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Conceptual Design Report for the Sludge Receiving Station

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Richland, WA 99352

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Abstract: This document describes the conceptual design for the Sludge Receipt Subproject that meets the functional design criteria. Also included in this document are the cost estimate and schedule.

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CONTENTS

	Page
1.0 INTRODUCTION	1
2.0 SUMMARY	2
3.0 JUSTIFICATION	2
4.0 DESCRIPTION OF PROJECT SCOPE	3
4.1 IMPROVEMENTS TO LAND (460)	3
4.2 BUILDINGS (501)	3
4.3 OTHER STRUCTURES (550)	3
4.4 UTILITIES (600)	4
4.5 SPECIAL EQUIPMENT/PROCESS SYSTEMS (700)	5
4.6 STANDARD EQUIPMENT (710-799)	7
4.7 IMPROVEMENTS FOR OTHERS (800)	7
4.8 DEMOLITION (810)	7
4.9 TUNNELING (820)	7
4.10 DRILLING (830)	8
4.11 OTHER PROJECT COSTS (900)	8
4.12 DESIGN COMPLIANCE	8
5.0 METHODS OF PERFORMANCE	9
5.1 ENGINEERING (TEC)	9
5.2 DESIGN	9
5.3 PROCUREMENT	10
5.4 INSTALLATION	10
5.5 START-UP	10
6.0 REQUIREMENTS AND ASSESSMENTS	10
6.1 SAFEGUARDS AND SECURITY	10
6.2 HEALTH AND SAFETY	10
6.3 DECONTAMINATION AND DECOMMISSIONING	12
6.4 PROVISIONS FOR FALLOUT SHELTERS	13
6.5 MAINTENANCE AND OPERATION REQUIREMENTS	13
6.6 AUTOMATIC DATA PROCESSING/TELECOMMUNICATIONS EQUIPMENT	14
6.7 QUALITY ASSURANCE AND SAFETY CLASSIFICATION	14
6.8 ENVIRONMENTAL COMPLIANCE	15
6.9 PERMITS	16
6.10 PRELIMINARY SAFETY EVALUATION	16
6.11 RISK IDENTIFICATION AND ANALYSIS	16
7.0 REFERENCES	16

APPENDICES

A	COST ESTIMATE	A-1
B	SCHEDULE	B-1
C	PRELIMINARY DESIGN REVIEW REPORT	C-1
D	PRELIMINARY DESIGN REVIEW PACKAGE	D-1
E	DRAWINGS	E-1

CONCEPTUAL DESIGN REPORT FOR THE SLUDGE RECEIVING STATION

1.0 INTRODUCTION

The Sludge Receiving Station is one of four sub-projects under Project A.13, Sludge Removal Project. The three other sub-projects of Project A.13 are: 1) Sludge Retrieval, 2) Sludge Process and Loadout, and 3) Sludge Transportation.

The 105 K fuel storage basins are water-filled concrete pools which contain over 2,000 metric tons of N Reactor metal fuel elements stored in aluminum or stainless steel canisters. Associated with this Spent Nuclear Fuel (SNF) is an accumulation of particulate layered material which is generally called sludge. Sludge is found on the basin floors, in canisters, and in the basin pits which are used for miscellaneous tasks such as cask handling. Project A.13, Sludge Removal Project, will remove this sludge from the K Basins and deposit it into a double-shell tank (DST).

The Sludge Transportation System will deliver the sludge to the Sludge Receiving Station. The Sludge Transportation System will consist of a trailer, a container, a pumping system capable of transferring the sludge from the container through the transfer line into a DST, a flexible hose for connecting the pumping system to the transfer line, and equipment for monitoring and controlling the offload process (Tomaszewski 1996). The main interfaces with the Sludge Receiving Station include: available space within the Tank Waste Remediation System (TWRS) facility, TWRS supplied utilities (i.e., electrical, flush water), and the sludge transfer line (i.e. connections, leak detection sensors).

