

# ORIGINAL

HNF-EDC- 04 - 19825

Page 1 of 2

## ENGINEERING DOCUMENT CHANGE CONTROL

### Change Identification

## 1. Category:

☐ Direct Revision ☐ Supplemental Change ☐ Page Change  
☐ Supersedure ☐ Cancel/Void ☒ New

## 2. Classification of Change, or if New, CB?

\* ☒ Major ☐ Minor ☐ Conf Baseline (CB)

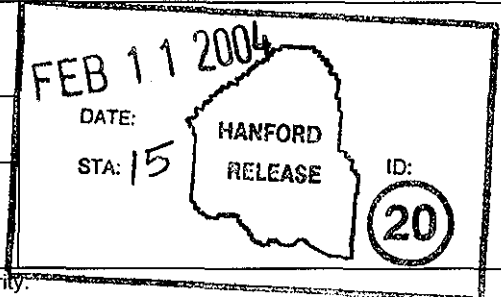
## 3. Date:

2/4/04

## 4. Originator's Name, Organization, MSIN, and Telephone No.:

MJ Schliebe, Fluor Hanford, H8-25, 376-1472

## 21. Release:



## 5. USQ Required?

USQ No.:

☐ Yes ☒ No

CX No.:

## 6. Technical Authority:

C. A. Petersen per 2/10

## 7. Project/Program (WMP, FFTF, etc.):

SNF

## 8. Area:

100K

## 9. Building:

105KE

## 10. Reviewer Designator:

\* N/A

## 11. Plan:

Release of <sup>S</sup>ANF-19690, Revision 0jda  
2/10

## 12. Criteria:

N/A

## 13. Change or Document Description:

New document being released to Hanford Document Control System.

## 14. Documents Issued or Changed by this EDC:

Document	Page	Revision	Document Title or Comments
<sup>S</sup> ANF-19690 jda 2/10		0	KE Sludge Consolidation Process Description

## 15. Technical Justification (Need):

New document being released to Hanford Document Control System.

### Evaluation and Coordination

## 16. Change or Document Impact:

\* N/A

## 17. Affected Documents:

Document Number	Page	Revision	Person Notified/Comments
* N/A			

\* per telecon w/ M.J. Schliebe & D.S. McShane, 2/10/04 - J. Aardal/Sta. 15

# ORIGINAL

HNF-EDC- 04 - 19825

Page 2 of 2

**ENGINEERING DOCUMENT CHANGE CONTROL (continued)****Verification**

## 18. Verification:

Peer review by FH Project Operations Center.

## 19. Approvals/Reviews:

Initials, Last Name, Date, MSIN	Initials, Last Name, Date, MSIN
Technical Authority: CA Petersen <i>Chris C. Petersen</i> 2/9/04	Technical Authority Manager: MJ Schliebe <i>MJ Schliebe</i> 2/9/04
Reviewer (Title): Process Engineer EF Krohn <i>MJ Schliebe for (per telcom)</i> 2/10/04	Reviewer (Title): Process Engineer CR Miska <i>MJ Schliebe for (per telcom)</i> 2/10/04
Reviewer (Title): Process Engineer GL Dunford <i>GL Dunford</i> 2/6/04	Reviewer (Title):

**Solution**

## 20. Change Description (Solution) - Continuation Sheet:

# KE Basin Sludge Consolidation Process Description

Prepared for the U.S. Department of Energy  
Assistant Secretary for Environmental Management

## **Fluor Hanford**

P.O. Box 1000  
Richland, Washington

Contractor for the U.S. Department of Energy  
Richland Operations Office under Contract DE-AC06-96RL13200

Approved for Public Release  
(Upon receipt of Clearance approval)  
Further Dissemination Unlimited

# KE Basin Sludge Consolidation Process Description

Michael Schliebe, Fluor Hanford  
Ned Krohn, Fluor Hanford  
Gary Dunford, AEM Consulting

Chris Petersen, Fluor Hanford  
Curtis Miska, Fluor Hanford

February 2004

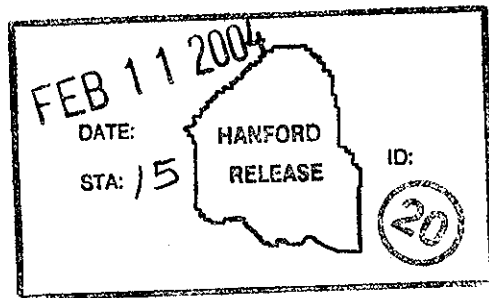
Prepared for the U.S. Department of Energy  
Assistant Secretary for Environmental Management

## Fluor Hanford

P.O. Box 1000  
Richland, Washington

Contractor for the U.S. Department of Energy  
Richland Operations Office under Contract DE-AC06-96RL13200

Jarvis Alardal 2-11-04  
Clearance Approval Date



Release Approval (stamp)

Approved for Public Release  
(Upon receipt of Clearance approval)  
Further Dissemination Unlimited

For use with Technical Documents (when appropriate)	
EDC-	FMP-
EDT-	ECN-
Project No.:	Division: SNF
Document Type: ES	Page Count: 46

For use with Speeches, Articles, or Presentations (when appropriate)			
Abstract	Summary	Full Paper	Visual Aid
Conference Name:			
Conference Date:			
Conference Location:			
Conference Sponsor:			
Published in:			
Publication Date:			

#### LEGAL DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Scientific or technical information is available to U.S. Government and U.S. Government contractor personnel through the Office of Scientific and Technical Information (OSTI). It is available to others through the National Technical Information Service (NTIS).

This report has been reproduced from the best available copy.

Printed in the United States of America

**TABLE OF CONTENTS**

1	Introduction .....	1
2	Summary .....	1
3	Background .....	2
3.1	Facility Description .....	2
3.2	Sludge Description .....	3
4	Approach and Requirements .....	4
4.1	Requirements .....	4
4.2	Assumptions and Risks.....	4
4.3	Functions .....	5
5	Functional Breakdown .....	5
6	Process Options/Selection.....	7
6.1	Prepare Basin.....	7
6.2	Retrieve and Transfer Sludge .....	8
6.3	Deposit Sludge in Container.....	9
7	Process Description.....	11
7.1	Prepare Basin and Install Liners.....	11
7.2	Prepare Weasel Pit and Install Liner .....	12
7.3	Prepare Bays for Retrieval.....	12
7.4	Retrieve Sludge from Bays.....	13
8	References .....	16
	Appendix A. Requirements and Assumptions.....	17
	Appendix B. Risk Management.....	20
	Appendix C. Interface Management .....	22
	Appendix D. Supporting Information.....	23

**ABBREVIATIONS/ACRONYMS**

ALARA	as low as reasonably achievable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
D&D	decontamination and decommissioning
DOE	U. S. Department of Energy
EPC	engineering, procurement, and construction
EPA	U. S. Environmental Protection Agency
FFD	functional flow diagram
FTS	Fuel Transfer System
IXM	ion-exchange module
KE	K East (Area)
KW	K West (Area)
LDC	large diameter sludge container
MCO	multi-canister overpack
OTP	operational test procedure
NLOP	North Loadout pit
PFD	process flow diagram
PLC	programmable logic controller
PNNL	Pacific Northwest National Laboratory
RL	U. S. Department of Energy, Richland Operations Office
SLOP	South Loadout pit
SNF	spent nuclear fuel
SWS	Sludge and Water System
TPA	Tri-Party Agreement (Hanford Federal Facility Agreement and Consent Order)
TRU	transuranic (radionuclides)
USQ	unreviewed safety question
WAC	waste acceptance criteria

## 1 Introduction

Spent nuclear fuel in canisters has been stored under water in the K-reactor fuel storage basins (K Basins) for more than 40 years. Over time, corrosion products from the degrading fuel rods, storage rack rust, concrete from pool walls, and environmental particulates have accumulated as sludge in fuel canisters, on the floors, and in the pits of the K Basins.

The spent nuclear fuel and sludge release soluble fission products into the basin water. The potential exists for basin water and/or sludge to leak into the environment because of the age and condition of the basins. This potential hazard provides the impetus for removing spent nuclear fuel and sludge from the basins as soon as possible.

The Fuel Transfer System (FTS) is moving the K East (KE) fuel canisters to K West (KW) for packing in multi-canister overpacks (MCOs). The KE sludge has two disposition paths; the sludge in the North Loadout pit (NLOP) will be transferred in large diameter sludge containers (LDCs) to the 325 Building for treatment as contact-handled transuranic (CH-TRU) waste and the remainder of the sludge will be consolidated in a liner(s) in KE for future treatment. Sludge containerization was directed by the U. S. Department of Energy, Richland Operations Office (RL) (Klein 2003) and allows decontamination and decommissioning (D&D) activities to progress.

This document identifies process requirements, assumptions, functions, and recommends architecture to complete KE sludge consolidation. Included are a process description and potential risks and interfaces to be managed at KE to consolidate the sludge.

## 2 Summary

The following design concept was selected based on the process requirements, functions, and assumptions developed. Three pit locations (both Tech View pit channels and the Weasel pit) were selected to receive a rigid liner to consolidate the sludge. A fourth location (the Weasel pit channel) was identified as contingency volume pending detail design of the liners. Rigid and free-standing pit liners were selected so the liners do not interface with the pits walls and potentially compromise the safety function of the pit walls.

The sludge will be retrieved using a combination of portable Tri-Nuclear pump(s) and (once NLOP work is completed) the Sludge and Water System (SWS) equipment. A screen/strainer will be used to remove particles greater than 1/4 in. from the sludge and this larger material will be moved to the dummy elevator pit for the FTS to transfer to KW for disposition.

Sludge consolidation is expected to require the addition of flocculants to aid in its settling and support basin water quality requirements. The flocculants will be added and mixed with the sludge just prior to its discharge into the liners. Discharging to multiple liner locations will be used to reduce velocities and therefore improve settling.



Programmatic risks were identified for the sludge consolidation and the following near-term actions are recommended:

- Confirm that the design concept is consistent with the current Authorization Basis
- Confirm flocculant addition conditions and rates
- Define end points (or how clean is clean)
- Develop an integrated schedule for KE Basin, including resources and floor space needs

### **3 Background**

KE Basin was constructed in the early 1950s. It has been used to store N Reactor spent nuclear fuel since 1975 and single-pass reactor spent nuclear fuel for much longer. A significant fraction of spent nuclear fuel in the K Basins is degraded because of cladding breaches caused during reactor discharge and corrosion during underwater storage.

Fuel in KE Basin is stored in open-top canisters. Some canisters have closed bottoms, while others have screened bottoms. The screened bottoms allow pieces of spent nuclear fuel and fuel corrosion products to combine with sludge below the canister on the basin bottom. To differentiate spent nuclear fuel from sludge, any material that will pass through a 1/4-in. screen is defined as sludge.

The KE sludge stream includes floor, pit, and canister sludge. This sludge primarily consists of iron and aluminum corrosion products from degrading fuel rods, uranium oxides, ion-exchange resin beads, canister rack rust, environmental particulates (windblown sand, rocks and organic debris), and spalled concrete from the basin walls.

#### **3.1 Facility Description**

KE Basin is 125-ft long by 67-ft wide and is divided into three, approximately equally sized bays, with several pits located to the east and west of the main basin. The dividing walls between bays are cantilevered from the floor and do not tie into the outer walls. A 38-in. gap exists on each end of the dividing walls between the dividers and the outer walls to allow for a pathway between bays. Figure 3-1 provides a schematic diagram of KE Basin.

