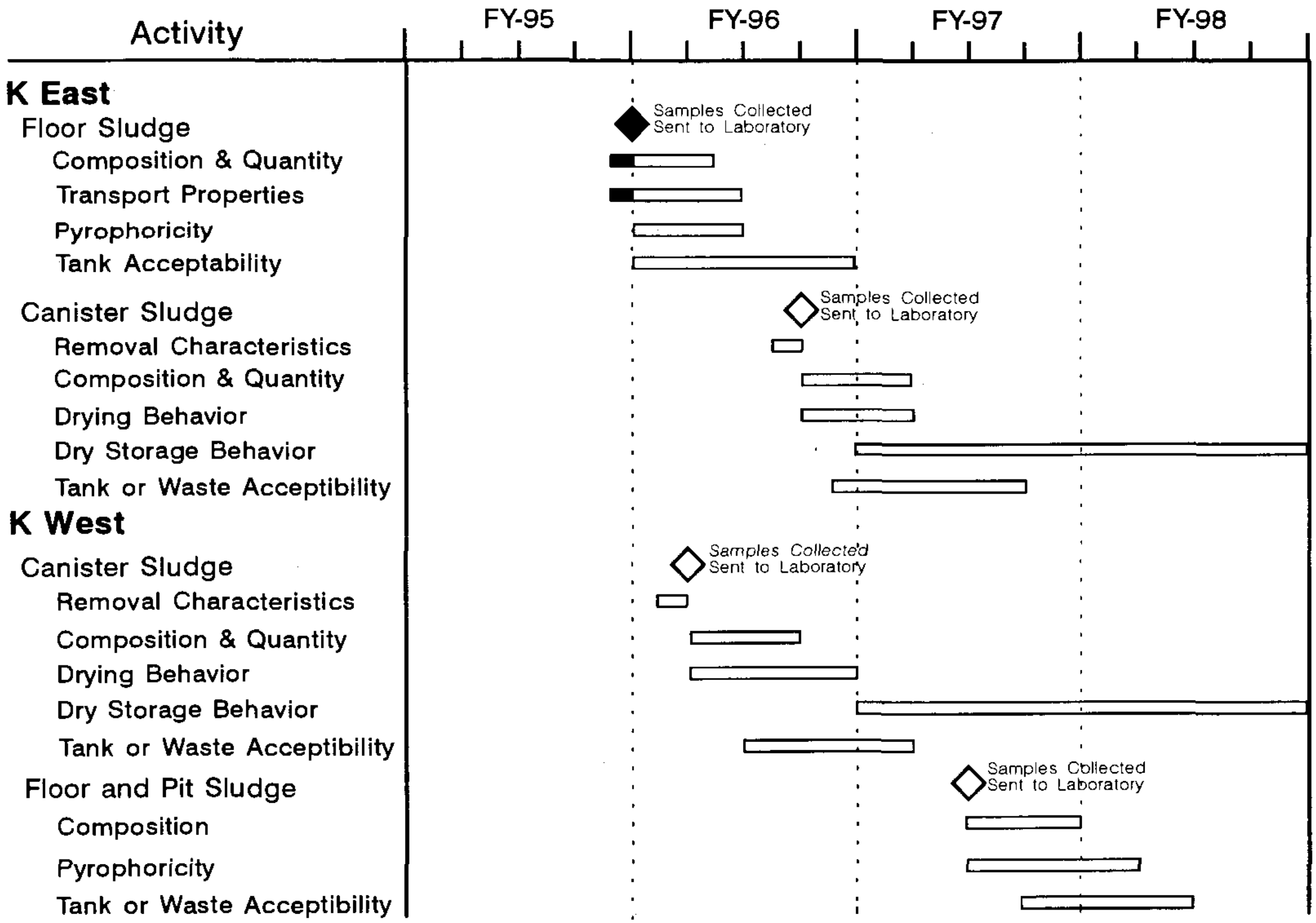


Figure 3. Schedule for Spent Nuclear Fuel Sludge Characterization Activities.

5.1.2 Canister Sludge

The sludge present in the canisters is expected to contain fuel corrosion products. Canister sludge drying and conditioning data are considered to be critical items to the demonstration of the adequacy of the IPS (Miska 1995). 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.

5.1.3 K West Floor and Pit Sludge

K West floor and pit sludge is scheduled to be sampled in FY 1997 consistent with the initial version of the Characterization Plan and the original recommended Path Forward for sludge (Fulton 1995). Sampling will utilize the equipment and procedures developed for the K East floor and pit sludge sampling activities.

5.2 SLUDGE LABORATORY EXAMINATIONS

Sludge characterization activities will be conducted to obtain the following data: 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 analytical laboratories, i.e., 325 Building and 222-S, which are capable of handling and examining the particular material.