The Sludge Receiving Station will require temporary physical modifications at tank farms necessary to enable direct transfer of sludge from the Sludge Transportation System into a DST designated as the appropriate receiver by TWRS. Current baseline has identified 241-AW-105 as the selected DST. It is located in the 200 East Area. The Sludge Receiving Station sub-project consists of a nonpermanent, intra-farm transfer line (with double-containment) to an existing pump pit, a pipe jumper inside the pump pit connecting the transfer line to an existing DST riser, and a new spill retention basin for confining the Sludge Transportation System during the offload process.

Functional Design Criteria for the K Basin Sludge Removal System, WHC-SD-SNF-FDC-004 (Precechtel and Monthey 1996), establishes the high level design requirements for Project A.13. *Functional Design Criteria for the Sludge Receiving Station*, WHC-SD-WM-FDC-052 (Brisbin and Pearce 1996) establishes the detailed functions and design requirements for the Sludge Receiving Station. The purpose of this conceptual design report (CDR) is to describe the conceptual design for the Sludge Receipt sub-project that meets the functions and requirements identified in WHC-SD-WM-FDC-052.

This work is conducted under the *Sludge Receipt SubProject Workplan*, WHC-SD-SNF-WP-020 (Pearce 1996).

2.0 SUMMARY

The Sludge Receiving Station will be capable of carrying K Basin sludge into the selected DST. The Sludge Receiving Station will include a nonpermanent, intra-farm transfer line; a pump pit jumper; and a spill retention basin which interface with the selected tank farm facility and the Sludge Transportation System (provided by others).

The Sludge Receiving Station will be designed to capture and collect any spills or leaks that may occur from offloading the sludge from the Sludge Transportation System while it is located in the spill retention basin.

The Sludge Receiving Station will interface directly with the selected DST and the Sludge Transportation System. Drawing H-14-100727, *Tank 105 AW Temporary Transfer Line Interface Control* (Uhlman 1996), depicts the physical interfaces associated with this sub-project.

The design is based, in part, on a composite of projects including: the C-103 design for direct pumping organic waste from a tank into a high integrity container (Wilson 1994); Project W-058, replacement of the cross-site transfer system (Brantley 1996); and the above ground transfer line for single shell tanks (i.e., BX-106 to BX-109) (Boyles 1994).

Tank 241-AW-105 is the selected DST for the current baseline. This tank is located in the 200 East Area.

The Sludge Receiving Station will accept up to 68 m³ (18,000 gal) of sludge beginning January 2000 and finishing in December 2000. In addition to the sludge, transfer and flush water will also be accepted.

The Sludge Transportation System will contain 10 to 30 percent solids, by volume, per shipment. The maximum flow rate for the offload process will be 3 L/sec (50 gal/min).

Project A.13 is an SNF Project sub-project. The total estimated cost for installation is \$600,000 and other costs are estimated at \$300,000. The total project cost is estimated at \$900,000. These cost estimates do not include contingency.

3.0 JUSTIFICATION

Westinghouse Hanford Company Recommended Strategy for K-Basin Sludge Disposition, WHC-SD-SNF-SP-001 (Alderman 1995) documents the preferred path forward alternative for K Basin sludge removal. The TWRS DST system is

currently permitted as a treatment, storage, and disposal (TSD) facility pursuant to WAC 173-303. The TWRS conducted an initial feasibility study, based on preliminary sludge characterization data, to determine if the sludge could be accepted into the DST system. The study concluded that the data did not indicate chemical compatibility problems with the waste stored in the prospective receiver DSTs; however, further evaluation is required before a definitive conclusion can be reached (Fowler 1995).

A Memorandum of Understanding (MOU) executed between the SNF Project and the TWRS management, and the Department of Energy, Richland Operations Office (RL), outlines the general process for acceptance of K Basin sludge into the DST system (Fulton 1996).

