Department of Energy
Washington, DC 20585

October 6, 2005

The Honorable A.J. Eggenberger
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, N.W., Suite 700
Washington, DC 20004-2901

Dear Mr. Chairman:

This is in response to your February 4, 2005, letter which expressed concerns about the continued difficulties and slow progress in the Sludge Retrieval and Disposition Project. On April 8, 2005, former Acting Assistant Secretary Paul Golan provided our path forward to resolve issues with this project to the Defense Nuclear Facilities Safety Board. Details are provided in the enclosure.

The Department of Energy remains committed to the safe removal of sludge from the K-Basins. Despite the challenges and issues associated with this complex activity, we believe that moving forward with containerization, transfer, and treatment to achieve a stable waste form still represents a significant improvement in risk reduction and cleanup progress.

If you have any questions, please call me at (202) 586-0738 or Mr. Dae Chung, Acting Deputy Assistant Secretary for Integrated Safety Management and Operations Oversight, at (202) 586-5151.

Sincerely,

Ines Triay

Dr. Inés R. Triay
Chief Operating Officer for
Environmental Management

Enclosure

cc: M. Whitaker, DR-1
K. Klein, RL

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

05-SED-0107

MAY 17 2005

Mr. R. G. Gallagher, President
and Chief Executive Officer
Fluor Hanford, Inc.
Richland, Washington 99352

Dear Mr. Gallagher:

CONTRACT NO. DE-AC06-96RL13200 – SAFETY AND ENGINEERING DIVISION (SED) ASSESSMENT REPORT A-05-SED-SNF-011, TECHNICAL ASSESSMENT OF FLUOR HANFORD INC. HOSE-IN-HOSE (HIH) SLUDGE TRANSFER SYSTEM

RL conducted an assessment of FHI's HIH sludge transfer system during the period January 20 to March 14, 2005. This assessment reviewed the associated engineering designs and supporting documentation to determine if any vulnerabilities exist. The assessment revealed operational, equipment, environmental, radiological, and schedule vulnerabilities that were supported by three findings and eight observations. Please provide a Corrective Action Plan in accordance with the criteria specified in SCRD O 0470.2B, describing causal analysis results and corrective actions being taken to address the findings, within 30 days of receipt of this letter. The response to the observations should indicate how they will be dispositioned. RL will retain closure authority for these findings and observations.

The Government considers this action to be within the scope of the existing contract and therefore, the action does not involve or authorize any delay in delivery or additional cost to the Government, either direct or indirect.

If you have any questions, please contact me, or your staff may contact Doug S. Shoop, Assistant Manager for Safety and Engineering on (509) 376-0108.

Sincerely,

Keith A. Klein
Manager

SED:CAA

Attachment

cc w/attach:
D. M. Busche, FHI
D. W. Fraley, FHI
H. Hermanas, FHI
P. M. Knollmeyer, FHI

DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE

TECHNICAL ASSESSMENT OF FLUOR HANFORD INC. HOSE-IN HOSE SLUDGE TRANSFER SYSTEM KE/KW BASINS

January 20–March 14, 2005

Assessment Number: A-05-SED-SNF-011

April 2005

U. S. Department of Energy
Richland Operations Office (RL)
Technical Assessment of Fluor Hanford Inc.
Hose-In-Hose Sludge Transfer System
KE/KW Basins

Report Approval

Assessment Team:

Burt Hill, DOE-RL,
Team Lead

Cliff Ashley, DOE-RL

Tom Nirider, DOE-RL

For
Dennis Anderson DOE-RL

Fred Beard, DOE-RL

Greg Morgan, DOE-RL

U. S. Department of Energy
Richland Operations Office (RL)
Technical Assessment of Fluor Hanford Inc.
Hose-In-Hose Sludge Transfer System
KE/KW Basins

EXECUTIVE SUMMARY

The DOE Richland Operations Office (RL) conducted a technical assessment of the Fluor Hanford Inc. (FHI) Hose-In-Hose Sludge Transfer (HIH) system, where the assessment team reviewed the associated engineering designs and supporting documentation to determine if any vulnerabilities exist. This assessment was conducted from January 20 to March 14, 2005.

The overall conclusion of this assessment is that the HIH system could operate as proposed. However, numerous vulnerabilities exist due to "fast track" scheduling of design and construction and the resulting willingness to accept incomplete engineering.

The following were the five areas of HIH system vulnerabilities presented to RL and FHI management on March 14, 2005.

- Operational
- Equipment
- Environmental
- Radiological
- Schedule

Since the HIH system design was continually being modified during this assessment, it was difficult for the assessment team to ensure that they were reviewing the most current design. The assessment team's feedback provided to FHI project management in some cases caused change to the HIH system design. These changes along with many others identified by FHI required the assessment team to review and re-review sub-HIH system designs. This partially explains the lengthy assessment review time, and difficulty in summarizing HIH system vulnerabilities.

The assessment team identified two noteworthy practices, three findings and eight observations which are listed below.

Noteworthy Practices

(1) *The FHI project management utilized a very rigorous and effective engineering change request and punch list system for tracking, trending, and documenting engineering changes.*

(2) *The FHI project management utilized a comprehensive and detailed schedule system to monitor progress made on HIH system activities.*

U. S. Department of Energy
Richland Operations Office (RL)
Technical Assessment of Fluor Hanford Inc.
Hose-In-Hose Sludge Transfer System
KE/KW Basins

Findings

(F-1) Finding A-05-SED-SNF-011-F01
The master pump shutdown system does not stop sludge flow.

(F-2) Finding A-05-SED-SNF-011-F02
ALARA concerns for personnel contamination and environmental impact exist due to inadequate mitigation of splash, spray, and splatter exiting the booster pump boxes.

(F-3) Finding A-05-SED-SNF-011-F03
Primary hose growth is not formally analyzed.