5.2.1 Quantity and Composition

The amount and composition of the sludge collected will be measured. The amount of sludge may dictate the disposal pathway selected for the material. Analyses of the composition are required to support acceptance for the DSTs or for solid waste or to address general hazardous materials concerns.

The quantity and composition of the sludge collected provides data on the fuel damage and moisture contents for desludging and long term storage in addition to supporting most of the categories associated with sludge retrieval, transport, and acceptance for transfer to the DSTs. Specific constituents to measure will be identified in the DQOs for the specific sampling activity.

5.2.2 Physical Properties

Sludge physical properties such as particle size, density, viscosity, settling rate, etc., will be measured utilizing routine laboratory techniques. The physical properties are important input for the design and selection of equipment to retrieve, handle, and transport the sludge. For example, pumps must be chosen to handle the viscosity of the sludge, and filters must be selected based on particle size and settling rates. Physical properties are also necessary to establish DST acceptability and for development of a simulant. Simulants will be used to test sludge handling equipment or to adjudicate a competition between vendors who propose systems for sludge retrieval and handling.

5.2.3 Ignition Testing

Pyrophoricity is a safety issue for sludge retrieval and transport and for acceptance at the DSTs. The pyrophoricity issue for K East floor sludge is being addressed by X-Ray diffraction measurements for hydrides and metal. Ignition temperatures of the sludge may be measured. Samples may be measured in the system developed for the fuel or a similar system in the chemistry laboratories to take advantage of different laboratory capabilities to meet program schedules (Figure 3).

Safe long term storage of the material that will accompany the fuel in the MCO requires data on the ignition characteristics of the sludge since desludging is assumed to be less then 100% effective (Table 2). Sludge represents a unique problem for modeling ignition behavior since current efforts are focused on fuel elements. Models are demonstrating that exposed fuel surface area, extent of hydride, oxide etc., are primary input parameters to these models. In the case of sludge laboratory measurement of representative samples may be the only way to adequately predict behavior.

5.2.4 Radiochemistry

Radionuclide content and the radiological properties of the sludge will be measured. Measurements will indicate uranium, plutonium, americium, neptunium, europium, and cesium isotopic contents and total beta/gamma and alpha radiation levels. Fissile and fission product content are necessary for material accountability, criticality calculations, and process shielding considerations. Nondestructive techniques such as gamma scanning may be utilized at the collection site to measure some of the radionuclides, as well as determine radiation levels. Samples may also be evaluated at the analytical laboratory subject to the logistics of the sampling, schedule, and cost considerations.

5.2.5 Conditioning Testing

Canister sludge samples will be dried and subjected to the conditioning process since a small fraction of the canister sludge is expected to accompany the fuel in the MCOs to the CSB. Measurements may be conducted in the laboratory or in the controlled atmosphere furnace in the hot cell. The TGA system may be utilized for these measurements if feasible based on schedule and cost considerations. These tests will address similar concern and issues identified for conditioning testing fuel samples for safe long term dry storage (Section 4.2.4).

5.2.6 Dry Storage Simulation

The dry storage simulation tests will envelop the CSB parameters in a similar manner to the corresponding tests for fuel elements (Section 4.2.5). These tests are again based on the assumption that a small fraction of sludge will accompany the fuel in the MCOs to the CSB.

Development of the testing capability will in general be on the same schedule as for the fuel elements. Specific questions to be addressed by these tests will be developed in the DQOs for the specific test series.

6.0 DOCUMENT HIERARCHY FOR CHARACTERIZATION

The WHC and PNL document hierarchy for the SNF Characterization activities is summarized in Table 5. A Program Management Plan jointly authored by WHC and PNL defines the roles and responsibilities for Characterization (WHC 1995b). 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 (DQOs) 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 and by WHC for 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 5. 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 integrated Process Strategy	WHC and PNL
Data Quality Objectives	Documents DQO process for specific characterization activities	WHC
Test Plans, Test Instructions, and Sample Analysis Plans	Detailed testing requirements and plans to implement the corresponding DQO	PNL, WHC*
Reports	Data reports and evaluations and interpretation of the data	WHC, PNL**

*PNL for laboratory examinations and WHC for in-situ examinations.
**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 Quality Assurance for the characterization activities and data management will be in full compliance with the QA plans and requirements of the Office of Civilian Radioactive Waste Management (OCRWM), "Quality Assurance Requirements and Description (QARD)," RW-0333P, (Sellers 1995).

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.

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 current schedules for fuel conditioning are revised and or the recommendations for the sludge are 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. 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 4).