The basins are covered with a grating system suspended from the superstructure. An overhead monorail system is used to support equipment in the basin. Cables can be run from the monorail to the basin through slots in the grating.

Each basin is 21-ft deep, and the water depth is maintained at approximately 16 ft. The basin floors are covered with a rack system to hold the fuel canisters. These racks are constructed of angle iron and pipe. The tops of the racks are 19 in. above the basin floor. The racks contain a matrix of 12-in. by 20-in. openings to hold the fuel canisters in a vertical position.

Six pits and the inactive fuel discharge chute are located around the perimeter of KE Basin. Barrier doors at the NLOP, discharge chute, Tech View pit, and Weasel pit can isolate the pits from the main basin area. The South Loadout pit (SLOP) and the

discharge chute do not contain any significant sludge. The quantity of sludge to be consolidated is nominally  $36 \text{ m}^3$  (bound value is  $47 \text{ m}^3$ ).

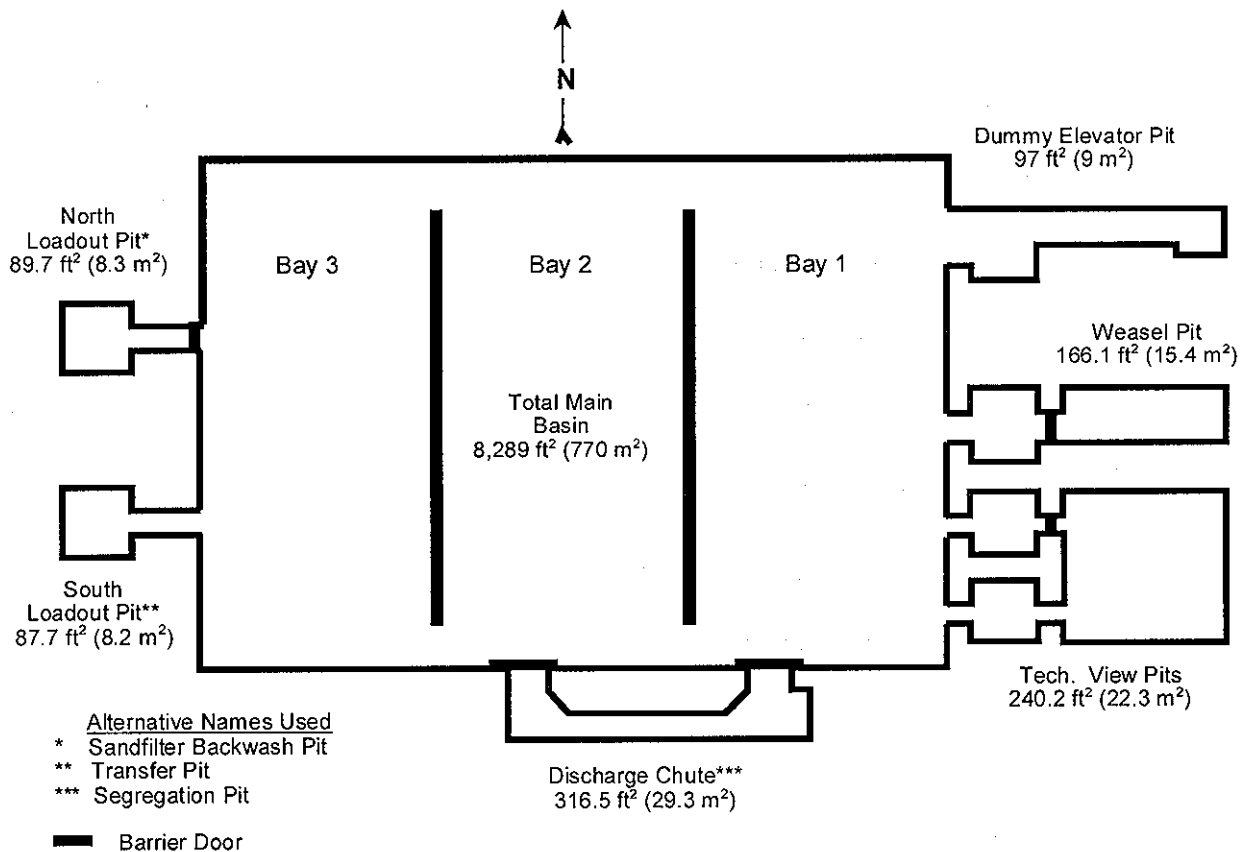
### 3.2 Sludge Description

To differentiate spent nuclear fuel and debris from sludge, any material that will pass through a 1/4-in. screen is defined as sludge. The Spent Nuclear Fuel Project Technical Databook, Volume 2, *Sludge* (Pearce 2001a) provides project-approved summary tables of selected sludge parameters and derived physical quantities, with nominal design and safety basis values.

#### 3.2.1 Sludge Volume

The estimated volume of sludge within the confines of the KE Basin floor and pits is based on a series of direct measurements made in 1994 using metal scales and underwater video cameras. The depth of sludge in empty canisters was measured in a similar fashion. Sludge depths within the pits were measured again in 1995 and 1999.

Figure 3-1. Schematic of the K-East Basin Overview



### **3.2.2 Floor sludge**

On a nominal basis, floor sludge is almost 50% of the total sludge volume and contains about 31% of the total U metal associated with the KE sludge. Approximately 760 ft<sup>3</sup> (21.5 m<sup>3</sup> nominal estimate) of sludge is on the basin floor. The average depth of basin floor sludge is just over 1.1 in.

### **3.2.3 Pit sludge**

Pit sludge is about 42% of the total nominal sludge volume. It is assumed to have the same relatively lower U metal content as floor sludge. If combined, floor and pit sludge would accounts for about 57% of the total U metal in the KE sludge.

### **3.2.4 Canister sludge**

Canister sludge includes sludge from full canisters and coatings. Canister sludge generally has more uranium metal and oxide sludge than floor and pit sludge. This material represents only about 8% of the total nominal sludge volume. However, it contains about 43% of the U metal in KE Basin sludge.

## **4 Approach and Requirements**

The process development team established a set of requirements to govern the design concept of a process to containerize the sludge in KE Basin. Top-level assumptions which drove the requirements were also identified. With requirements and assumptions established, a set of functions that needed to be satisfied were prepared. The team recognized that the total sludge mission as currently recast was more expansive than merely containerizing KE Basin sludge; however the immediate charter of the team was to provide a workable process concept for KE sludge consolidation. Thus the process requirement set was limited.

### **4.1 Requirements**

The requirements focused primarily on top-level process requirements and elements, such as nuclear safety, schedule, existing capacities, etc., which would influence process design or unit operation selection. Input from operations, nuclear safety, and potential interfacing sub-projects was obtained to ensure the requirements set at the top level were complete and to either validate supporting key assumptions or recast them. A requirements list was identified to guide the process design and unit operation selection for KE sludge consolidation (see Appendix A, A-1).

### **4.2 Assumptions and Risks**

A list of key assumptions is shown in Appendix A, A-2. The assumption list was used to identify areas of risk (Appendix B) that will ultimately require mitigating actions or boundaries for the requirements and subsequent activities. As the process development activity progressed, a number of the assumptions were validated or revised based upon factual input and need no further mitigation. The remaining assumptions were transposed to a risk list and actions were identified to mitigate them. Further interface issues were identified (see Appendix C).

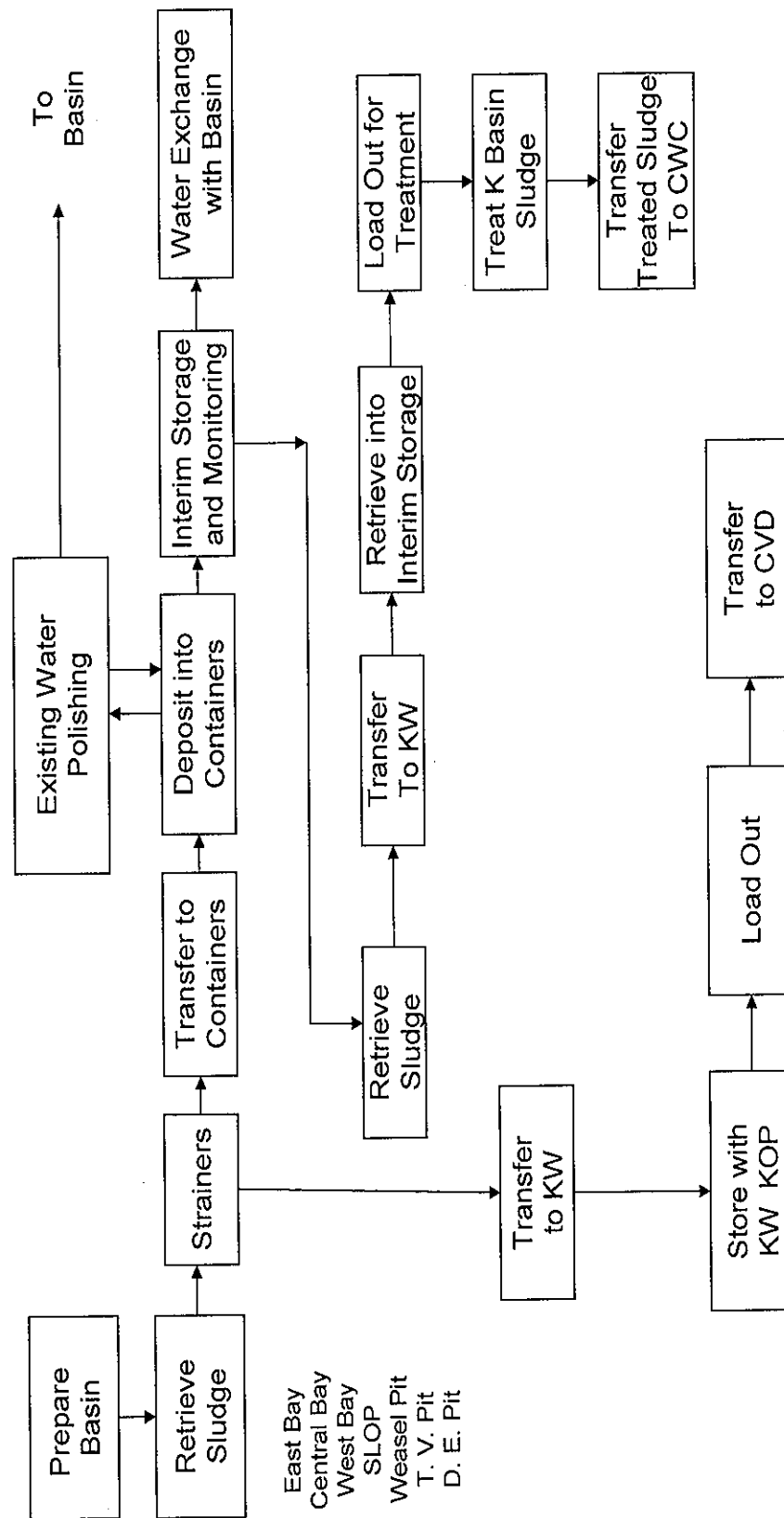
### **4.3 Functions**

Based on top-level process requirements and bounding assumptions, functions were developed that satisfied the requirements. In recognition that KE sludge consolidation was not the entire scope of the sludge effort, preliminary upper-level functions for the bulk of the sludge mission were derived (Figure 5-1). More detail was provided for the effort to containerize KE sludge as that was the primary focus of the process design team.