Observations

(O-1) Observation A-05-SED-SNF-011-O01
Incomplete fast track engineering caused cost and schedule increases.

(O-2) Observation A-05-SED-SNF-011-O02
The stated time of 40 hours of system operation to move KE sludge is not possible to achieve.

(O-3) Observation A-05-SED-SNF-011-O03
Pump erosion testing was based on hours of operation, not directly on the volume of sludge pumped.

(O-4) Observation A-05-SED-SNF-011-O04
"Fast Track Approach" results in incomplete engineering and greater risks.

(O-5) Observation A-05-SED-SNF-011-O05
The shielding analysis does not incorporate an emergency response for a concentration of debris in the hose.

(O-6) Observation A-05-SED-SNF-011-O06
Pump seal reliability will be in jeopardy if not protected from a reverse differential pressure.

(O-7) Observation A-05-SED-SNF-011-O07
Probability of rupture disk activation could have been reduced by selecting a higher design pressure.

(O-8) Observation A-05-SED-SNF-011-O08
There is a general lack of immediate contingency planning developed at this point in time.

U. S. Department of Energy
Richland Operations Office (RL)
Technical Assessment of Fluor Hanford Inc.
Hose-In-Hose Sludge Transfer System
KE/KW Basins

TABLE OF CONTENTS

U. S. Department of Energy
Richland Operations Office (RL)
Technical Assessment of Fluor Hanford Inc.
Hose-In-Hose Sludge Transfer System
KE/KW Basins

1. INTRODUCTION

The DOE Richland Operations Office (RL) conducted a technical assessment of the Fluor Hanford Inc. (FHI) Hose-In-Hose Sludge Transfer (HIH) system, where the assessment team reviewed the associated engineering designs and supporting documentation to determine if any vulnerabilities exist. This assessment was conducted from January 20 to March 14, 2005.

2.0 Background

The Safety and Engineering Division (SED) was requested by the Assistant Manager for Central Plateau (AMCP) to perform an assessment of the HIH project looking for vulnerabilities in the design and schedule. The RL assessment team had a great deal of interest in the selection of the pumps and the materials used to manufacture them. RL consulted with a senior mechanical engineer with many years of direct experience in pumping erosive slurries and who was highly recommended by Krebs Engineers, a world leader in the development and manufacturing of slurry pumping equipment. Also, the BNFL HIH hydraulic analysis was evaluated by a DOE-RL fluid flow expert.

3.0 ASSESSMENT RESULTS

The following is a discussion of the noteworthy practices, findings, and observations derived from the team's assessment of the HIH system design efforts.

The overall conclusion of this assessment is that the HIH project could operate as proposed. However as previously discussed, numerous vulnerabilities exist due to "fast track" scheduling of design and construction and the resulting willingness to accept incomplete engineering.

The assessment revealed issues with FHI's HIH system design efforts, as indicated by the findings and observations discussed in the following sections.

3.1 Noteworthy Practices

(1) **The FHI project management utilized a very rigorous and effective engineering change request and punch list system for tracking, trending, and documenting engineering changes.**

(2) **The FHI project management utilized a comprehensive and detailed schedule system to monitor progress made on HIH system activities.**

U. S. Department of Energy
Richland Operations Office (RL)
Technical Assessment of Fluor Hanford Inc.
Hose-In-Hose Sludge Transfer System
KE/KW Basins

3.2 Findings

(F-1) Finding A-05-SED-SNF-011-F01

The master pump shutdown system does not stop sludge flow. (ENG-CM, CONOPS-EQCTRL, RADCON-ALARA, QA-DESIGN)

Requirement: *10-CFR-830.122 (f)(2) states, "Incorporate applicable requirements and design bases in design work and design changes."*

Discussion: The PDSA requires the master pump shutdown to shut down all pumps providing sludge transfer. When activated, the master pump shutdown system stops eight of nine pumps in series that provides water for sludge transfer. It does not stop the IXM pump or flow from the IXM system that provides the dilution water for sludge transfer. The contractor has been informed of this and is designing an isolation valve to secure the flow when the master pump shutdown system is activated.

RL Closure Required: YES [X] NO [ ]

(F-2) Finding A-05-SED-SNF-011-F02

ALARA concerns for personnel contamination and environmental impact exist due to inadequate mitigation of splash, spray, and splatter exiting the booster pump boxes. (RADCON-ALARA, ISMS-ANALYZE, CONOPS-EQCTRL, QA-DESIGN)

Requirement: *CRD O 420.1A, Section 4.1.1.2, first sentence states, "Nuclear facilities shall be designed with the objective of providing multiple layers of protection to prevent or mitigate the unintended release of radioactive materials to the environment. Defense in depth shall include: ...the use of successive physical barriers for protection against the release of radioactivity...."*

Discussion: The Preliminary Documented Safety Analysis (PDSA) for KE to KW sludge transfer states that the safety functions of the booster pump boxes are to mitigate direct release of spray, splash and splatter from a leak in the box, while at the same time allowing the hydrogen to escape to preclude a deflagration. The boxes do provide some mitigation of direct releases and vent hydrogen. However, they do not adequately prevent or mitigate the unintended release of radioactive materials to the environment via three open vents located on top of each pump box. Poor characterization of the sludge in relation to production of hydrogen results in a design that allows some release of contamination in order to assure sufficient hydrogen venting occurs.

Due to the high operating pressure of the booster pumps relative to the design pressure for actuation of the passive rupture disks (380 psi vs. 500 psi), improper operator action or a system upset will cause the rupture disk to activate causing spray and splashing in the box, which may release a small amount to the environment. This creates a likely, but unnecessary potential uptake and contamination hazard to the workers and environment. Using some type of splash shield or demister on the box vents would provide a low cost, highly effective method of preventing (or significantly reducing) unintended releases.