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 6). 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 August 1995 were obtained and used as the basis for projecting future costs consistent with the outlined work, cost estimate, scope and program schedules in the Multi Year Program Plan for characterization. The proposed Characterization Program budget for a projected 4 year program is summarized in Table 7.

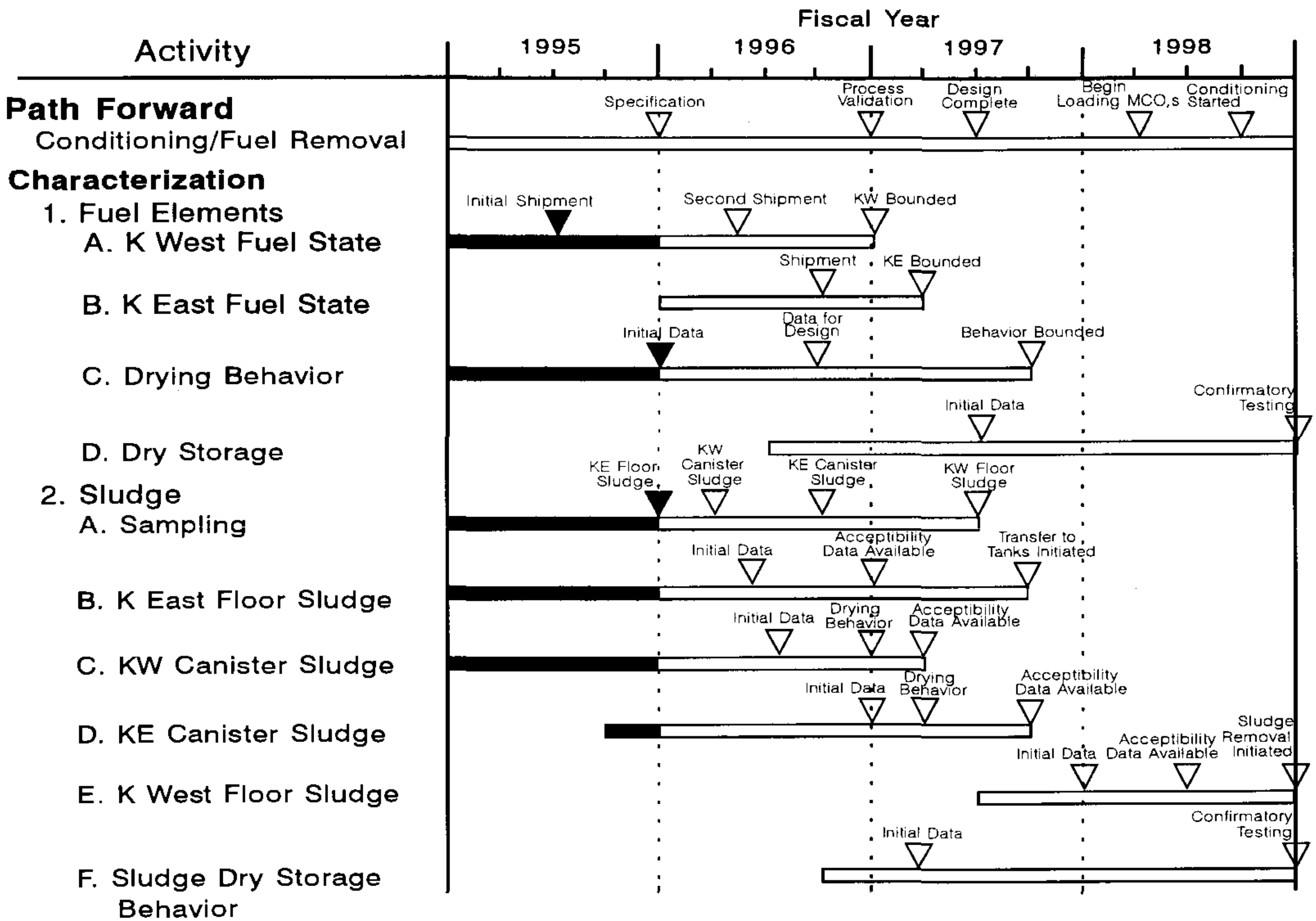


Figure 4. Overall Characterization Schedule for K Basin Fuel and Sludge Supporting the Accelerated Path Forward.

Table 6. 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	February 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	February 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 Complete K East floor/pit sample laboratory examinations	December 1995
	3.3 K West canister sludge samples sent to laboratory	February 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 7. Spent Nuclear Fuel Characterization Program Budget.