## **5 Functional Breakdown**

The top-level process requirements set and assumptions were used to develop a top-level functional flow diagram (FFD) (see Figure 5-1) for unit operation selection and process flow diagram preparation. The FFD considered elements of the broader scope of the sludge mission as currently envisioned, but focused in greater detail on those functions that were required for KE sludge consolidation. From the functions, various unit operations/architectures were considered and qualitatively measure against the requirements. A preferred technical solution was selected and is recommended for further development (see section 6).

Figure 5-1. Functional Flow Diagram



## 6 Process Options/Selection

KE Basin sludge consolidation is grouped into three main processes areas in this section:

- Basin preparation
- Sludge retrieval, separation, and transfer (within KE)
- Deposition of sludge into receptacles (containers) and sludge storage at KE (awaiting treatment and final disposal)

The selection process emphasized ease of operation and operator familiarization with existing equipment and hardware where possible. Externally imposed time constraints limited options that were proven during routine basin operations. Furthermore, evaluation of options considered both processing time constraints and physical limitations (e.g., sludge receiver container size, settling area, etc.). The finite/one-time nature of the overall sludge consolidation process was also a factor in selecting effective process options (e.g., design life, availability of equipment, maintenance and change-out of spare parts, etc.). Interviews were conducted with operations, nuclear safety and criticality personnel to ensure process options adequately considered practicality while constraining process options to those within the existing Authorization Basis (or, if not previously analyzed, would result in a negative USQ determination).

Process “architecture” features were imposed to ensure workable conditions for basin operations (e.g., flocculent addition system to optimize the volume and surface area of sludge containers for settling and enhance water clarity) and to minimize design and construction actions for the sludge consolidation task. Sludge retrieval hardware (e.g., hoses, long-poled vacuum attachments, etc.) had to be proven concepts, readily acceptable by operators and basin operations personnel. The location of the sludge container(s) was a constraint imposed by subsequent decontamination and decommissioning (D&D) activities, i.e., sludge collection containers could not be located in the main basin because of adverse impact on subsequent D&D objectives.

### 6.1 Prepare Basin

The volume of sludge to be containerized is nominally 36 m<sup>3</sup> with a bounding estimate of 47 m<sup>3</sup>. Applying a similar volume expansion concept as used for the LDCs, but using design values from the Sludge Databook, it is estimated that a 1.2 volume expansion factor should be used. If the sludge volume is near the anticipated values, the Tech View channels and Weasel pit are the only locations that require liners. But if the actual sludge volume approaches the bounding estimate, the Weasel pit channel also will need to be lined.

Several key activities must be completed before commencement of actual sludge retrieval/consolidation:

- Design, fabrication, and installation of containers to hold the sludge
- Installation preparation of the space within the basin
- Preparation of areas where sludge will be retrieved

Preparation of designated locations (Weasel pit and the entry areas to the Weasel pit and the two Tech View pit areas) must be completed as soon as possible to prevent impact to container installation. Work sequencing to prepare KE Basin areas for sludge retrieval need to be factored into the D&D project's plan to begin grouting activities in the west bay of KE Basin as the preferred starting point. All three preparatory steps can be performed concurrently assuming adequate resources are available.

## **6.2 Retrieve and Transfer Sludge**

Sludge retrieval, separation, and transfer options focused on using existing technology and hardware currently in place in KE Basin. Factors considered during the selection process include performance (against the functional requirements), installed status, reliability, operator familiarity, etc.)

Two sludge transfer options considered were use of the SWS and use of the existing Tri-Nuclear in-basin pumps. The SWS was not given consideration as the primary approach to sludge transfer to 1) avoid interference with the SWS mission/use for NLOP transfer operations and 2) prevent (or defer) significant rework of the SWS piping and system control logic.

### **6.2.1 Sludge Retrieval/Separation/Transfer - Alternatives**

Two existing in-basin systems, with some possible modifications, are proposed for retrieving KE Basin sludge: the Tri-Nuclear vacuum system, and the KE SWS. Both systems employ strainers or screens upstream of the main pumps, which help to enhance pump life. The Tri Nuclear system has been used routinely for sludge manipulation activities in the basins. The SWS is installed and previously underwent limited testing. However, the SWS will be used for transfer of NLOP sludge into LDCs for transfer to Pacific Northwest National Laboratory (PNNL).

The Tri-Nuclear system typically utilizes a 135 gpm pump with a suction screen basket having 1/8-in. holes. The system can employ a suction point end effector to perform initial segregation by keeping larger pieces of fuel and debris from entering the suction hose.

The SWS consists of three separate, parallel retrieval systems, each containing a booster pump, followed by a simplex strainer containing a basket with 1/4-in. holes, followed by a main retrieval pump. The system is intended to operate at approximately 60 gpm. This system is also designed to utilize a suction point end effector to keep out larger fuel and debris pieces. End effectors typically have openings no larger than about 5/8 in. to keep out large debris.

During the retrieval operation, denser materials will fall out due to reduced flow rates in the strainers/baskets. Also, as the retrieval operation proceeds, system pressure drop increases as the strainers/baskets become plugged. This requires removal of the SWS strainer baskets for transfer via the FTS to sorting tables in KW Basin. Alternatively, sludge/debris contents from the Tri-Nuclear pump screen baskets are emptied into excess

closed bottom canisters and the baskets are re-used. The canisters will be transferred via the FTS to KW Basin for disposition.

### **6.2.2 Sludge Retrieval/Separation/Transfer - Drivers**

Using the Tri Nuclear system with minor modifications is intended to stay within the current Authorization Basis. Furthermore, use of the SWS for KE Basin sludge consolidation could compromise the success of NLOP transfer activities and minimize impact on the sludge consolidation schedule and activities. Use of existing equipment will also reduce readiness review activities.

### **6.2.3 Sludge Retrieval/Separation/Transfer - Selected Alternative**

The selected alternative is using the Tri Nuclear pumping system and the existing strainer hardware (for particle separation). The SWS is considered an alternative and/or backup to the Tri Nuclear system and would also provide additional capacity and flexibility. The reliability and performance of the Tri Nuclear system are well documented. Discussions with basin operational personnel confirmed that the operators are very comfortable with the use of the Tri Nuclear system and it is their preferred option. However, if the SWS equipment were used, equipment and piping modifications and possibly control logic changes would be necessary. There is minimal operational risk using the Tri Nuclear system. Results of analysis to determine the effective cleaning area and relative sludge transfer distance will dictate what additional capacity is needed to reach all areas of KE Basin (e.g., two Tri-Nuclear pumps in series).

The SWS equipment may be used in lieu of, or in conjunction with, the Tri-Nuclear system. However, lack of experience with this system, coupled with the potential competition with NLOP activities, presents risk eliminated by using the Tri-Nuclear system as the initial method for transferring sludge to the in-basin containers.

Interviews with operational personnel support the Tri-Nuclear pumping system (see Appendix D, Attachment 1). The system is easy to operate, it can be relocated as necessary, and it has a demonstrated history of transferring sludge.

## **6.3 Deposit Sludge in Container**

Liners are required for storing at least 43 m<sup>3</sup> of sludge (36 m<sup>3</sup> x 1.2 factor for volume expansion due to corrosion and gas generation). Collection into one or more container is required to provide operational flexibility and increased surface area for solids settling.

Visibility is expected to be affected during sludge deposition in the engineered containers. An approach to mitigate the impact of slow solids settling and the resulting water clarity issues is required during sludge transfer and loading to prevent impact on sludge consolidation activities, i.e., to prevent temporary suspension of sludge transfer operations.

### **6.3.1 Sludge Deposition and Storage - Alternatives Considered**

There are limited location options in KE Basin for sludge containers: NLOP, SLOP, fuel discharge chute, the Weasel pit, Tech View pits, the channels to the Weasel and Tech



View pits and the main basin floor area. Table 6.1 summarizes the status and condition of the storage location options.

**Table 6.1. KE Basin Container Option/Status**

Option	Status
NLOP	Contains sand filter backwash. Work in progress to transfer sludge to PNNL for treatment. Co-mingling of basin floor and canister sludge would obviate treatment options currently under consideration and add prohibitive level of complexity to future treatment options.
SLOP	Former fuel transfer and loadout equipment serves as a major obstruction
Fuel Discharge Chute	"Empty." Scheduled for grouting by D&D. Use of the chute would have a significant negative impact on scheduled D&D activities. Construction joint is a potential leak source.
Weasel Pit	Currently contains ~11 m <sup>3</sup> of sludge. Appears to be one large obstruction and unknown debris beneath the sludge.
Tech View Pit	Contains old cartridge filtering equipment.
Channel to Tech View and Weasel Pits	"Empty" but requires some cleanout and obstructions (e.g., barrier door to the Tech View pit).

Numerous container concepts were evaluated, including permeable geotextiles, rigid non-metallic liners, and rigid metallic liners. The options were evaluated and relative rankings established to determine the preferred option. The criteria used to select the preferred liner material were: design, installation, sludge retrieval, and D&D. The metallic liner approach was clearly superior to the other options considered (see Appendix D, Attachment 2).

Methods to mitigate slow solids settling were evaluated. Since overall surface areas for gravity settling are limited, filters, gravity settlers, hydrocyclones, and flocculants were considered as reasonable candidates to assist in solids separation and settling.

### 6.3.2 Sludge Deposition and Storage - Drivers

The main drivers for selecting the sludge container materials and related design were bounding by the Spent Nuclear Fuel Project Authorization Basis (or expected negative USQ determination), Criticality Safety Evaluation Report, and the CERCLA Record of Decision. The final state of the containerized sludge in KE Basin could not create a condition where the sludge could not be retrieved for future processing and disposal.

### 6.3.3 Sludge Deposition and Storage - Selected Alternative

The preferred alternative is to design, build, and install a metallic container(s). The maturity, experience base, and complexity of other options clearly indicated that a simple metallic liner concept represented the least risk to timely completion of sludge consolidation in KE Basin. Furthermore, constructibility and overall control of the

engineering, procurement, and construction (EPC) process for options other than metallic liners translated to unacceptable project risk (both cost and schedule).

Assessment of methods to mitigate the impact of slow settling solids and the resulting water clarity issues resulted in recommending the use of flocculants. Flocculants will provide enhanced settling times to minimize water clarity issues. In 1996, cursory flocculant tests with basin sludge were very encouraging. Additional confirmatory tests will be performed concurrent with design to confirm overall flocculant effectiveness.

Inclined plate "settlers" are viewed as a simple yet effective method to increase the net surface area available for settling. Design of sludge containers should facilitate cleanout and may include features similar to those used in inclined plate settlers. Flocculant addition and increased solids settling surface area are expected to provide sufficient process and engineered features to maintain water clarity during sludge transfer operations. (See Appendix D, Attachment 3.)