RL Closure Required: YES [X] NO [ ]

(F-3) Finding A-05-SED-SNF-011-F03

Primary hose growth is not formally analyzed. (NUC-USQ, CONOPS-EQCTRL, ISMS-IDHAZ, ISMS-ANLYZE, QA-DESIGN)

Requirement: *10-CFR-830.122 (f)(1) states, "Design items and processes using sound engineering/scientific principles and appropriate standards."*

Discussion: It is expected that the inner hose will grow approximately 0.06 inches per foot, or about 30 inches, which is less than 1% of the approximate 500 foot distance between booster boxes. The outer hose will not grow significantly, causing the inner hose to snake within the outer hose. The snaking of the hose will cause an unforeseen number of bends with undetermined radii. The KE sludge transfer system inner hose is totally constrained by the outer hose, unlike tank farms where the outer hose is open to a pit. Informal calculations by the contractor show the outer hose can contain the inner hose with up to 4% growth without creating a problem. This issue was not even considered by the contractor until raised by the assessment team. Due to cost and schedule, the contractor does not intend to perform formal calculations. The inner hose is classified as safety significant and the design of the hose should be formalized.

RL Closure Required: YES [X] NO [ ]

3.3 Observations

(O-1) Observation A-05-SED-SNF-011-O01

Incomplete fast track engineering caused cost and schedule increases. (ENG-RQMNTS, ENG-DSCNTL, QA-DESIGN)

Discussion: When the booster pumps were manufactured and tested they overloaded the 50 HP motors. 75 HP motors were successfully coupled to the pumps and tested. The contractor believes the wipe out vanes on the seal side of the impeller were not taken into account when the 50 HP requirement was derived.

This unexpected design change during construction has a significant ripple effect on the design requirements of other components. The electrical cabling, the variable speed motor controllers, and the motor breakers must now be upgraded with higher load rated equipment to accommodate the larger motors, along with changes to the motor platforms, shaft couplings, and drawings. These changes are still ongoing.

RL Closure Required: YES [X] NO [ ]

(O-2) Observation A-05-SED-SNF-011-O02

The stated time of 40 hours of system operation to move KE sludge is not possible to achieve. (ENG-RQMNTS, QA-DESIGN)

Discussion: Forty hours operation of the sludge transfer pumps is what has been stated as needed to transfer the 36 cubic meters of available sludge. This could only be true if during those forty hours the sludge transfer is continuously taking place at the design maximum concentration of 1.77 %.

It is not possible to maintain this concentration continuously during operation; at best this concentration can only be maintained intermittently. Testing of the dilution system showed the concentration was automatically maintained at an average of about 1% when set at the design concentration, meaning that 1.77% is the maximum concentration the dilution system will allow. When the system senses this concentration more water is directed to reduce the concentration. To make the dilution system control at an average of the design concentration would require allowing the control system to knowingly overshoot the design concentration so that during the natural hunting of the control system the average would be approximately 1.77%. Additionally there will be periods of operation when the water lances are being used manually to clean out the tanks, where the concentration may be quite low.

It is very probable that the actual system operating time for removal of KE sludge is double or more the advertised time.

RL Closure Required: YES [X] NO [ ]

(O-3) Observation A-05-SED-SNF-011-O03

Pump erosion testing was based on hours of operation, not directly on the volume of sludge pumped. (ENG-RQMNTS, QA-DESIGN, QA-INSP)

Discussion: The testing used the design concentration of 1.77% for 50 hours and then a concentration of 0.5% for another 50 hours. The tables in *RPT-0105455-M-00012 Rev A,* dated March 3, 2005, show that this reduction in concentration of a little more than 3

(1.77% to 0.5%) results in approximately a reduction of 2 in the rate of erosion taking place on the pump casing. The implication here is that even with lower than design concentrations, but with longer than stated times (see observation above), the reduction in erosion is not linear with the change in concentration. Therefore the rate of erosion will still be significant even if the concentration is low. If the expected operational time increases significantly, then reaching minimum wall thickness and loss of pump integrity becomes significantly more likely.

RL Closure Required: YES [X] NO [ ]

(O-4) Observation A-05-SED-SNF-011-O04

"Fast Track Approach" results in incomplete engineering and greater risks. (QA-DESIGN, ENG-RQMNTS, ENG-DSCNTL, CONOPS-EQCTRL, RADCON-ALARA, ISMS-IDHAZ)

Discussion: Schedule does drive the contractor to accept more risk. BNFL did provide a discussion in RPT-0105455-M-00012 where they expressed the thought for the booster pumps that while harder material or modifications may well be beneficial "the project schedule does not permit such development. Any reduction in erosion can only be estimated without performing additional testing."

The duplex stainless steel pump impeller and casing are relatively soft and do not resist erosion well. This material is good at resisting corrosive environments which do not exist in this HIH transfer. The ph of the basin water is 6.8 which would make harder less corrosion resistant materials well suited. In *RPT-0105455-M-00012 Rev A Dated 3/3/05* BNFL concluded that the production pump would reach min wall thickness (lose pump integrity) when pumping at or near the volume of sludge in K Basins East and recommended a second pump be used in each of the four booster station assemblies. The pump design includes a pump wall thickness monitoring system using ultra sonic probes placed strategically around the pump casing where the maximum wear took place on the test pumps.

An issue emerges from the BNFL analysis showing that the booster pumps will lose their integrity at or near the volume of sludge being pumped from KE. The issue is reaching minimum wall thickness during operation and the possibility of a leak developing, resulting in contamination of the booster station enclosure. Mitigation of this problem will depend entirely on process controls, used to monitor wall thickness, that are still being developed.

It should be pointed out the testing logic and processes used to upscale the test data and determine that the production pump would lose integrity at or near 36 cubic meters in KE could have been used with commercially available data of better suited materials to make significant improvements to pump integrity.