In response to the MOU, a waste compatibility assessment was performed. The TWRS recommends acceptance of the K Basins sludge waste stream into tank 241-AW-105 following satisfactory disposition of the issues identified in the compatibility assessment (Bacon 1996).

4.0 DESCRIPTION OF PROJECT SCOPE

4.1 IMPROVEMENTS TO LAND (460)

The area for the retention basin will require grading to maintain a slope of 1 percent to 2 percent. Compaction of the soil under the retention basin may be required to avoid uneven settling. The amount of compaction required will be determined during definitive design.

A concrete pad, 1.22 m x 1.22 m (4 ft x 4 ft), will be placed next to the retention basin. This will be used for the sludge transfer line piping support stand.

The temporary transfer line will be laid above grade. However, any soil displaced during construction will be kept inside the tank farm. All areas disturbed during construction will be graded and stabilized.

4.2 BUILDINGS (501)

Modifications to the Waste Tank Gas Chromatograph (WTGC) building, located near DST 241-AW-103, electrical system will be performed to provide power to support the offload process.

4.3 OTHER STRUCTURES (550)

The spill retention basin will be an off-the-shelf item that is designed specifically for containing hazardous waste spills from commercial tankers. The spill retention basin will be fabricated of a material that is capable of

being decontaminated or of being sealed with a material that is essentially impermeable to radioactive material.

The basin will be able to contain the entire contents of the transportation container plus anticipated flush water in the event of a spill. The basin will contain a spill of at least 18,000 liters (4800 gal) and be constructed of a material which is compatible with the K Basin sludge as adjusted to meet TWRS waste acceptance criteria. The basin will be capable of supporting the sludge transportation system which consists of a tractor and trailer. The maximum trailer size will be 9 m (30 ft) in length, 3 m (8 ft) in width, and 4 m (12 ft) in height. The maximum gross vehicle weight for the trailer will be 45,400 kg (100,000 lbs). The maximum tractor weight is estimated to be approximately 6800 kg (15,000 lbs).

All new or modified structures, equipment, and piping will be designed and analyzed in accordance with natural phenomena loading criteria of DOE 6430.1A and GC-LOAD-01 (ICFKH 1996). The loading of components and equipment will be a function of the safety designation identified in the Project safety assessment.

New structures, equipment, and components will be designed to withstand the design criteria for natural phenomena such that the system can be rendered to a safe status without undue risk to public health and safety. The sludge offload process is not required to operate during or immediately following a safe shutdown earthquake.

4.4 UTILITIES (600)

The utilities to service the offload process will be extended from the selected tank farm.

4.4.1 Electrical Systems

The electrical systems will comply with *The National Electrical Code* (NFPA 70); ANSI C2, *National Electrical Safety Code*; and applicable sections of DOE Order 6430.1A, *General Design Criteria*. No equipment or materials installed by this sub-project will contain mercury or polychlorinated biphenyls.

All safety switches and circuit breakers will be equipped with provisions for locking out.

One 480 VAC, three phase power supply and two 120 VAC, single phase power supplies will be provided to service the offload equipment provided by the Sludge Transportation System. The 480 VAC source has a 60 amp current rating and will be supplied from the pump pit. The two 120 VAC sources will be supplied from the WTGC building. [Note: These power supplies are different from those shown on drawing H-14-100727, *Tank AW 105 Temporary Transfer Line Interface Control* (Uhlman 1996). The drawing will be revised during definitive design.]

4.4.2 Flush Water

Raw water for flushing the Sludge Transportation System and transfer line will be provided from an existing supply located in the tank farm. A portable water source may be used as a contingency. Raw water will be supplied at a minimum flow rate of 1.3 L/sec (20 gal/min) at a gage pressure of 350 kPa (50 psig). The minimum volume of flush water available for each offload event will be 12 m³ (3200 gal). Water services required for process applications will be protected from potential back-flows and contaminations from the offload process.