## **7 Process Description**

The processing concept for the sequencing and operational steps required to safely consolidate KE sludge include:

- Clean out the Tech View pit channels
- Install liners in the Tech View channels
- Retrieve Weasel pit sludge into the lined pits and clean out Weasel pit
- Install liner in Weasel pit
- Prepare first bay (west bay per D&D)
- Retrieve sludge from first bay into lined pits
- Prepare second bay
- Retrieve sludge from second bay into lined pits
- Prepare third bay
- Retrieve sludge from third bay
- Retrieve sludge from miscellaneous locations

### **7.1 Prepare Basin and Install Liners**

As discussed in Section 6, the two Tech View pit channels and the Weasel pit (and if needed, the Weasel pit channel) were selected as the locations to install liners and consolidate the sludge. To install liners, first, these locations have to be cleaned out. Further, since the access to the Tech View pit will be obstructed by the liners, material in the Tech View pit that will either not be grouted in place or will require water shielding during movement should be removed at this time.

The planning sequence is to clean up the Tech View channels by moving single pass reactor fuel to the FTS, moving the debris (to the basins for disposition by D&D), and vacuuming the sludge to the Weasel pit. The open barrier door in the south channel can be removed or left in-place; however if left in place, it does reduce the liner volume capacity. Depending on schedule impacts, debris/hardware in the Weasel pit and channel could also be moved at this time.

If the Tech View pit is not cleaned and vacuumed at this time, an access hose should be evaluated and/or installed with the liners to allow for sludge retrieval at a later date. The Tech View pit and channel sludge will be moved with the standard Tri-Nuclear pump and hose arrangement to the Weasel pit. Material larger than 1/4 in. will be collected from the screens and moved to the FTS for transfer to KW. Any fuel pieces will also be moved to the FTS for transfer to KW.

The liners are expected to be rigid steel liners (stainless or painted carbon steel), installed in sections. A free-standing base section will be inserted into the Tech View pit channels and each sequential level will be bolted to the previous section. The top of the liners will be below the basin water level to maintain shielding and hydraulic communication with the main basin. It is expected that the liners will have a sloped bottom to aid in clean out and a distributor for the incoming stream. Since the liners are not attached to the walls, the Tech View pit will still be hydraulically linked to the main basin.

## **7.2 Prepare Weasel Pit and Install Liner**

Wall-mounted and loose equipment will be removed from the Weasel pit. If final design requires supplemental storage space, the Weasel pit channel will be cleaned up including removal of the barrier door. The Weasel pit sludge will be moved with a standard Tri-Nuclear pump and hose arrangement to the lined Tech View channels (slurry will go to both liners at the same time to enhance settling). The flocculant addition system will be operated to retain the smaller lighter solids in the liners. Water-jetting action may be used to "sparge" sludge towards open areas from hard-to-reach locations in corners or behind obstructions or to loosen hardened sludge.

Once the pit has been cleaned, the rigid liner will be installed in a similar fashion to those installed in the Tech View channels. If not already removed, the sludge in the Tech View pit will be vacuumed to the liners at this time.

There will be volume expansion of sludge during retrieval. This means that there are times when clean up will have to wait for the sludge to compact to ensure adequate head space for settling and to maintain water clarity.

Material larger than 1/4 in. will be collected from the screens and moved to the FTS for transfer to KW. Any fuel pieces will also be moved to the FTS and onto KW for disposition.

## **7.3 Prepare Bays for Retrieval**

The current plan is that main basin sludge retrieval will integrate directly with D&D activities. Also, NLOP and fuel transfers to KW are ongoing during this time (see Appendix C for input on some of these interactions).

The west bay is the first bay on D&D schedule. Since NLOP work is still ongoing, the SWS will not be available and a multiple Tri-Nuclear pump arrangement (in series) will be required because the Tri-Nuclear pumps are expected to only be able to efficiently

operate with about 75 ft of discharge hose and west bay areas are up to 170 ft away from the liners.

Any remaining fuel in the bay will be moved to the east bay. The fuel racks and debris will be moved to either another bay (center) or to the opposite end of the west bay. Any loose sludge is expected to fall off during rack/debris movement. This movement of racks allows easier access to the floor area. A process for cleaning the floors needs to be developed and agreed upon by the regulators. Currently, there are no plans for floor sampling to meet the D&D end point criteria.

Once an area has been cleaned and inspected, D&D will mark the cut areas. The original racks will be replaced back to the cleaned area along with racks from the next area to be cleaned. The racks can be stacked, however the cut areas will remain open for D&D to hydrolase the cut lines. Racks can be stacked/nested on top of each other to several feet high; they will effectively act as rebar in the grout. Selected debris will also be placed on the racks for in-place grouting. Movement of racks and debris and sludge retrieval will continue until the entire basin floor has been cleaned and inspected.

#### **7.4 Retrieve Sludge from Bays**

Once an area of the west bay floor is cleared, the Tri-Nuclear pump and end effectors will be used to vacuum the floor. Material larger than 1/4 in. will be collected in the screens, which will require routine cleanout/emptying to canisters for loadout at FTS and transfer to KW. Any found fuel pieces will be moved to FTS for transfer to KW.

A detailed cleaning process will need to be qualified. Sludge retrieval will have to retrieve and contain basin settled sludge ranging from light fines, that are easy to suspend and slow to settle, to the heavier uranium oxides that are more difficult to "pick up" but easier to settle out and contain. The process could require minimum flowrates, floor cleaning sequences, or multiple passes over the floor, etc. Until this process is determined, one pass with one end effector is assumed acceptable.

The control scheme for the flocculant addition will have to be designed. The concept is to add and mix the flocculant down stream of the pump but prior to discharge to the liners. During sludge retrieval for short times, 3 to 5 % slurry is being transferred, while at others times, only a trace amount of sludge is being vacuumed. At this time, it is assumed that the flocculant will be added at a constant flowrate when the floor is vacuumed.

During west bay sludge retrieval, the discharge from the first pump will be routed to the inlet of a second pump. The second Tri-Nuclear pump will discharge to the liners. The flocculant addition system will be operated and sludge will be collected in the liners.

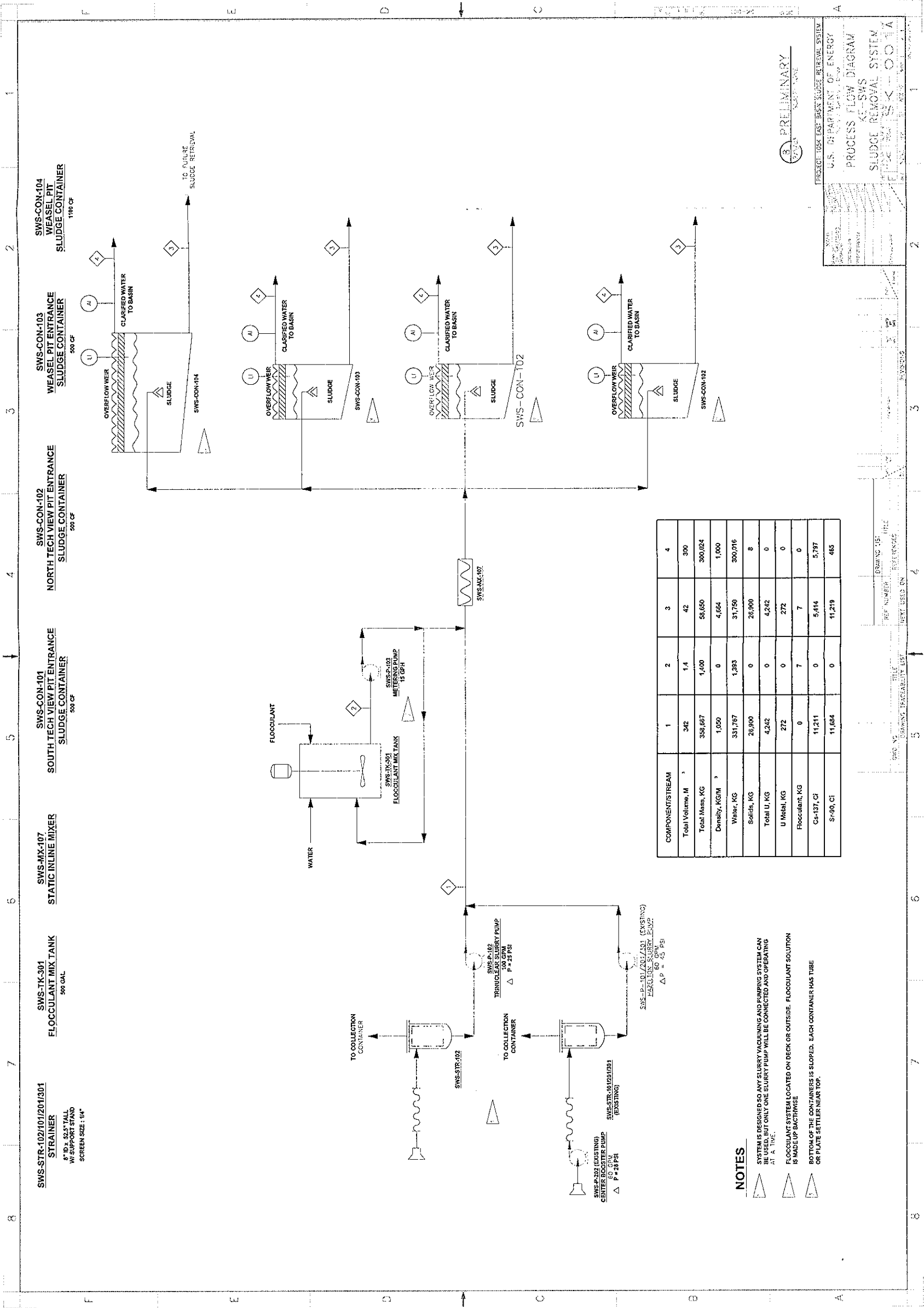
An ideal flowrate during sludge retrieval would be about 60 gpm. If the flowrate is significantly lower, the end effectors will not pick-up the heavier solids. If the flowrate is significantly higher, it impacts settling in the liners. There is no instrumentation flow control and monitoring with the Tri-Nuclear system and the pump will potentially

cavitate at this lower flow. Therefore, batch transfers to the liners may be required to allow settling.

Once the NLOP work is complete, the SWS discharge can be rerouted to the liners and the pump controls modified to eliminate LDCs requirements. The SWS has flow instrumentation and operates continuously at approximately 60 gpm. The SWS can support sludge retrieval in the other two basins.

No change in the existing basin water treatment operation is planned, however sludge retrieval (including NLOP) can increase the load on the ion-exchange modules (IXMs) and the IXMs may have to be changed out more often. The inlet and outlet to the IXMs are sampled and counted each week; this data and the monthly composite samples are used to characterize the IXMs.

Figure 7-1 is a simple process flow diagram of KE sludge consolidation.



## 8 References

Kessler, S.F., 2001, *Criticality Safety Evaluation Report for Loading and Storage of K Basin Sludge Containers*, CSER-01-002, HNF-8513, Rev.0, Fluor Hanford, Richland, Washington.

Pearce, K. L., 2001a, *105-K Basins Material Design Basis Feed Description for Spent Nuclear Fuel Project Facilities, Volume 2, Sludge*, HNF-SD-SNF-TI-009, Volume 2, Rev. 4, Fluor Hanford, Richland, Washington.

Pearce, K. L., 2001b, *Spent Nuclear Fuel Project Technical Databook, Volume 2, Sludge*, HNF-SD-SNF-TI-015, Volume 2, Rev. 8, Fluor Hanford, Richland, Washington.