Activity	Funding Requirement ($1,000)*			
	FY 1995	FY 1996	FY 1997	FY 1998
WHC				
In-situ visual	275	250	0	0
Gas/liquid sampling	725	530	0	0
Shipping	1,800	1,450	0	0
DQOs and program direction	500	400	400	500
Sludge	1,000	2,020	1,500	1,000
Technical support, analysis, and documentation	500	835	945	1,500
Subtotal	4,800	5,485	2,845	3,000
PNL				
Hot cell preparation	1,635	150	0	0
Hot cell examinations	950	1,800	2,325	1,500
Technical support	1,010	1,120	1,250	1,000
Subtotal	3,595	3,070	3,575	2,500
TOTAL	8,395	8,555	6,420	5,200

*Constant FY 1995 dollars.

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, 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 August 1995. If the data projected to be available within the schedule of this plan is considered to be too limited to support IPS 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.

9.0 REFERENCES

Abrefah, J., 1994, "Characterization Plan for Hanford Spent Nuclear Fuel," PNL 10210, Rev. 0, December 1994.

Baker, R. B., "Summary Status of K Basins Sludge Characterization," WHC-SD-SNF-TI-006, Rev. 0, January 1995.

Fulton, J. C., 1994, "Hanford Spent Nuclear Fuel Project Recommended Path Forward," WHC-EF-0830, October 1994.

Fulton, J. C., 1995, Letter to C. A. Hansen, "K Basins Sludge Disposition Strategy," 9552284, April 24, 1995.

Hansen, C. A., 1995a, Letter to A. L. Trego, "Approval of Spent Nuclear Fuel (SNF) Path Forward Recommendation," 95-SFD-132, dated July 31, 1995.

Hansen, C. A., 1995b, Letter to A. L. Trego, "Approval of Spent Nuclear Fuel (SNF) Path Forward Recommendation," 95-AMW-003, dated February 14, 1995.

Independent Technical Assessment, "1994 Dry Storage of N Reactor Fuel," Volume 1, September 1994.

Lawrence, L. A. 1994, "Spent Nuclear Fuels Project Characterization Data Quality Objectives Strategy," WHC-EP-0795, dated December 1994.

Lawrence, L. A. 1995a, "Plan for Characterization of K Basin Spent Nuclear Fuel and Sludge," WHC-SD-SNF-PLN-007, Rev. 0, dated June 1995.

Lawrence, L. A. 1995b, "Data Quality Objectives for the Initial K West Fuel Examinations," WHC-SD-SNF-DQO-001, Rev. 0, dated February 1995.

Makenas, B. J., 1995a, "Data Quality Objectives for Gas and Liquid Samples from Sealed K Basin Canisters," WHC-SD-SNF-DQO-003, Rev. 0, dated February 1995.

Makenas, B. J. 1995b, "Data Quality Objectives for K East Basin Floor and Weasel Pit Sludge Sampling," WHC-SD-SNF-DQO-005, Rev. 0, dated May 1995.

Miska, C. R., cc:Mail to L. A. Lawrence, "Comments to Characterization Plan," WHC, September 22, 1995.

Pitner, A. L., 1995, "K East Basin Underwater Visual Fuel Survey," WHC-SD-SNF-TI-012, Rev. 0, February 1995.

PNL, 1994, "QA Plan Number ETC-011, for Hanford Spent Nuclear Fuel Technical Support Project," ETC-011, dated December 1994.

Puigh, R. J., et al., 1995, "Technology Status in Support of Refined Technical Baseline for the Spent Nuclear Fuel Project," WHC-SD-SNF-TI-014, Rev. 0, July 7, 1995.

9.0 REFERENCES (continued)

Scott, J. L., "Final Draft of the Technology Acquisition Plan," dated February 10, 1995.

Sellers, E. D., 1995, Letter to President of Westinghouse Hanford Company, "Office of Civilian Radioactive Waste Management (OCRWM)," Quality Assurance Requirement and Description (QARD), RW-033P, 95-SFD-098, dated July 12, 1995.

Smith, D. W., 1995, Letter to R. P. Omberg, DOE/RW 0333P, Review for K Basins Fuel Characterization," SNF-PQA-95-002, dated March 9, 1995.

Welsh, T. L., 1995, "Sampling and Analysis Plan for Floor Sludge of the 105-K East Main Basin and Weasel Pit," WHC-SD-SNF-PLN-006, Rev. 0, dated August 1995.

WHC, 1995a, "Integrated Process Strategy for K Basins Spent Nuclear Fuel, Volume 1: Strategy and Recommendations," WHC-SD-SNF-SP-005, Rev. 0, July 1995.

WHC, 1995b, "Characterization Program Management Plan for Hanford K Basin Spent Nuclear Fuel," WHC-SD-SNF-SP-010, Rev. 0, August 1995.