A flush pipe/hose will be provided to flush the Sludge Receiving Station via the Sludge Transportation System following the offload process. The flush piping/hose will connect to the Sludge Transportation System. Connection location will be determined during definitive design.

The flush line will accommodate the routine flow rates up to 1.3 L/sec (20 gal/min) with a minimum flow velocity of 2.1 m/sec (7 ft/sec).

4.4.3 Lighting

Installation, operation, and removal of the Sludge Receiving Station are planned to occur during daylight hours. If night operations occur, either existing tank farm lighting or portable lighting will be used.

4.5 SPECIAL EQUIPMENT/PROCESS SYSTEMS (700)

4.5.1 Instrumentation

Instrumentation shall be provided for the early detection of leakage from the primary confinement system including the transfer line and pump pit jumper.

Leak detection sensors will interface with the monitoring and control systems provided by the Sludge Transportation System. The Sludge Transportation System will provide for interlocks between the leak detection sensors and the transfer pump to facilitate safe shutdown in the event that the primary confinement system is breached. The leak detection sensors will be installed between the primary and secondary confinement barriers.

Instrumentation will conform to The National Electrical Code, (NFPA 70), applicable sections of DOE 6430.1A, and applicable American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE) and Instrument Society of America (ISA) standards. Instrumentation shall also conform to *Flammable Gas/Slurry Growth Unreviewed Safety Question and Justification for Continued Operation for the Tank Farms at the Hanford Site*, WHC-SD-WM-JCO-007 (WHC 1996).

4.5.2 Piping

The transfer line will consist of a 3.8 cm (1.5 inch) flex hose encased in a 7.6 cm (3 inch) stainless steel pipe. The pipe and hose provide a double containment system. The transfer line will be designed to handle the routine flow capacities up to 3 L/sec (50 gal/min) with a minimum flow velocity of 2.1 m/sec (7 ft/sec). Piping/hose pressure will not exceed 1 MPa (150 psig). The transfer line will have adequate slope to prevent solid settling or liquid pooling (minimum average slope of 1.0 percent). The slope will be such that liquids will not separate from the solids during normal operation.

The transfer line will include provisions for removing settled solids or recovering from a blockage. These provisions will be determined during definitive design.

The piping/hose materials will be compatible with the characteristics of the DST environment and K Basins sludge as adjusted to meet TWRS waste acceptance criteria. The piping/hose connections will be self sealing, no drip, quick disconnect. Connection design will accommodate the use of glovebags during the offload process. A male coupler will be provided for connection to the Sludge Transportation System.

The transfer line will discharge into DST 241-AW-105 via a connection in the central pump pit. Sludge will be discharged into the DST using an existing slurry distributor to facilitate uniform distribution. The transfer line will have the capability to be water flushed.

All piping/hose assemblies will comply with ASME B31.3. Qualification of the piping will be per *Pressure Testing of Pressure Vessels, Piping, and Components*, HS-BS-0090 (WHC 1995)

All new or modified piping will be designed and analyzed in accordance with natural phenomena loading criteria of DOE 6430.1A and GC-LOAD-01 (ICFKH 1996). The loading of components and equipment will be a function of the safety designation identified in the Project safety assessment.

New equipment will be designed to withstand the design criteria for natural phenomena such that the system can be rendered to a safe status without undue risk to public health and safety. The sludge offload process is not required to operate during or immediately following a safe shutdown earthquake.

Piping will be designed for the following fluid properties:

- Viscosity: >10 mPa-S
- Maximum pressure: 1 MPa (150 psig)
- Minimum flow velocity: 2.1 m/sec (7 ft/sec)
(Note: The minimum flow velocity will be finalized during definitive design)
- Waste streams that contain Washington State Dangerous Waste constituents

4.5.3 Concrete Shielding

Removable concrete shielding blocks will be placed over the transfer line to provide radiation shielding. The design objective for external exposure for the Sludge Receiving Station shall be that no individual worker will receive an annual dose equivalent in excess of 0.5 rem/year from all sources. This is based on *Radiological Design Guide*, WHC-SD-GN-DGS-30011 (Evans 1995). A final shielding analysis based on K basin sludge characterization data will be performed during definitive design. A preliminary shielding analysis is included in Appendix D.