Plys, M., and K. L. Pearce, 2001, *Supporting Basis For Spent Nuclear Fuel Project Sludge Technical Databook, Volume 2*, SNF-7765, Rev. 0, DRAFT, Fluor Hanford, Richland, Washington.

Klein, K.A., 2003, Letter AMCP-0129, *Contract No. DE-AC06-96RL13200 – Final Fee Reduction for Failure to Complete Regulatory Milestone*, to R. G. Gallagher, December 31, 2003.

## **Appendix A. Requirements and Assumptions**

### **A.1 Process Design Requirements**

#### **Programmatic/Schedule Bin**

- 1) Containers available to receive sludge by 4/28/04 (based on operations need for ~4 months retrieval time)
- 2) Sludge containerized by 8/31/04 (reference RL letter 04-AMCP-0129)

#### **Safety/Nuclear Safety Bin**

- 3) Perturb Authorization Basis as little as possible (negative USQ desirable)
- 4) ALARA < 0.5 mrem (worker exposure on the grating)
- 5) All active systems will be fail-safe

#### **Process Bin**

- 6) Nominal volume to be collected 36 m<sup>3</sup> (47 m<sup>3</sup> bounding) (SNF-7765)
- 7) NLOP (KE) excluded (reference RL letter 04-AMCP-0129)
- 8) Water quality shall be maintained so basin personnel can maintain the ability to perform sludge collection or other activities
- 9) Container volume(s) will contain all unsettled sludge – consider gas retention/corrosion expansion/“fluff” factor of as-received unsettled sludge
- 10) Sludge definition < 1/4-in. screen
- 11) Material segregated by strainers during sludge removal will be transferred via FTS to KW
- 12) Retrieval system is under water
- 13) Sludge storage container needs to have water exchange with the basin
- 14) Preclude flammable/explosive hydrogen accumulation
- 15) Design life: active retrieval systems – 1 year; passive systems – 2 years

#### **Equipment (including operability/maintainability) Bin**

- 16) Use existing equipment to maximum extent possible
- 17) Sludge collected in KE containers can be retrieved for transfer
- 18) Sludge retrieval system will be operable/maintainable under water
- 19) Accumulation containers shall be self-supporting/free standing and shall continue to contain sludge in the event of a basin leak (reference RL letter 04-AMCP-0129 and 1-19-04 e-mail from G. Ryan to S. Sax, et al., subject: Nuclear Safety Thoughts on KE Basin Sludge Consolidation)
- 20) New equipment fits within existing weight (crane) and dimensional envelopes
- 21) Design shall not preclude volume measurement/determination
- 22) KE Basin interim storage configuration will not lead to localized temperature excursion within the AB

#### **Regulatory Bin**

- 23) Record of Decision (ROD) cannot be impacted



- 24) Rad nuclide water concentration will not compromise air permit
- 25) Design of the containerization system is contingent upon EPA approval of the remedial design (conceptual design) of the containerization system including the specified design life (reference 1-22-04 e-mail from D. Watson to T Erickson, et al., subject: Re: Proposed TPA M-34 Changes due to Sludge and Deactivation)

#### **Accountability Bin**

- 26) Sludge composition issues need to be resolved; approach will require RL approval

### **A.2 Process Design Assumptions**

#### **Programmatic/Schedule Bin**

- a) These operations will be concurrent with at least part of the KE sludge consolidation: KE NLOP sludge transfer; completion of KE fuel transfer; initial D&D efforts
- b) Readiness preparations are undefined but it is assumed they will require 3 weeks

#### **Regulatory Bin**

- c) Proposed TPA changes have no effect on schedule for containerization of KE Basin floor and pit sludge by 8-31-04. (reference 1-22-04 e-mail from D. Watson to T Erickson, et al., subject: Re: Proposed TPA M-34 Changes due to Sludge and Deactivation)

#### **Resource/Logistics/Interface Bin**

- d) Resource/equipment available to support schedule (NLOP/fuel retrieval)
- e) Container installation/access to basin not impacted by Fuel/NLOP sludge
- f) Strainer baskets material from sludge accumulation is transferred to KW via FTS, which is maintained until no longer needed
- g) Found fuel to be transferred from KE for disposition by others
- h) D&D activities will not affect sludge design or operation (issue: numerous concurrent activities need to be intensively managed)
- i) Operations will provide sufficient shift coverage to complete sludge retrieval in the time frame specified
- j) The retrieval process is sufficient to support sludge cleanup end point criteria (which have not been defined), to support D&D

#### **Process Bin**

- k) Basin water clean up system continues to operate for the entire life of the containerization system (retrieval, storage and transfer to KW or elsewhere) (issue: where will KE sand filter backwash after NLOP is cleaned out?)
- l) Deliberate metal separation not required; incidental U metal expected/anticipated. This will be within the Authorization Basis or can be satisfactorily resolved within the USQ process

**Safety/Nuclear Safety Bin**

- m) No extra requirements for CSER

**Equipment (including operability/maintainability) Bin**

- n) The project will not provide tools to remove "hard packed" sludge. Assume existing operating tools are adequate
- o) Container has no safety function/environmental concerns; therefore, assume no leak detection system
- p) No basin ventilation upgrades required
- q) Additional viewing system components will be required to support operations

## Appendix B. Risk Management

### KE Sludge Containment Project – Risks and Mitigating Actions

Category	Issue	Risk Level	Mitigating Actions
1. Programmatic/schedule	100-KR-2 Operable Unit Record of Decision (1999) - EPA review and approval of the remedial design (RD).	Low	1. Early preparation of required design documentation. 2. Early involvement with and approvals from EPA on the RD.
	AB changes which require DOE approval	High	1. Use existing systems to the maximum extent possible. 2. Early and ongoing Nuclear Safety involvement.
	Competing activities in the basin (fuel transfer, KE NLOP retrieval, D&D, consolidation, etc.)	High	1. Identify and vigorously manage interfaces 2. Develop and execute a detailed integrated schedule
	Approvals for early equipment procurement	High	1. Approach should maximize existing equipment augmentation.
	Air Permit/construction permit approvals	Low	1. Use existing designs and systems to the greatest extent.
	Formal or semi-formal startup activities	High	1. Minimize or eliminate processes requiring new active equipment and/or procedural requirements
	KE sludge consolidation impacts eventual treatment and final waste form for acceptance to dispose	Low	1. Consider potential treatment options during process selection.
	KE Basin sludge cleanup endpoint;	High	1. Obtain early agreement with the EPA on process qualification. 2. Early preparation and agreement with a detailed retrieval sequence and schedule 3. Characterized the fines that are not retained for TRU content.
	Achieve KE sludge consolidation and containerization by 8/31/04	High (Extreme)	1. Establish a dedicated project team to execute sub-project activities. 2. Prepare and prosecute a detailed schedule.

Category	Issue	Risk Level	Mitigating Actions
2. Process design	Actual volume of sludge containerized exceeds nominal/bounding amounts	Low	Ensure container(s) are adequately sized to accommodate this contingency, including initial fluffiness after lay-down and prior to self compaction.
	Turbidity created by sludge dispersal during retrieval operations impedes or delays consolidation/containerization	High	Process design must maximize solid/liquid separation opportunities (use of flocculants, separators, parallel bay operations, etc.)
	Retrieval system end effector design	Medium	Work closely with operations personnel on design
	Viewing systems inadequate or fail prematurely	Medium	Provide additional/backup systems
	Process confirmation	Low to Medium	Initiate early confirmation testing of flocculant
3. Nuclear Safety	Incidental Uranium segregation during retrieval results in an unanalyzed configuration (criticality)	Low	Previous analyses appear to bound sludge consolidation
	Critical lift/basin modifications will require DOE approval	Medium	Early development of preparation/installation plan
4. Operability/ Maintainability	Issues captured elsewhere		
5. Accountability/ Safeguards	KE sludge consolidation does not fit within current safeguards/accountability plan	Low	Reconfirm with Safeguards that planned containerization is bounded by current plan.

## Appendix C. Interface Management

### KE Sludge Containment Project – Interfaces

Interface with	Summary Description
Fuel Transfer from KE to KW	Fuel transfer operations will be ongoing from KE to KW during preparation for sludge containerization. In addition, the FTS system will be required for transfer of strainer baskets filled with (nominally) >1/4-in. material accumulated during sludge retrieval and containerization.
KE sludge transfer to KW or elsewhere for interim storage or final treatment/packaging for disposal	Design of the container and process(es) to collect and retain the KE sludge must consider eventual retrieval and transfer to another location. The KE containerization process must not preclude this.
Final treatment and disposal	The process to collect and containerize must consider future treatment and disposal. Current planning suggests that the K Basin sludge will be treated for disposal as RH-TRU waste at WIPP. At present only a draft RH-TRU Waste Acceptance Criteria exists, however it and anticipated modifications need to be considered.
D&D	D&D has developed a detailed schedule of KE in-basin activities consistent with established milestones for basin decommissioning. Some D&D activities are expected to be in progress during preparation and transfer of KE sludge to the interim container. Competition for scarce resources and real estate is anticipated.
KE NLOP Sludge Transfer to 325	Transfer of KE NLOP sludge for treatment as CH-TRU will begin 45 days prior to initiation of general basin sludge containerization and be on-going through the end of FY 04. Again, competition for real estate and scarce resources is expected.
Existing KE Basin activities/infrastructure	It is anticipated that many existing basin systems/capabilities (water treatment, electrical, etc.) will be necessary to support the activities to install and successfully operate the systems provided to retrieve and containerize the KE basin sludge.
Institutional interfaces will exist which need rapid definition and quantification. Chief amongst those but not exclusively are DOE (RL and HQ), EPA, DNFSB, and Nuclear Safety	Though harder to quantify, the interfaces with institutional organizations are equally important to the success of the effort to consolidate and containerize the sludge in the KE basin. Proactive identification and management of those interfaces is essential to the success of the project.

## Appendix D. Supporting Information

### Attachment 1: Curt Miska Input

*Operations management input on use of Tri Nuke sludge vacuum pump vs SWS pumps for consolidation of KE sludge*

On 1/23/04, the following operations managers were interviewed about the relative desirability of using the Tri Nuke sludge transfer pump(s) vs a modified SWS pump system to consolidate sludge in to a lined pit in KE basin:

- Jim Gamin
- John Dent
- Tom Ruane
- Jim Klos
- Manuel Guzman

100% of the operations personnel interviewed agreed that the Tri Nuke pumps work well at transferring sludge, especially with the flexible pick up nozzle from SWS affixed to the pump suction (as configured and operated for sludge removal from KE fuel).

Significant advantages for use of the Tri Nuke pump stated included:

- Good pump suction
- Ease of operation (on off, no PLC issues)
- Pumps can be relocated as needed
- North Loadout pit (NLOP) sludge retrieval will need to use the installed SWS pumps, and this will prohibit or significantly restrict the use of the SWS pumps for consolidation of sludge in a pit.

Potential restrictions on successful use of the Tri Nuke pump mentioned included:

- The strainers fill quickly and must be dumped out (previously into empty canisters)
- The pump amps should be watched to determine when flow rate drops off (when strainer needs to be emptied).
- The pumps only suck up sludge if the pick up is very close to the sludge being retrieved (true of all sludge retrieval pumps)
- The pump will not "push" the water and sludge very far on the pump discharge (~ 75 ft max)
- The original Tri Nuke suction heads with screens plugged a lot and needed to be cleaned often during use.