This "fast track approach" is at the root of most the findings and observations in this report. Below is a listing where this approach has had a direct effect.

- Lack of good characterization of the sludge in relation to hydrogen production.
- Increased probability of activating a rupture disk.
- Seal reliability.
- Optimum materials not used in pumps.
- Hose growth not formalized.
- Decision to not remove the major solids before pumping.

RL Closure Required: YES [X] NO [ ]

(O-5) Observation A-05-SED-SNF-011-O05

The shielding analysis does not incorporate an emergency response for a concentration of debris in the hose. (EP/SEC-EP, RADCON-ALARA, ISMS-WORK)

Discussion: There are a number of low points in the hose, such as the approaches to the booster boxes, rail road tracks, or under roadway tunnels where a concentration of debris could develop if an unplanned shut down occurred during sludge transfer. The calculated dose from a 6 inch long accumulation of sludge is 32 R/hr at 30 cm. This adds a degree of complexity requiring clear contingency plans. Process controls that are being developed and the emergency response procedures are needed to mitigate this issue.

This phenomena of having local concentrations of debris will also mimic one of the tell tail signs of a hose leak by creating localized hot spots on the outer hose.

RL Closure Required: YES [X] NO [ ]

(O-6) Observation A-05-SED-SNF-011-O06

Pump seal reliability will be in jeopardy if not protected from a reverse differential pressure. (QA-DESIGN, ENG-RQMNTS)

Discussion: The seals for the booster pumps are special in that they contain a barrier fluid that the manufacturer recommends to be kept at 20 to 50 psi above system pressure. Additionally, the materials (tungsten carbide) used in the seal rings on the pump side can not operate at differential pressures much over 120 psi. A very small amount of barrier fluid must continually flow across the seal faces to provide lubrication. If pressure were equalized, just the centrifugal force generated at the pump seal is enough to push slurry over the seal surfaces and into the seal cavity. In addition, if system pressure exceeds seal pressure the seal will be unseated and slurry will be forced over the seal surfaces and into the seal cavity. FHI is recommending setting the barrier fluid at a pressure which is higher than the suction pressure at the seal during normal operation, and lower than 100 psi. This sounds reasonable if there were no likely mechanisms to cause a reverse differential pressure. The following is a list of probable circumstances that can raise system pressure higher than seal pressure.

1. Standby pump 3-way discharge valve may not be pressure tight and allow the seal to see discharge head of the running pump.
2. During system operation an upset causing a running pump to shut down could cause the seal on that pump to see a very high reverse differential pressure injecting quantities of slurry into the seal.
3. Inadvertent startup of a booster pump in fact could cause a high reverse D/P at the seal of the next pump in the series.

Slurry entering the seal will likely cause the outboard seal (has carbon seal ring) to fail with a loss of barrier fluid and contamination of the booster box. In the cases where very little slurry concentration would enter, such as inadvertent startup or from the discharge valve not being pressure tight, it is less likely to fail the seal. The addition of a volume of liquid to a seal may result in an increase in pressure as the nitrogen float is compressed. In order to prevent this John Crane, the seal manufacturer, recommended a tracking regulator that would operate from a high pressure nitrogen bottle and maintain a constant D/P under all conditions of operation. The risk imposed here is slight but possible, but due to where the project is in construction the schedule will not allow the addition of the tracking regulator system.

RL Closure Required: YES [X] NO [ ]

(O-7) Observation A-05-SED-SNF-011-O07

Probability of rupture disk activation could have been reduced by selecting a higher design pressure. (QA-DESIGN, ENG-RQMNTS)

Discussion: The operational pressure is approximately 380 psi, which is 120 psi from the rupture disk activation of 500psi, which is the design pressure. Operational upsets due to equipment failure or personnel error can cause the pressure at one or more of the booster pump stations to activate a rupture disk. The probability that a rupture disk may be activated could have been reduced by selecting a higher design pressure. The design pressure was selected before testing was completed that showed the actual burst pressure of the hose. The test data along with using the Rubber Manufacture Association Standard would have allowed a higher operating pressure to be selected. Allowing the rupture disks to be set at a higher pressure, beyond operational perturbations, would cause an activation of the rupture disk. At this point in time the entire system has been designed and procured as 500 psi system making it not practical to make changes.

RL Closure Required: YES [X] NO [ ]

(O-8) Observation A-05-SED-SNF-011-O08

There is a general lack of immediate contingency planning developed at this point in time. (QA-DESIGN, EP/SEC-EP, CONOPS-QACTRL)

Discussion: Emergency response and operational procedures are being developed and will need to be looked at closely prior to startup. The following is a list of upset conditions where prior immediate contingency planning for these upset conditions would prevent further degradation and aid recovery.

- Hose plugging
- Ruptured hose
- Leak or rupture disk activation in a booster station.
- Booster pump seal failure
- Localized high concentration of sludge in hose

RL Closure Required: YES [X] NO [ ]

4.0 CROSSWALK: VULNERABILITIES & FINDINGS/OBSERVATIONS

The following provides a crosswalk summary of system vulnerabilities identified and presented to RL and FHI management on March 14, 2005, to the findings and observations identified during this assessment.

4.1 Operational Vulnerabilities

- Operating up to 9 pumps in series via three separate control stations manned by operators with only radio communications
- Lack of an integrated design
- Maintaining radiological posting on a 2000' corridor

Related Findings and Observations:

Finding: (F-1)(F-2)(F-3)
Observations: (O-1)(O-4)(O-5)(O-6)(O-7)(O-8)

4.2 Equipment Vulnerabilities

- Pumps not designed for slurries

- Pump seal not protected from reverse differential pressures
- Questionable overpressure protection systems
- Hose growth
- Draining of hose
- Equipment disassembly/movement/eventual disposal

Related Findings and Observations:

Finding: (F-2)
Observations: (O-1)(O-2)(O-3)(O-4)(O-6)(O-7)

4.3 Environmental Vulnerabilities

- Booster Pump Station not designed to fully contain slurry, spray, mist from....
  - Overpressure protection systems
  - High pressure leakage due to pump seal failure
  - Design accident (worst case)
- An automatic pump shutdown does not stop the IXM flow which could continue to fill the booster containments.