4.6 STANDARD EQUIPMENT (710-799)

4.6.1 Spill Removal Pump

A pump is needed for removing spills from the spill retention basin. The output of the pump will be routed to a point in the transfer line such that the contents will be directed into the DST 241-AW-105. Provisions will be included for backflow prevention into the spill removal line.

4.6.2 Pipe Stands

Standard, adjustable pipe stands will support the transfer line and maintain a slope in the transfer line.

4.6.3 Sandbags

Standard sandbags will be used to hold down the pipe stands.

4.6.4 Communication Equipment

Standard issue radio communication devices will be provided for use during operation of the offload process to coordinate operations between 242-A Evaporator Control Room and the sludge offload process.

4.7 IMPROVEMENTS FOR OTHERS (800)

Not applicable.

4.8 DEMOLITION (810)

Equipment installed under this sub-project will be removed following offloading of the final sludge shipment.

4.9 TUNNELING (820)

Not applicable.

4.10 DRILLING (830)

Not applicable.

4.11 OTHER PROJECT COSTS (900)

4.11.1 TWRS Construction Support

To support on-site construction forces working in the tank farm, the Job Control System (JCS) will be utilized to authorize work. JCS work packages will be generated, reviewed and approved and issued to the construction crews for implementation. In addition, radiological control technicians will be utilized to support work in radiation zones. Operations will provide engineering and nuclear operators support as required as work progresses in the tank farm.

4.11.2 TWRS Start-up Support

Upon completion of construction, an Acceptance Test and Operational Test will be conducted to verify construction adequacy and to address testing requirements. This will require operations engineers and maintenance to support these tests. An Operational Readiness Review/Assessment will be conducted to ensure that the system has met all requirements and the tank farm operations group is adequately prepared to initiate transfer activities.

4.12 DESIGN COMPLIANCE

The latest edition/revision of all codes, standards, and manuals will be used. As a minimum, the following national codes and standards will be considered:

- ASME B31.3, *Process Piping*
- IEEE 336, *Standard Installation, Inspection, and Testing Requirements for Power, Instrumentation, and Control Equipment at Nuclear Facilities*
- ISA S5.1, *Instrument Symbols and Identification*
- ISA S50.1, *Compatibility of Analog Signals for Electronic Industrial Process Instruments*
- ISA S82.01, *Safety Standard for Electrical and Electronic Test, Measuring, Controlling, and Related Equipment--General Requirements*
- ISA S82.03, *Safety Standard for Electrical and Electronic Test, Measuring, Controlling, and Related Equipment--Process Measurements and Control Equipment*

- NFPA 70, *National Electrical Code*

The following DOE Orders will be considered, as applicable.

- DOE 4700.1, *Project Management System*
- DOE 5400.1, *General Environmental Protection Program*
- DOE 5400.5, *Radiation Protection of the Public and the Environment*
- DOE 5480.1B, *Environment, Safety, and Health Program for Department of Energy Operations*
- DOE 5480.4, *Environmental Protection, Safety, and Health Protection Standards*
- DOE 5480.7A, *Fire Protection*
- DOE 5480.10, *Contractor Industrial Hygiene Program*
- DOE 5480.19, *Conduct of Operations Requirements for DOE Facilities*
- DOE 5480.24, *Nuclear Criticality Safety*
- DOE 5480.28, *Natural Phenomena Hazards Mitigation*
- DOE 5481.1B, *Safety Analysis and Review System*
- DOE 5820.2A, *Radioactive Waste Management*
- DOE 6430.1A, *General Design Criteria*

5.0 METHODS OF PERFORMANCE

5.1 ENGINEERING (TEC)

The operating contractor will provide engineering support to develop the JCS work packages, as low as reasonably achievable (ALARA) reviews, design changes during construction, progress statusing and final document closeout and turnover.