When asked about the viability of using the SWS to consolidate sludge into a lined pit in KE basin, the majority of personnel interviewed declined to give an opinion (they did not have operational experience with the system). The notable exception to this was Jim

Gamin, who indicated that while the SWS would work for this it would require significant reconfiguration and modification of the control system. He also noted that the availability of the SWS for use or modification would be greatly limited by the need to use the SWS for retrieval of NLOP sludge. Jim indicated that the Tri Nuke pump "would have to be used initially" for consolidation of sludge at KE basin until the SWS was available and could be modified.

**Attachment 2     David McShane Input**

The objective of this document is to evaluate options for lining pits in the KE basin. The lined pits will combine to contain approximately 40 m<sup>3</sup> of sludge.

Considerations when evaluating the liners are as follows:

**Design**

Technical maturity including:

Material compatibility with the sludge

Nominal volume to be collected 36 m<sup>3</sup> (47 max)

Accumulation containers shall be self-supporting/free standing and shall continue to contain sludge in the event of a basin leak (second part also may be regulatory requirement)

Design shall not preclude volume measurement/determination (also process)

KE Basin interim storage configuration will not lead to localized temperature excursion

**Installation****Schedule**

New equipment fits within existing weight (crane) and dimensional envelopes

**Retrieval**

Sludge collected in KE containers can be retrieved for transfer to KW

**D&D**

The installation fits into the D&D plan.

The evaluation will be performed by ranking each option

The five primary methods of lining the pits are:

- 1) Permeable liner
- 2) Flexible plastic liner
- 3) Rigid plastic liner
- 4) Plastic Tanks
- 5) Solid metal liner

**Permeable Liner:**

The material for this liner would be geotextile using a polypropylene or polyester. This type of liner would allow the water in the sludge to pass through the membrane, trapping some the smaller sludge particles and assisting with water clarity. The material would be similar to the filters used in the LDC and is compatible with the sludge. This filtering would be effective until the liner pores are plugged the quantity of sludge that could be processed is unknown. This type of material is installed by securing the liner at the top to the wall with batten strips. Securing the liner to the wall would not be practical so the installation would use a metal support frame which would provide support at the top of the liner. Also important to the installation of this type of liner would be keeping a space between the membrane and the wall. The frame would be designed to accomplish this.



The bottom of the liner will also require a metal support to provide a slope into a sump area for retrieval. Fabrication of the geotextile portion of the liner would be performed out of the area. Fabrication of the frame would be performed by a local fabricator. Retrieval of sludge from this type of liner could be more difficult because this liner would act as a filter and some of the sludge could be left in the pores of the liner after removal. Measuring the quantity of material left behind would be difficult and could present a problem for D&D.

#### Design:

Technical maturity including: This use of the geotextile for this application is non-standard. The quantity of sludge that can be processed is unknown and developing a system to back flush is not practical.

Material compatibility with the sludge There should be material compatible with the waste. Some research would be required to find the specifics

Nominal volume to be collected 36 m<sup>3</sup> (47 max) This requirement can be met

Accumulation containers shall be self-supporting/free standing and shall continue to contain sludge in the event of a basin leak (second part also may be regulatory requirement). The liner can be made self standing. If this turns out to be a regulatory issues this one could be hard to sell

Design shall not preclude volume measurement/determination (also process) Volume measuring could be accomplished

KE Basin interim storage configuration will not lead to localized temperature excursion. The configuration should prohibit the local temperature excursion. However, if a local temperature excursion were to happen, the material could be a problem.

#### Installation

Schedule Several unknowns with design. A source would have to be found to produce the liner.

New equipment fits within existing weight (crane) and dimensional envelopes This would not be a problem

#### Retrieval

Sludge collected in KE containers can be retrieved for transfer to KW

#### D & D

The installation fits into the D & D plan The flexible membrane will retain material. The quantity of the remaining material would be unknown. Grouting should not be a problem.

#### Evaluation

Category	Design	Installation	Retrieval	D&D	Total
Ranking	2	2	2	2	8

## Flexible Plastic Liner

The material for this liner would be a flexible coated geotextile such as vinyl-polyester or rubberized nylon. Materials compatible with the sludge are readily available outside of the general area. Flexible liners are installed in the same manner as the permeable liners, with the exception that there isn't a need to leave a space between the liner and the wall. Instead, the flexible coated liners can be punctured and would have to be protected from existing components that are left on the wall. This would require metal sheeting to be a part of the frame. The bottom of the liner would still require a metal frame to shape the discharge area. This area would be covered with the flexible liner. The liner can also be connected to pipe penetrations. Retrieval from the liner could be performed through an opening at the bottom. Retrieval by sucking the sludge would be difficult since the suction wand could draw in the liner slowing the process of removal. Once cleaned out the liner system could be grouted in place.

### Design:

**Technical maturity including:** This use of flexible liners for this application is common in industry. However use of flexible liners for this small of a pit is not common at Hanford.

**Material compatibility with the sludge:** There is should material compatible with the waste. Some research would be required to find the specifics and provide the technical backup.

**Nominal volume to be collected 36 m<sup>3</sup> (47 max):** This requirement can be met Accumulation containers shall be self-supporting/free standing and shall continue to contain sludge in the event of a basin leak (second part also may be regulatory requirement). The liner can be made self standing.

**Design shall not preclude volume measurement/determination (also process);** volume measuring could be accomplished.

**KE Basin interim storage configuration** will not lead to localized temperature excursion. The configuration should prohibit the local temperature excursion. However, if a local temperature excursion were to happen the material could be a problem.

### Installation:

**Schedule** Several unknowns with design. A source would have to be found to produce the liner. Fabrication of the support would be more complicated and require more assembly time.

**New equipment fits within existing weight (crane) and dimensional envelopes** This would not be a problem.

### Retrieval:

Sludge collected in KE containers can be retrieved for transfer to KW

### D&D

The installation fits into the D&D plan. The flexible membrane could be a problem if the sludge is suction out of the liner. A flexible liner would interfere with the suction wand

slowing the retrieval process down. Grouting could be a problem if the grout does not adhere to the liner material.

#### Evaluation:

Category	Design	Installation	Retrieval	D&D	Total
Ranking	2	2	3	3	10

#### Rigid plastic liners:

Rigid plastic liners would be made from materials such as high density polyethylene (HDPE). HDPE liners are installed in the same manner as the permeable liners with the exception that there isn't a need to leave a space between the liner and the wall. The HDPE is thicker and stiffer than the flexible membrane so the support frame could be simpler. The installation requires special pieces made for the corners that could be a long lead item. The stiffness of the HDPE liner would require the liner to be placed in sections. The joints between sections will require extrusion welding. Where extrusion welding is common in the industry, extrusion welding in the basin will require special training and equipment making this liner installation difficult. The bottom of the liner would still require a metal support with the liner fabricated to match. Retrieval from the liners could be accomplished either by a port in the bottom or by suction. Suction on this type of liner would be successful since the liner material is stiff. Once the sludge is removed and the liner cleaned the liner system could be grouted. The only concern with grouting would be adhesion between the grout and the liner, since the grout may not stick to the HDPE.

#### Design:

Technical maturity including: This use of HDPE for this application is common. .

Material compatibility with the sludge. The material should be compatible with the waste. Some research would be required to find the specifics

Nominal volume to be collected 36 m<sup>3</sup> (47 max): This requirement can be met

Accumulation containers shall be self-supporting/free standing and shall continue to contain sludge in the event of a basin leak (second part also may be regulatory requirement). The liner can be made self standing by using a metal frame. If this turns out to be a regulatory issue, this would be easy to sell.

Design shall not preclude volume measurement/determination (also process): Volume measuring could be accomplished

KE Basin interim storage configuration will not lead to localized temperature excursion. The configuration should prohibit the local temperature excursion. However, if a local temperature excursion were to happen the material could be a problem.

#### Installation:

Schedule Several unknowns with design. A source would have to be found to produce the liner. The liner material is very rigid and would have to be install in sections. The section would have to be welded together in the field or a more elaborate frame be fabricated to make the liner leak tight.

New equipment fits within existing weight (crane) and dimensional envelopes. This would not be a problem.

#### Retrieval:

Sludge collected in KE containers can be retrieved for transfer to KW

#### D&D

The installation fits into the D&D plan. Remove of the sludge from the HDPE will be successful. Grouting could be a problem if the grout does not adhere to the liner material.

#### Evaluation:

Category	Design	Installation	Retrieval	D&D	Total
Ranking	3	2	4	2	11

#### Ridged Plastic tanks:

This would be a free standing tank similar to a metal liner. The material used is Copolymer Polypropylene. The copolymer polypropylene is thermal plastic and the vendor wasn't aware of material resistance to radiation. The liner is reinforced with a metal frame. The metal support pieces are encapsulated by the plastic. The liner would be fabricated offsite in pieces small enough to transport from the entrance of the KE basin to the pits, and bolted together using gaskets to make the liner leak tight. Liner fabrication would be performed out of the area. The vendors primarily make smaller tanks and, where fabricating a larger tank seems achievable, some changes to their standards would be required. Retrieval would be the same as the metal tank and can be accomplished either through a bottom nozzle or by suction out of the top. After the sludge has been removed and the liner cleaned the liner could be grouted. The only concern is the adhesion of the grout to the liner material. If the grout doesn't adhere there would be a separation between the grout and the liner.

#### Design:

Technical maturity including: This use of rigid plastic tanks for this application is common. However, this size of tank is larger than normal and will require more attention during design.

Material compatibility with the sludge. The material should be compatible with the waste. Some research would be required to find the specifics

Nominal volume to be collected 36 m<sup>3</sup> (47 max). This requirement can be met

Accumulation containers shall be self-supporting/free standing and shall continue to contain sludge in the event of a basin leak (second part also may be regulatory requirement). The plastic tank is self standing by tank. If this turns out to be a regulatory issue work would have to be done to show material is compatible.

Design shall not preclude volume measurement/determination (also process). Volume measuring could be accomplished

KE Basin interim storage configuration will not lead to localized temperature excursion. The configuration should prohibit the local temperature excursion. However, if a local temperature excursion were to happen the material could be a problem.

**Installation:**

Schedule: Several unknowns with design. A source would have to be found to produce the tank. Preliminary search shows the tank would have to be fabricated out of the area. The plastic tank will have to be install in sections.  
New equipment fits within existing weight (crane) and dimensional envelops. This would not be a problem.

**Retrieval:**

Sludge collected in KE containers can be retrieved for transfer to KW

**D&D**

The installation fits into the D&D plan. Remove of the sludge from the plastic tank will be successful. Grouting could be a problem if the grout does not adhere to the liner material.

**Evaluation:**

Category	Design	Installation	Retrieval	D&D	Total
Ranking	3	2	4	2	11

**Metal Liners:**

The metal liner would be a free standing liner. The materials used could be either painted carbon steel or stainless steel. The materials are acceptable in a radiation environment. The liner would be fabricated by a local vendor in pieces small enough to transport from the entrance of the KE basin to the pits. The pieces will be bolted together using gaskets to make the liner leak tight. This is a common method used to line pits and has been used before. Sludge retrieval from the liner can be accomplished by suction from a pipe at the bottom or by suction out of the top. After the sludge has been removed and the liner cleaned the liner could be grouted.