Related Findings and Observations:

Findings: (F-2)
Observations: (O-2)(O-3)(O-4)(O-6)(O-7)(O-8)

4.4 Radiological Vulnerabilities

- Maintaining radiological posting on a 2000 foot corridor
- Worker Dose
- Worker Inhalation

Related Findings and Observations:

Finding: (F-2)(F-3)
Observations: (O-2)(O-4)(O-5)(O-6)(O-7)(O-8)

4.5 Schedule Delay Vulnerabilities

- Remaining equipment procurement, fabrication, system acceptance testing, and problem resolution.

U. S. Department of Energy
Richland Operations Office (RL)
Technical Assessment of Fluor Hanford Inc.
Hose-In-Hose Sludge Transfer System
KE/KW Basins

Related Findings and Observations:

Findings: All Findings
Observations: All Observations

U. S. Department of Energy
Richland Operations Office (RL)
Technical Assessment of Fluor Hanford Inc.
Hose-In-Hose Sludge Transfer System
KE/KW Basins

APPENDIX A-1

DOCUMENTS REVIEWED

1. Acceptance Inspection Plan, A-21 Spent Nuclear Fuel Project, KE & KW Sludge Retrieval and Storage, Plan No. A-21-001 Rev. 0, Approved October 5, 2004
2. Commercial Grade Item (CGI) Plan, A-21, Submittal No. 166, dated 1/25/05
3. K-East to K-West Erosion Evaluation, RPT-01054555-M-00012 Rev. A, (Preliminary dated February 7, 2005)
4. KW Sludge Retrieval and Storage System, Development Test Plan and Procedure for KE Container Retrieval Proof-of-Principle Test, PL-0105455-TP-00007 Rev. 0, dated November 4, 2004.
5. KW Sludge Retrieval and Storage System, Test Plan/Specification for Slurry Critical Velocity and Abrasion Test, Rev. 0, dated August 2, 2004
6. HIH-P-265 Pump Datasheet Booster Pump KW, DS-0105455-PR-00011, dated November 29, 2004.
7. HIH-P-112 Pump Datasheet Booster Pump KE, DS-0105455-PR-00006, dated November 29, 2004.
8. HIH-P-113 Pump Datasheet Con Suction Pump, DS-015455-PR-00007, dated November 29, 2004.
9. HIH-P-301, -302, -303, -304, -331, -332, -333, -334 Pump Datasheet, Pump Station 1, 2, 3, and 4 Booster Pump.
10. Hose in Hose Transfer Line (HIH), Presentation to RL, dated January 20, 2005.
11. APPCOR Letter to US-DOE-RL, Sludge Transfer from Basin K East to Basin K West, An Engineering Review of The Present System as Being Installed, dated March 7, 2005.
12. -KW Sludge Retrieval and Storage System, Test Plan/Procedure for Pump Erosion Development Test, PL-0105455-TP-00008 Rev. 0, dated December 28, 2004.
13. FHI Letter, Transmittal of Fluor Hanford Broader Scope Issues Summary Report; Sludge Water System, dated February 26, 2004.
14. KW Sludge Retrieval and Storage System SNF Project A-21, Detailed Design Report, HNF-22070 Rev. 0, dated January 24, 2005 (Report RPT-0105455-G-00001, Rev. 0 and all Appendix's)
15. KW SRSS Project, Hydraulic Analysis of the Hose-In-Hose Transfer Line Delivery System, HNF-22070, Rev 0, Appendix D-12, Dated January 12, 2005.
16. Preliminary Documented Safety Analysis for the KE to KW Sludge Transfer Project, SNF 21821 Rev. 0, Dated August 2004.
17. Statement of Work for Project A-21 for KW Sludge Retrieval & Storage System, A-21-SOW-001 Rev. 3, dated March 2004.
18. KE to KW Basin Sludge Transfer Accident Analysis Calculation Note and Appendix's, SNF-23230 Rev. A, (DRAFT), dated January 2005

19. KE to KW Basin Sludge Transfer Hazard Control and Analysis Allocation, SNF-21821 Rev. 0 (DRAFT), January 2005
20. High Pressure Instrumentation Vendor Data, 34-ST-03-57 (Honeywell)
21. KE-KW Transfer/KW Consolidation Schedule, Weekly Meeting Schedule, dated January 18, 2005.
22. KW Sludge Retrieval and Storage System, Test Procedure for Slurry Critical Velocity Test, PL-0105455-TP-00006 Rev. 0, dated August 24, 2004.
23. KW SRSS Project, KE/KW Hose-In-Hose Procurement Specification, SP-0105455-G-00003, Rev. 1, dated October 19, 2004.
24. KW Sludge Retrieval and Storage System, Construction Acceptance Test Procedure, for the Hose-In-Hose Transfer System Rev. 0, TSRT-0105455-QI-00005 Rev. 0, dated December 2004.
25. KW Sludge Retrieval and Storage System, Construction Acceptance Test Procedure, for the Hose-In-Hose Transfer System, Excluding Top Retrieval System, TSRT-0105455-QI-00006 Rev. 0, dated December 2004.
26. KW Sludge Retrieval and Storage System, Construction Acceptance Test Procedure, for the Hose-In-Hose Transfer System Top Retrieval Equipment, TSRT-0105455-QI-00007 Rev. 0, dated December 2004.
27. KW Sludge Retrieval and Storage Equipment, Fabrication Specification, SP-0105455-G-00001 Rev. 1, dated September 2, 2004.
28. KW Sludge Retrieval and Storage Equipment, Construction and Installation Specification, SP-0105455-G-00002 Rev. 1, dated October 20, 2004
29. Final ALARA Report for the KW SRSS Project, HNF-22072 Rev. 0, dated October 19, 2004.
30. KW SRSS Dose and Shielding Analysis, RPT-01-05455-SA-00003 Rev. 0, dated October 26, 2004.
31. K Basin Sludge Project SNF Project A-21, Safety Equipment List, HNF-22073 Rev. 0, dated September 20, 2004.
32. KW SRSS Project, Design Complex Matrix, HNF-22074 Rev. 0, dated January 21, 2005.Sludge Retrieval and Storage System, Test Plan, Rev. 0, dated October 15, 2004.
33. HIH Data Sheets
34. KW SRSS Drawings
35. Vendor pump documentation and drawings.
36. Vendor hose documentation.
37. FHI Punch lists, and Design Punch lists
38. Process Datasheets.
39. Engineering Change Notifications (ECN's)
40. Leak Detection Documentation
41. Draft HIH Operating Procedures
42. Comments on BNFL HIHTL hydraulic analysis (HNF-22070, Rev. 0- Appendix D-12), e-mail from Harry E. Bell, dated March 21, 2005