5.2 DESIGN

The engineer/constructor contractor will prepare the design package in accordance with the technical baseline. Definitive design drawings and specifications, and supporting engineering documentation are included in this Work Breakdown Structure.

5.3 PROCUREMENT

The engineer/constructor will procure any long-lead items or any specialties such as the spill retention basin.

5.4 INSTALLATION

The engineer/constructor will perform all construction activities associated with this project. This includes the work inside the tank farm boundary, utility tie-ins, and all contaminated work inside the central pump pit.

5.5 START-UP

The operating contractor will provide verification of the operability of the receiving station to ensure that functional requirements have been met. Included in this WBS are preparation of the acceptance test procedure/operational test procedure conducting the testing and resolution of deficiencies.

6.0 REQUIREMENTS AND ASSESSMENTS

6.1 SAFEGUARDS AND SECURITY

A safeguards and security plan will be provided in accordance with Westinghouse Hanford Company (WHC) procedures. This plan will be in effect at the time of construction.

6.2 HEALTH AND SAFETY

Radiation dose to workers will be minimized and comply with 10 CFR 835, *Occupational Radiation Protection*, as implemented by Hanford Site Radiological Control Manual, HSRM-1 (PNL 1994). The guidance provided in *Radiological Design Guide*, WHC-SD-GN-DGS-30011 (Evans 1995), will be considered.

Piping/hose assembly design will address criticality considerations identified in the Criticality Safety Evaluation Report.

The transfer line and flush line will be clearly marked/identified. The routing of the transfer line and flush line will conform to any restrictions established by the cognizant Operations manager. Freeze protection will be provided for pipes/hoses, connectors, and valves, as necessary. Leak detection sensors will be installed, operable, and interlocked to the transport system prior to operation of the offload process.

Equipment will be designed such that no single failure of equipment will cause a loss of control that will result in an unrecoverable condition. Features will be provided which will facilitate placement of the equipment in the appropriate position to establish a safe configuration (i.e., unpressurized with minimal retention of radioactive material).

The Sludge Receiving Station will be designed to permit routine maintenance activities with minimum operator exposure to hazardous or radioactive environments or to industrial hazards. ALARA practices will be used in all maintenance activities. The system will be designed to be operated and maintained in a radiation zone and operated under contaminated conditions.

An Unreviewed Safety Question evaluation will be performed prior to construction of field modification activities at TWRS. DOE-STD-1027-92 will be used for hazards analysis.

Criticality requirements will be identified during the design process. A Criticality Safety Evaluation Report (CSER) will be generated for the offload process. Requirements identified in the CSER will be incorporated into the Sludge Receiving Station design.

The Sludge Receiving Station will be designed to confine contaminants within the combination of boundaries defined by the existing DST, the confinement surfaces of the Sludge Receiving Station, and any other barriers that may be required. A double confinement system will be employed to control contamination due to a failure of the primary confinement, or other off-normal situation. Guidance provided in WHC-SD-GN-DGS-30011 will be considered.

Shielding of the Sludge Receiving Station will be provided to reduce worker exposure to ALARA goals. Shielding may be fixed or moveable. Engineering calculations to define specific shielding needs will be made during the definitive design process. Consideration will be given to normal operation, abnormal events, and maintenance activities.

Shielding design will be based on life-cycle cost, to include the ease of removal of shielding for subsequent removal of the transfer line at the end of the project.

Routine construction hazards will exist while the Sludge Receiving Station is under construction and during installation of the system at the tank farm. Field operations will be conducted in conformance with WHC-CM-1-10, *Safety Manual*; WHC-CM-1-11, *Industrial Hygiene*; and WHC-CM-4-40, *Industrial Hygiene Manual*, in addition to applicable OSHA standards to ensure a safe working environment.