**Design:**

Technical maturity including: This use of steel liners for this application is common. There are any particular unknown challenges.

Material compatibility with the sludge. The material is compatible with the waste. Nominal volume to be collected 36 m<sup>3</sup> (47 max). This requirement can be met Accumulation containers shall be self-supporting/free standing and shall continue to contain sludge in the event of a basin leak (second part also may be regulatory requirement). The metal tank is self standing. If this turns out to be a regulatory issue, this would be easy to sell.

Design shall not preclude volume measurement/determination (also process), Volume measuring could be accomplished.

KE Basin interim storage configuration will not lead to localized temperature excursion. The configuration should prohibit the local temperature excursion. However, if a local temperature excursion were to happen the material will not be a problem.

#### Installation:

Schedule: This is a common application and can be fabricated and install to meet schedule. The liner is fabricated in sections. Gasket flanges will be used to make the tank leak tight.

New equipment fits within existing weight (crane) and dimensional envelopes. This would not be a problem.

#### Retrieval:

Sludge collected in KE containers can be retrieved for transfer to KW

#### D&D

The installation fits into the D&D plan. Remove of the sludge from the will be successful. Grouting will not be a problem.

#### Evaluation:

Category	Design	Installation	Retrieval	D&D	Total
Ranking	4	4	4	4	16

#### Ranking Summary:

Category Option/Ranking	Design	Installation	Retrieval	D&D	Total
Permeable liner	2	2	2	2	8
Flexible liner	2	2	3	3	10
Rigid Liner	3	2	4	2	11
Plastic Tank	3	2	4	2	11
Metal Tank	4	4	4	4	16

### Attachment 3      Graham MacLean Input

#### Introduction

The process of collecting the sludge from all locations in the K East Basins and placing it in a container, so as to isolate it from the basins water, is composed of four functions:

- Capture or entrain the sludge
- Separate solid particles and pieces larger than about 0.25 inches in diameter
- Move the sludge to the container
- Separate the sludge solids and water so as to concentrate it for storage

The first function is performed with a vacuum head, the second with a strainer, the third with an underwater slurry pump, and the fourth (solid-liquid separation) is the subject of this paper.

#### Solid-Liquid Separation

The sludge is slurried with basin water and pumped to a collection container, such as lined basin pits. A settling enhancement device, such as an inclined plate separator, or a heavy and large particle separator, such as a hydrocyclone, can be employed to improve the process. It is estimated that the slurry concentration will not exceed 10% solids by volume, and will likely average less than a few % due to the large amount of water that will be vacuumed with the sludge (see KE-SWS PFD, H-1-86776 or HNF-FMP-02-13724-RO). When or before it is deposited into the container, the slurry must be concentrated so the solids can be contained in a reasonable size container.

It is estimated that to be contained in the two Tech View Pits, the slurry will have to be concentrated back to the approximately the original sludge solids concentration. This is assuming that about 20 m<sup>3</sup> of sludge can be placed in each pit. If the Weasel Pit is also used, the concentration can be more in the range of freshly settled or "fluffed" sludge, which is about twice the volume or half the concentration of compacted sludge ("The Settling and Compaction of Nuclear Waste Slurries," G. T. MacLean, Paper 132G, AIChE Spring National Meeting, March 2000). Therefore, most of the water that is contained in the sludge slurry must be removed to permit storage in the pits.

There are many devices for separating water from solids, but the only ones that are appropriate for metal hydroxide based slurries and underwater operation are filters, gravity settlers, and hydrocyclones. The last are useful only for separating relatively dense and large particles from a stream, such as sand or metal particles from a metal hydroxide slurry. The basin sludges are mainly composed of iron hydroxide, uranium oxide and hydroxide, and aluminum hydroxide, with various amounts of dirt, sand, uranium metal, ion exchange resin beads, etc. (HNF-SD-SNF-TI-009, "105-K Basin Material Design Basis Feed Description for Spent Nuclear Fuel Project Facilities, Vol. 2,

Sludge"). For the purpose of separating sludge particles from water in an underwater environment, filters or settlers must be used.

In the filter category, there are pressure filters with flow perpendicular (dead end) or parallel (cross-flow) to the media, and granular media filters (sand/garnet/anthracite). Granular media filters are useful for removing low concentrations of solids, but not for filtering slurries such as will be encountered in the K Basins. They do not have the capacity to hold larger amounts of solids. Cross-flow filters are being used in the Hanford Waste Treatment Plant, and have been proposed by BFNL for the K Basins. Operating pressures are high, flux rates are very low, and size and cost are high for this type of filter.

The remaining category is conventional pressure filtration, in which filter media plates, belts, cartridges, sintered metal or ceramic tubes, bags, etc. can be used. These filters all require the use of filter aids (such as diatomaceous) with metal hydroxide sludges to prevent rapid plugging. Since the use of filter aids is not desirable with K Basins sludges, as it adds substantially to the quantity of waste and presents difficulties in handling, pressure filters are not well suited for metal hydroxide sludges in underwater service.

The last type of equipment for separating metal hydroxide based solids from water is gravity settlers, the main stay of the solid-liquid separation business. These devices can be enclosed tanks or open basins, but they all rely on the higher density of the solids to cause the solids to settle through the liquid and form a sludge on the bottom of the vessel or basin. Inclined plates can be added to substantially reduce cross sectional area, and baffles can be added to horizontal flow tanks to enhance settling. This is the type of device that is most suitable for use in sludge removal and confinement in the K Basins.

### Flocculation

Metal hydroxide based slurries do not settle rapidly (see "Thickening and Dewatering of Hydroxide Sludges," J. H. Warden, Chpt. 7 in possession of G. T. MacLean). This is because of the small particle size (from less than one to ten or more microns) and the morphology of the particles. Metal hydroxide particles are composed of nanometer scale particles bound into 1-10 micron snowflake like particles (PNL-10761, "Effect of Colloidal Aggregation on the Sedimentation and Rheological Properties of Tank Wastes"). These particles do not behave like salt granules or solid spherical particles, and they typically settle as intertwined mats. As a result, slurry flow or settling properties cannot be determined based on particle size, as with sand or coal slurries. Zone settling rate tests (Standard Methods for the Examination of Water and Wastewater, Procedure 2710E) are generally required to provide data for designing settling processes ("Improve Clarifier and Thickener Design and Operation," p. 50, Chem. Eng. Prog., July 1994).

In order to achieve practical separation of slow settling particles slurries, flocculants have been developed that bind together particles. Organic flocculants are typically long chain organic polymer molecules with ionic ends that are attracted by the surface charges on the particles. Cationic acrylamide based flocculants have been found to work well with K



East Basins sludges (Process Chemistry and Development Laboratory letter 76754-PCS96-059, "Results from Flocculant and Filtration Testing on 105-K Basin Water"). Slurries composed of K Basins sludges are known to disperse easily and be difficult to settle. Success in using gravity settling as a method to separate water from the solids in the available pits will very likely require the use of a flocculant (WHC-SD-SNF-ES-008, "K Basin Sludge Retrieval Flocculant and Material Compatibility Evaluation").

If basin sludge slurry is fed to both Tech View pits in parallel, the upflow velocity will be about 1.5 m/hr (assuming 60 gpm flow rate and about 100 ft<sup>2</sup> or 9.3 m<sup>2</sup> cross sectional total area). If the Weasel pit is also included, the velocity will be somewhere around 0.5 m/hr. Actual settling data for K East Basins sludge is very limited (WHC-SP-1182, "Analysis of Sludge from Hanford K East Basin Floor and Weasel Pit," Appendix L). The only meaningful zone settling curve in the above reference is shown in Fig. L2, which appears to have a maximum settling rate of about 2-3 cm/hr, very typical of Hanford tank wastes (HNF-5177, "The Settling and Compaction of Nuclear Waste Slurries") and metal hydroxide slurries in general. Therefore, the probability that the slurry can be settled without flocculation by pumping to the three pits in parallel is small.

If it is assumed that particles equal or less than 10 micron in size are the only ones that will be in slow settling sludge, than in general 25% or greater of the sludge will overflow the pits and be returned to the basins as a fine suspension. A very cloudy appearance can result from concentrations as low as 100 ppmv, and 25% of the sludge could be as high as 25,000 ppmv (based on the design value of 10 volume % solids in the pumped slurry).

Since good results were obtained with a commercial flocculant (Letter 76754-PCS96-059, cited previously), it is recommended that any process to settle sludge include the proper addition and mixing of a flocculant into the slurry stream ahead of the settler, whether it be a lined pit, an inclined plate device, or a tank. This is easily done with a static in-line mixer, with the flocculant addition just before the mixer. The systems for storing and pumping flocculant solutions are small, readily available commercially, and very suitable for use in the K East Basins area (see example flocculant mixing and feed systems in WHC-SD-SNF-ES-008, cited previously).

**Attachment 4      Nuclear Material Accountability**

-----Original Message-----

**From:** Schlegel, Steven C [mailto:sc.schlegel@pnl.gov]

**Sent:** Tuesday, January 27, 2004 9:54 AM

**To:** Sax, Scott M

**Cc:** Perkins, L F Jr (Lenny); Walton, Craig W; Bowser, Allen B; Schlegel, Steven C

**Subject:** RE: Sludge Accounting

The sludge in the KE and KW basins are not on nuclear material accounting records, now. The accounting records for each Basin are held at the fuel canister level. This is good for FH since we currently do not have a good way to inventory the sludge or implement other requirements. For example, if the material was on FH's accounting records, the sludge would require verification measurements involving sampling and destructive analysis every six months, a costly and schedule-impactive process. However, when FH starts to package and move the sludge, the nuclear material concentration is high enough to require documenting it on the accounting records. FH currently has a plan to address this requirement. It is included in a deviation for KW and in the FH contract, Modification 166, November 11, 2002, for KE.

Safeguards unsuccessfully pursued terminating Safeguards in place on the sludge in KE, prior to its packaging and removal/movement. Safeguards believed that with the concentration values calculated from the sludge characterization data and fresh sludge volume measurements, the sludge would be adequately measured for turn over to waste management. Under this plan, the whole basin of sludge would have been entered into accountability records, and, since the average Attractiveness Level for the whole basin was E, transferred to the waste account. This would have terminated Safeguards on the material and FH would transfer control of it to its waste management organization. FH Safeguards believes this is a reasonable approach, however RL did not approve.

Since RL will not approve terminating Safeguards on the sludge in place, FH has to measure the material upon packaging. This is approached differently in the two basins.

KE contains both Attractiveness Level D and E sludge populations with the "floor" sludge generally Attractiveness Level E and the canister sludge generally Attractiveness Level D. FH currently has a deviation to Safeguards measurement requirements allowing the use of existing characterization data and operational volume measurements from filling the Large Diameter Containers for the establishment of accountability values. By mixing sludge from different areas around the basin, the Attractiveness Level of every container can be made "E." Then, Safeguards can be terminated when the material leaves 100K and is turned over to FH waste management. Except for a small amount of additional paperwork, there is little operational impact as all required information is available from operational data and previously-acquired characterization data.