U. S. Department of Energy
Richland Operations Office (RL)
Technical Assessment of Fluor Hanford Inc.
Hose-In-Hose Sludge Transfer System
KE/KW Basins

APPENDIX A-2

PERSONNEL CONTACTED
(By Title)

1. FHI KW Sludge Project Manager
2. FHI Engineering Design Authority
3. FHI DFSH Project Manager
4. FHI KE/KW Transfer Project Manager
5. BNFL HIH Project Manager
6. BNFL HIH Project Engineer
7. BNFL HIH Project Designers
8. BNFL HIH Project Test Engineers/Specialists

Enclosure

EM Response to the Board February 4, 2005 Letter

Status of EM Sludge Review Board (SRB)
In our April 8, 2005, Department of Energy (DOE) response, we stated that a review board (the Sludge Review Board or SRB) would be convened to review the adequacy of the information available on K Basins sludge to determine whether we had sufficient information to have an adequate technical basis to proceed. In addition, sludge would continue to be containerized unless there was a condition that stopped the operation and the removal of racks and larger debris from the basins was accelerated while awaiting the SRB determination. The SRB completed their review and the final report was provided to you on May 26, 2005. While the members of the SRB shared your concern that the series of design changes to date were problematic, they did conclude that there was sufficient knowledge and understanding of the properties and characteristics of the sludge to proceed safely. The major factors cited by the SRB were the as-found physical conditions in the basins themselves and poor project management practices. To date, 7 of 12 recommendations have a final disposition and 6 have been closed by Richland Operations Office (RL) staff. Table 1 at the end of this enclosure contains the current status of all of the SRB recommendations.

Summary of Integrated Safety Management and Project Management Issues and the Current Corrective Actions
Our prior successful experience in vacuuming sludge from the top of the canisters and elsewhere in the basin proved not to be an adequate basis for confidence in our ability to move sludge from other parts of the basin. The contractor's plans did not reflect the degree of sludge compaction encountered, the varied types and amounts of debris interspersed in the sludge, and the clouding and capture issues resulting from accessing and mobilizing the sludge. As a result, the project schedule lacked realistic assumptions regarding the as-found condition of the sludge and sufficient contingency for incorporating lessons learned from confirmatory testing. This was a breakdown of Integrated Safety Management (ISM) at the project level. Without a complete picture of the required project scope, appropriate analysis of the hazards and appropriate controls were not possible. This is also a project management failure resulting from inadequate implementation of the defined project management processes since an analysis of the project risks was not performed and adequate mitigation measures were not identified and applied. DOE has now begun to develop the project schedule and risk mitigation plans in accordance with appropriate project management principles to correct these deficiencies. The selection of Mr. James A. Rispoli as the Assistant Secretary for Environmental Management underscores the DOE's commitment to use sound project management principles for work identification and ensure that deficiencies similar to those identified in the sludge project are not repeated. The Department will also be enhancing the DOE project management with the assignment of a Senior Qualified Federal Project Director for K Basins Closure Project who will report directly to the RL Manager.

Enclosure

Summary of Design, Engineering and Test Issues and the Current Corrective Actions

DOE concurs with your concern that K Basin Closure Project performance in the areas of engineering, design and testing, and work scope definition including the subsequent identification of hazards, has been inadequate at the project level and needs improvement. Many of the problems of poor work scope definition were manifested as a result of weakness in the application of basic project management principles. While the understanding of the work scope to be accomplished was lacking, the implementation of ISM principles at the activity level ensured that operations had adequately identified hazards and implemented appropriate workplace controls to safely perform the work. Poor performance in the areas of engineering, design and testing, and work scope definition at the project level has been and continues to be closely monitored by RL. RL increased the size of the Integrated Project Team for K Basins Closure project in October 2004 in direct response to the slow pace of work progress and poor performance in the areas of engineering and design. Since that time, RL has completed the Hose in Hose Transfer System (HHTS) Engineering Design Review. This review identified several areas that required design changes in order to assure the required safety functions could be maintained as required by the Functional Design Criteria. We have included this report as an enclosure to this response. The 3 Findings from the HHTS Engineering Design Review have been closed and 6 of 8 Observations have also been closed with the remaining two scheduled to be closed prior to transferring sludge. Additionally, RL will continue the increased oversight of the K Basins engineering organization and work products, with the current oversight focus being the installation of the HHTS components and review of the test documents for start up testing of the HHTS. While these technical reviews indicate the need for additional attention to detail in the areas of engineering and design, the fundamental failures that contributed to the inability to complete the first Sludge Water System Operational Readiness Review have been largely corrected. The manifestation of deficiencies today stem from weak implementation of engineering programs rather than the non-use of those programs as cited in the Broader Scope Issues Report. As part of the continuing increased oversight RL is planning an engineering design review of the sludge treatment process equipment once that equipment design reaches approximately 60% complete. This review will be on-going until the design is complete.