The design of the Sludge Receiving Station will be reviewed and approved by the cognizant TWRS Fire Protection Engineer to ensure compliance with all applicable fire protection standards prior to installation. Combustible loading will be evaluated and conform with WHC-CM-4-41, *Fire Protection*.

The applicable requirements of the following documents will be met:

- 10 CFR 835, *Occupational Radiation Protection*
- HSRCM-1, *Hanford Site Radiological Control Manual*
- DOE 6430.1A, *General Design Criteria*
- WHC-IP-1043, *Occupational ALARA Program*
- DOE 5400.5, *Radiation Protection of the Public and the Environment*
- DOE 5820.2A, *Radioactive Waste Management*
- WHC-SP-1145, *WHC Radiation Protection Program Implementation of Title 10 Code of Federal Regulations Part 835*

In particular, the requirements of 10 CFR 835, Subpart K, Design and Control, will be satisfied. The design objective for external exposure for the Sludge Receiving Station will be that no individual worker will receive an annual dose equivalent in excess of 0.5 rem/year from all sources.

All (design agent) actions and decisions taken to maintain occupational exposures as low as reasonably achievable will be documented [10 CFR 835.704(b)]. These records will be retained until final disposition is authorized by DOE [10 CFR 830.701(b)].

For any cost-benefit analyses, the monetary value of 1 rem of collective dose including D&D will be \$30,000 (Bergsman 1996).

6.3 DECONTAMINATION AND DECOMMISSIONING

All piping and concrete shielding will be decontaminated, to ALARA, decommissioned, and disposed.

The transfer line will include provisions for flushing.

To facilitate decontamination, piping bends will be minimized and inside pipe materials will be capable of being decontaminated. Installation of access ports for decontamination will be considered for hard piping.

All equipment and/or facilities provided by this project will be designed and constructed to facilitate periodic decontamination, as well as eventual, final decontamination and decommissioning (D&D). Some of the equipment and/or facilities may require disposal as dangerous or mixed waste.

DOE 6430.1A, Sections 0205 and 1300-11 and DOE 5820.2A, Chapter V, will be referred to for D&D requirements.

Particular care will be exercised to ensure that modular components do not create crevices that will trap contamination (i.e., sludge). Inaccessible pockets, crevices, blind holes, and rough surfaces that could trap contamination will be minimized. All equipment used in contaminated areas will be able to withstand decontamination when wiped with cloths dampened by water, soap, alcohol, or other non-hazardous materials.

The design will minimize the creation of dangerous waste. In addition, care will be taken to ensure the ability to fill void spaces and avoid trapping liquids, to assist in complying with dangerous waste disposal regulations.

The design and material selection will include features that facilitate decommissioning of equipment and the facility [10 CFR 835.1002(d)]. Particular attention will be paid to any equipment in high and very high radiation areas that will exist at the end of the facility's life.

6.4 PROVISIONS FOR FALLOUT SHELTERS

There will be no provisions for fallout shelters as part of this sub-project.

6.5 MAINTENANCE AND OPERATION REQUIREMENTS

The Sludge Receiving Station will include features to allow for unplugging the transfer line. These features will be determined during definitive design.

The design life of the Sludge Receiving Station will be 3 years. Replaceable equipment and components that have a design life of less than 3 years will not have a design life of less than 1 year.

All equipment exposed to ambient conditions outside the DST will be designed to operate under adverse open field conditions as defined in *Functional Design Criteria for the Sludge Removal System*, WHC-SD-SNF-FDC-004 (Precechtel and Monthey 1996).