KW, as stated above, has the methodology for determining the accountability values for the Settler Piping, knock-out pots, and North Load out Pit defined in the FH contract with RL. A deviation to Safeguards measurement requirements is still required and Safeguards is working on that. The assumptions listed under Performance Objective 1c in Modification 166 include the following:

- The accountability value determination of the nuclear material (NM) located in the knock out pots in the K-West Basin will be determined by proportioning the total net knock out

pot weight (based on the scrap weight generated by each key), and multiplying the value by the NM concentration of scrap from each key, and summing up each portion to arrive at a total.

- The accountability value determination of the nuclear material (NM) located in the Settler Piping in the K-West Basin will be determined by proportioning the total net Settler Piping weight (based on the scrap weight generated by each key), and multiplying the value by the NM concentration of scrap from each key, and summing up each portion to arrive at a total.
- The North Loadout Pit sludge in K-West will be adequately characterized and measured to assign an accountability value. The same loading method as will be used for the K-East sludge, will be adequate for assigning accountability values to individual containers of this K-West sludge stream.

As can be seen in the third bullet immediately above, *sampling and destructive analysis* is required to establish the nuclear material concentration for the North Loadout Pit. The concentrations for the Settle Piping and knockout pots will be calculated. In fact, the concentrations for the first 10 knock out pots are already calculated. The knock out pots contain both Attractiveness Level D and E materials, and unless the Attractiveness Level D materials are diluted to Attractiveness Level E, the materials from these pots will be maintained on accountability records until shipment to WIPP similar to the Pipe-and-Go materials from PFP.

The only waste stream in KW that is not addressed in the contract is the floor sludge. Safeguards has met with engineers working on the KW sludge removal several times to discuss options; and Richard Sexton completed a paper in December describing the procedure that FH would like to use. In the paper, FH proposes to calculate the floor sludge concentration similar to the mathematical model used for calculating the concentrations in the knock out pots and Settler Piping. FH has not presented this proposal to RL, yet.

Recently, Safeguards has attended several meetings discussing alternatives to sending the sludge to T-Plant for storage. There is concern about the possible change involving moving the KE sludge to KW for storage. That will likely negate the KE deviation and the KW contractual language. If that happens, Safeguards will be there to try to help negotiate a reasonable approach with RL. Safeguards has already discussed some possible solutions with Wally Rutherford and others of your staff.

-----Original Message-----

**From:** Sax, Scott M

**Sent:** Friday, January 23, 2004 7:34 AM

**To:** Walton, Craig W; Schlegel, Steven C

**Cc:** Carter, Tim; Perkins, L F Jr (Lenny)

**Subject:**

Craig/Steve,

I am trying to come up to speed fast on sludge. Thus far it appears that there is no accountability values for the sludge on the books but we are still putting it onto the books and then terminating safeguards when shipping a LDC. This doesn't make sense to me. Can you prepare a short summary on the safeguards strategy associated with sludge for me to review and get up to speed?

In addition please look at terminating the safeguards on the north load out pit as is in the pit. It would remove work for both groups and in my opinion simplify our processes.

Scott Sax

**Attachment 5      Environmental Related Input**

-----Original Message-----

**From:** Watson, David J (Dave)  
**Sent:** Tuesday, January 06, 2004 2:16 PM  
**To:** Smith, Donald K (Kent); Umek, Anthony M  
**Cc:** Gurske, Richard H; Ruck, Fred A III; Winward, Robert T (Terry); Perry, Jon K; Shupe, Royal J; Rodriguez, C A (Ayoub); McKenney, Dale E; Suyama, Robert M; Erickson, Timothy L; Earley, Larry D  
**Subject:** Outcome of Meeting with EPA, January 7, 2004

Today's meeting with Larry Gadbois (EPA) was for the purpose of determining what type of change in CERCLA space the accelerated K Basins sludge disposal pathway is versus the selected remedy, i.e. remove and store at T Plant. Meeting with Larry were Carole Rodriguez (DOE-RL), Richard Gurske, Fred Ruck, Terry Winward, and myself. Here are some of the high points that are discussed in more detail below, some of which also involve the grout and remove deactivation approach for the basins:

- (a) DOE-RL can manage the removal of the 6.3 cubic meters of KE Basin NLOP sludge as a "time critical removal action". No ESD or ROD amendment is required for this.
- (b) EPA approval for "off site" treatment at of the KE Basin NLOP sludge at the 325 Building is still required and is pending issuance of PNNL's initial report and projected waste volume expansion due to treatment.
- (c) An amendment to the K Basins CERCLA ROD is necessary for the new accelerated sludge disposal pathway for the remaining sludge and that amendment should also include changes in the debris removal and deactivation approach associated the grout and removal of the basins.
- (d) A sludge end point criteria for not only the KE Basin NLOP but the rest of the basins need not be quantitatively defined but can be process defined.

Here are the points that came out of this meeting:

- 1. For the 6.3 cubic meters of sludge in the KE Basin NLOP, it was suggested this be managed as a "time critical removal action", a DOE-RL driven action (i.e. DOE-RL initiated and DOE-RL managed). Neither an Explanation of Significant Difference (ESD) or amendment to the Record of Decision will be necessary. DOE-RL will need to submit to EPA for concurrence a technical report describing the proposed action and how it will be performed in a manner that will be protective of human health and the environment. Larry will be providing a couple examples of such documentation. References to the Focused Feasibility Study (DOE/RL-98-66) and the current CERCLA ROD (including the response to public comments regarding sludge treatment) would be made. A Fact Sheet would be prepared and sent out for public consumption describing the new planning.
- 2. For the 6.3 cubic meters of KE Basin NLOP sludge, there is regulatory interest with respect to the volume of the treated waste in order to make it contact handled TRU waste. A volume increase of 100 times is not deemed economically and environmentally sound. It was explained that when PNNL completes their first phase of testing in mid January, we should have a better idea what type of volume increase would be necessary to create a CH TRU waste form. A suggestion was made to place this waste in a RH TRU waste form for interim storage at CWC if the volume

increase to make it CH was significant. This is an open item with EPA at this time. (Note: EPA has yet to grant approval for treatment of the 6.3 cubic meters of KE Basin NLOP sludge at the 325 Building, this is pending the issuance and conclusions of the PNNL report due the middle of the month).

3. For the remaining sludge (non KE Basin NLOP sludge) a ROD amendment is necessary since the proposed approach for treating the sludge to a RH TRU waste form ready for disposal at WIPP is different than the selected remedy in the CERCLA ROD. Larry consulted with one of EPA's attorneys in Seattle in which it was concluded a ROD amendment would be necessary. Larry pointed out there is an example in EPA's CERCLA work books just like what we have here in which the determination was that a ROD amendment was necessary. This CERCLA ROD amendment would also add the applicable, relevant, and appropriate requirements for disposal of waste at WIPP. This should be able to be done in time to support the schedule that was presented on December 15, 2003.
4. It was noted that the planned date for having the WIPP WAC amended to allow receipt of RH TRU waste was September 1, 2005 and this was a predecessor event for final sludge treatment. However it is planned to containerize the KE and KW sludge before that date.
5. As the K-Basins CERCLA ROD will need to be amended for the accelerated sludge disposal pathway, that amendment should also incorporate the changes in debris removal and deactivation stemming from the grout and remove deactivation approach. While the 100 Area Remaining Waste Sites CERCLA ROD already covers the removal of the KE and KW Basins, the extent of debris removal associated with the grout and remove deactivation approach is different.
6. With the changes occurring in sludge management that now include the disposal pathway and the changes in deactivation approach by grouting and removing the basins, Larry determined that it is now time to revise the K Basins Interim Remedial Action Remedial Design Report (DOE/RL-99-89).
7. The sludge end point criteria for use in determining when sludge removal from the KE Basin NLOP as well as the rest of the basins is complete was discussed. The sludge end point criteria (based on the grout and remove deactivation approach) need not be quantitatively defined but can be defined by the process and steps that will be taken to remove the basin sludge. For example vacuuming sludge on the basin floor with a single pass of an end effector including the lifting of the racks to get under them was offered as a possible sludge end point criteria. Coming back to get incidental sludge that has settled out on surfaces is not necessary so long as that does not impact the ability of the grout and remove waste form of the basins to meet the ERDF WAC.

Dave Watson  
373-3250

**Attachment 6. Nuclear Safety Input**

-----Original Message-----

**From:** Ryan, Grant W  
**Sent:** Monday, January 19, 2004 7:27 AM  
**To:** Sax, Scott M; Perkins, L F Jr (Lenny); Smith, Donald K (Kent)  
**Cc:** Erickson, Timothy L; Shupe, Royal J; Busche, Donna M; Ramble, Alan L; Ryan, Grant W; Carro, Craig A; Griffin, Gerald B (Gerry); Geisbush, Jon C; Williams, John D  
**Subject:** Nuclear Safety Thoughts on KE Basin Sludge Consolidation

Scott,

A major enabling assumption associated with the consolidation of the remaining K East basin sludge (after removal of the north load pit sludge) was that the installation and use of a lined pit for sludge consolidation could be authorized by FH via a negative USQ (i.e., proposed activity is negative and prior RL approval is not required).

You mentioned last week that engineering could use some assistance with respect to getting started on a conceptual design by having some basic input from Nuclear Safety. This message outlines the type of questions that would need to be answered from a Nuclear Safety perspective and I've added some information to help guide the conceptual and definitive design efforts. Documenting the information associated with the proposed activity will serve several purposes – (1) it will form the basis upon which to conduct the safety analysis process, (2) it will assist with the preliminary documented safety analysis decision that needs to be made regarding this project, and (3) and it will provide an overall understanding to interested parties regarding the path forward being pursued.

There are three areas to consider in order to maximize the possibility of a negative USQ for this proposed activity. These are listed below.

1. The design and location of intended facility modification.

- Where will the lined pit be located in the K East basin?
- Will the lined pit be a lined pit or tank?
- If it will be lined pit, what are the materials of construction?
- Will the lined pit or tank be of an "open top" design such that there is direct communication with the basin water? This is important because we know that the canister sludge generates hydrogen and requires mitigation/prevention if it is contained in a sealed container.

2. Installation methods of the intended facility modification.

- How will the lined pit/tank be installed?

A major consideration here is to maintain the integrity of the basins during installation/construction activities. These issues are usually reviewed at the work package stage of the facility modification; however, if we have the ability to consider these issues at the front end, then we should try and avoid hard spots and surprises later on.

- What interactions will the lined pit/tank have within the K East basin (e.g., is it anchored to the basin walls, grating, or superstructure)? Installation of anchors or other moorage into the Safety-Class basin walls would likely require prior RL approval of the activity.
3. Operation of intended facility modification.
- Will the pit/tank be filled with sludge using existing equipment (pumps, piping, etc.)?
  - Will the sludge being transferred to the pit/tank be preferentially segregated by operational action (e.g., specific retrieval pattern) or newly installed equipment (i.e., in-line separator, etc.)?
  - Will the pit/tank be filled through all underwater transfer operations? Transfers underwater will reduce/eliminate the possibility of an atmospheric spray release.

These are the major questions that I could come up with over the weekend.

As soon you have a project manager and project engineering resources assigned to tackle this task, please let me know and I will provide dedicated Nuclear Safety resources to participate so that we can help produce the necessary technical and safety basis documentation that will allow consolidation the remaining K East basin sludge into a lined pit.

Grant W. Ryan  
SNF Nuclear Safety Manager  
Phone: 376-5114  
Pager: 85-5913