Results of Assessment on Effectiveness of Corrective Actions Taken to Address the Broader Scope Issues

The Broader Scope Issues Report was prepared from a review conducted of the K Basins Project after numerous deficiencies were identified with program implementation at the K Basins. The areas of concern included engineering and design and testing as discussed in the previous section, as well as project management deficiencies. Corrective actions were taken for all the deficiencies identified in the Broader Scope Issues Report and were recently evaluated for effectiveness by independent assessment with the RL oversight. The report has been shared with your staff. The review showed that corrective actions were effective; however, there remains room for improvement in the area of project management implementation. See the section titled Path Forward for

Implementation Plan Update – Risk Analysis for how the project management deficiencies are being addressed.

Summary of Future Corrective Actions
You also requested we discuss how future corrective actions will be evaluated for effectiveness. DOE shares your view of the importance of this aspect of corrective action management. The site corrective actions program requires corrective actions to be reviewed for effectiveness after all actions have been performed and closed. This review will typically be scheduled for 3 to 6 months after the last action is closed. This ensures both the correction of the base behavior and the continuing effectiveness of the action.

Efficacy of corrective actions has been a long-standing issue at the K Basins. RL continues to provide oversight of FH in this area and in many cases, retains closure authority for corrective action completions. RL has also directed the contractor to develop a Conduct of Operations Improvement Plan which will determine why corrective actions are not always effective and address the cultural issue of resistance to change in addition to ensuring solid processes to evaluate issues and determine sound corrective actions, and will define immediate and long-term actions to continue the culture shift required to address the repeated deficiencies in this area. RL will continue to scrutinize FH performance in this area with the already planned assessments conducted by the RL Safety & Engineering Department staff.

Path Forward for Implementation Plan Update–Risk Analysis
To address the impacts of previous project management failures, RL has directed that FH examine and revise the project schedule in accordance with site project management procedures to properly account for the project risks. The risk assessment process consists of four main steps: identification, analysis, response, and management. Brainstorming sessions are held with key project team members to identify the risks. Once the risks are identified, the likelihood of occurrence and the potential consequences of the unmitigated risks are assessed. These potential consequences are quantified in days as best, most likely, and worst case impacts to the project schedule. These numbers are then used in a Monte Carlo analysis to correlate schedule dates with a confidence level of achieving that date. The combination of the likelihood and the potential consequences also identifies the risks with the largest potential impacts (either schedule or cost). A mitigation strategy is then developed for each high-risk item. The mitigation strategy outlines actions to mitigate the risk, estimates the cost of implementing the mitigation, assigns responsible personnel, and assigns a due date. The mitigation strategy also notes expected changes to the likelihood of occurrence or the potential consequences of the risks. Monte Carlo analysis then quantifies the impact to the schedule assuming the mitigation strategy is implemented.

The risk matrices being prepared document the outcome of the risk assessment process and will become a management tool that can be assessed by project management, reported against, and updated regularly. RL is closely following this effort to ensure that the work is adequately defined, the project risks are properly identified, and that mitigation plans are prepared for the more serious risks. Using the updated project schedule and new information learned during work performance and from external reviews, an update to the DNFSB Recommendation 2000-1 Implementation Plan will be proposed to better reflect our experience with sludge containerization and reflect appropriate project risk evaluations and mitigation plans.

This effort ensures that a realistic, deliverable set of milestones is prepared; one that is backed by a high confidence schedule of when the actions are to be completed. While the revision to the 2000-1 Implementation Plan is being prepared, work continues to containerize the sludge in the K East Basin. To date, the contractor has now containerized over three-fourths of the sludge in the K-East Basin and has a better understanding of basin conditions as a result of this experience. The removal of debris from the K-East and K-West Basins has also been accelerated. Removal of debris, coupled with the removal or suspension of fuel racks, has resulted in much greater access to the sludge and contributed greatly to the rate of containerization. Debris and rack removal will continue to ensure that the resultant waste form will meet the acceptance criteria for basin monolith disposal in the on-site disposal facility.

Enclosure

TABLE 1 - STATUS OF SRB RECOMMENDATIONS

	RECOMMENDATION	DUE DATE	STATUS/EVALUATION	RL CLOSURE
1	DOE-RL should immediately finalize the end-state criteria for the basins with the regulator.	N/A	DOE Action - Complete. End Point Criteria Document approved by RL 6/16/05	**CLOSED**
2	FH should develop mechanical tools to aid in breaking up compacted, hard sludge that may be encountered in the source containers to aid in sludge remobilization prior to transfer.	N/A	Already ongoing at the time of SRB presentations. Sludge transfer out of the in-basin tanks was demonstrated in mock-up facility in May 05, including tools to break up sludge. No further action planned or required.	**CLOSED**
3	FH should ensure that a "conservative" process control plan is developed for all sludge transfers that provide sufficient operational margin to accommodate changes in sludge physical characteristics	Prior to Sludge Transfer	Two parts. 1) Sludge transfer K East to K West – **under development** 2) Sludge transfer K West to the Sludge Treatment Facility (CVDF) – **development pending completion of process design**	D Faulkner
4	DOE-RL and FH should evaluate the benefit of changing the response to a leak detector alarm to an immediate water flush (small volume) versus an immediate shutdown of all transfer pumps, and if warranted, make appropriate changes to the Technical Safety Requirements.	8/15/05	The evaluation is complete. It addresses the potential dose consequences of sludge remaining in the line as a result of system shutdown and refers to the accident analysis for the effects of continuing to operate while performing a limited system flush (10 minutes) to reduce the sludge in the line. For the change in radiological dose rates on the hose line as a result of a 10 minute flush (90% reduction in dose rates) is more than offset by the increase in release to the environment of sludge and the subsequent increase in dose to the workers, public and the environment. The major concern with immediate system shutdown, after radiological dose issues, is the potential for line plugging due to settled sludge. The response contains the results of calculation of plug yield	**CLOSED**

TABLE 1 - STATUS OF SRB RECOMMENDATIONS

			strength for various size plugs at the maximum slurry content and concludes that without modification, the system being operated normally produces sufficient head to flush a plug should it form anywhere in the system. Recent design changes also provide an opportunity to increase the operating pressure (rupture disk setting has been increased by about 100 psi) providing additional margin beyond what was considered in the calculation for flushing a plug. RL concurs with closure of this item.	
5	FH should ensure that operators have the necessary knowledge and proficiency to operate this operationally-complex transfer evolution. FH should consider training operators at their mock-up test facility, especially in recognizing upset conditions, such as incipient plugging of a transfer line.	8/15/05	This evaluation is complete. It addressed training during planned testing, the use of dry-runs, and classroom instruction. As part of the integrated test, the system will be operated to simulate line plugging conditions to train the operators on indications of incipient plugging and the proper responses to those indications. FH is also reviewing the use of a computer simulation for operator training pending completion of a cost-benefit evaluation. FH also reiterated the commitment to the requirements of DOE Order 5480.20A with regard to the training of project and operations personnel. RL concurs with closure of this item.	**CLOSED**
6	Depending on the results of testing, FH will consider installing a spare pump in each pumping station for the K-West basin to Cold Vacuum Dry (CVD) transfer to provide additional operational margin.	9/30/05	Note: Applicable to transfer plans from K West to the Sludge Treatment Facility (CVDF).	D Faulkner

TABLE 1 - STATUS OF SRB RECOMMENDATIONS

7	For the planned oxidation process, FH should consider utilizing an expert-based operating methodology that relies on a Process Engineer, qualified on the process, to be on-shift for each batch as it ascends to its ultimate operating conditions and a stable reaction rate is achieved.	9/30/05	The recommendation is under review by the contractor at this time for actions to be taken. Once the contractor completes their review and action recommendation, RL will validate the adequacy of the selected path forward.	D Faulkner
8	FH should use a disciplined startup and acceptance process for the MOSS grouting system, just as one would for a first-of-a-kind process. Do not rely on past success in order to streamline these processes. **This is specific to the lack of a formal engineering review of the system design under the current contract.**	9/30/05	The recommendation is under review by the contractor at this time for actions to be taken. Once the contractor completes their review and action recommendation, RL will validate the adequacy of the selected path forward.	D Faulkner
9	DOE should firmly, to the extent feasible, establish clear regulatory requirements for the immobilized sludge.	N/A	DOE Action - Already done at time of SRB presentations. There is some risk to treating all of this material as sludge, however the path is to treat all sludge and package for disposal @ WIPP. Sludge is defined as all material that will pass through a screen with ¼" openings. As a contingency, RL staff is beginning preparation of a white paper to address the sources and constituents of sludge and why these should be considered waste based on the technical facts	**CLOSED**
10	FH should enhance the discipline and formality of the engineering and test programs for this project by finalizing the Functional Design Criteria (FDC), assigning a clearly accountable Design Authority, and conducting a 90 percent formal design review for the oxidation and immobilization processes, as well as finalizing the integrated test plan for the entire project in a timely manner. Wording of letter to FH: **"FH is to determine the root cause(s) and identify**	9/30/05	This item will remain open pending the additional response due 9/30/05.	D Faulkner

TABLE 1 - STATUS OF SRB RECOMMENDATIONS

	corrective actions for the failures to finalize Functional Design Criteria, assign a clearly accountable Design Authority, and to complete the integrated test plan for the sludge treatment project as required by PHMC procedures."			
11	FH should significantly enhance the quality of the test program for the remaining testing associated with the sludge project; utilize independent test experts to support the Joint Test Group; and provide an independent verification of the adequacy of the test programs.	8/15/05	This evaluation is complete. The Joint Test Group (JTG) has been established for FPSR and HiHTL subprojects. This is a formal body that has the ability to request support from independent experts in any area deemed relevant to the tests under review. To enhance the independent review function, the KBC Chief Engineer has been designated as the JTG Chairman, various other technically oriented persons from the responsible subproject manager, design authority, KBC Engineering staff and management, FH QA, and an independent test authority. The recent addition of the KBC Chief Engineer is to ensure verification of engineering work products is adequate given the necessity of having membership drawn from project resources. Complete independence is not achieved due the need for facility and system specific knowledge in order to fulfill the JTG charter. The Chair (Test Authority prior to designation of KBC Chief Engineer) is responsible to ensure appropriate independent experts are utilized when warranted. The integrated test plan has been written and approved by JTG. Due to JTG input, additional rigor in how the components to be tested are mapped to requirements is being developed. There is improving rigor in the test program at KBC Project as a result of formation of the JTG. RL concurs with closure of this item.	**CLOSED**

TABLE 1 - STATUS OF SRB RECOMMENDATIONS

12	The goal of FH should be to minimize the potential for delays by "planning for the unexpected" to the extent practicable by having contingency measures in place to deal with those situations. Therefore, FH should develop a more defensible and achievable schedule for managing this project to ensure that poor technical decisions are not influenced by an unrealistic schedule.	N/A	Already on-going at the time of presentations to the SRB. FH has committed to complete the identification and evaluation of project risks and to produce a defensible schedule for completion of the KBC scope of work. This was not assigned to FH since it was in progress. RL will use this as a basis to update their risk management plan, identify unique DOE risks, and produce a revision to the 2000-1 IP for the remaining sludge removal and treatment workscope. Item to remain open until schedule update is complete.	D Faulkner