Components and assemblies which come into contact with K Basins sludge will be radiologically, physically, and chemically compatible with the sludge. K Basin sludge characterization information is provided in *Spent Nuclear Fuel Project Technical Databook*, WHC-SD-SNF-TI-015 (Short 1995). Supplemental data is provided in *Analysis of Sludge from Hanford K East Basin Floor and Weasel Pit*, WHC-SP-1182 (Makenas 1996). Updated characterization may be provided by the Sludge Removal Project design authority.

The Sludge Receiving Station will have a minimum availability factor of 90 percent.

All selected equipment should be commercially available and include sufficient vendor documentation to support safe operation and maintenance. Equipment requiring special handling features should be avoided. All systems will be configured to be fail-safe upon power loss and minimize personnel radiation exposure during recovery.

The design and material selection will include features that facilitate maintenance of the equipment and the facility [10 CFR 835.1002(d)].

Particular attention will be paid to minimization of liquid retention and ease (containment and speed) of replacing valves, connectors, and any equipment in high or very high radiation areas.

Operation of the offload process will require tank farm operators and radiological control support.

6.6 AUTOMATIC DATA PROCESSING/TELECOMMUNICATIONS EQUIPMENT

No new automated data processing/telecommunications equipment is required for this sub-project.

6.7 QUALITY ASSURANCE AND SAFETY CLASSIFICATION

Quality Assurance (QA) activities for all contractors involved in the design, construction, testing, and inspection of the offload system are defined in 10 CFR 830.120 and WHC-SP-1131, *WHC Quality Assurance Program and Implementation Plan* (Moss 1996). Implementation of these requirements will provide the following assurances:

- Design data and design decisions are documented and traceable.
- The design and design criteria are adequately supported by the prepared plans, specifications, and analyses.
- The design meets baseline design criteria.
- Construction is performed in accordance with definitive design documents.
- Testing confirms the adequacy of design, the quality of construction and manufactured components, operability and maintainability, and reliability.

Safety designation of systems, components, and structures will meet the requirements of WHC-CM-4-46, *Safety Analysis Manual*, Section 9.0. On the basis of Section 9.0 requirements and a safety assessment, the relevant safety designation anticipated for any system, component, or structure will be determined and applied to this project. For conceptual design, all components of the sludge receiving station will be considered safety significant.

6.8 ENVIRONMENTAL COMPLIANCE

An environmental requirements checklist covering removal, transport, and storage of K Basin sludge has been prepared by Environmental Services (Tollefson 1995), through the SNF Regulatory Integration/Public Involvement group.

6.8.1 Dangerous Waste Requirements

The Sludge Receiving Station will comply with hazardous waste requirements as described within WHC-CM-7-5, *Environmental Compliance Manual*, Section 3.7, WAC 173-303, *Dangerous Waste Regulations*, and Section 4.2.2.2 of DOE/RL 88-21, *Double Shell Tank Interim Status Part A Permit* (DOE 1988a).

- Assure waste compatibility with waste handling and retention systems.
- Assure that adequate secondary containment of hazardous waste exists.
- Assure that systems are tested and inspected for continued compliance with standards developed to prohibit unnecessary release of hazardous materials to the environment.

6.8.2 Airborne Release Requirements

The Sludge Receiving Station will comply with regulations governing airborne release of toxic and radioactive materials. As all air flows from the proposed operation will have been in contact with the sludge, each potential emission point must comply with the following standards:

- Airborne release requirements for toxic material releases are embodied within WAC 173-400, *General Regulations for Air Pollution Sources*, and WAC 173-460, *Controls for New Sources of Toxic Air Pollutants*. These regulations place requirements upon the extent of air pollution abatement.
- Airborne release requirements for radioactive materials are embodied within 40 CFR 61, *National Emission Standards for Hazardous Air Pollutant (NESHAP)*, Subpart H, and Washington State requirements under WAC 173-480 and WAC 246-247. The functionality of these regulations is the assurance of sufficient pollution abatement.

6.8.3 NEPA Documentation

During definitive design, resolve with TWRS-RL if the TWRS Environmental Impact Statement (EIS) provides coverage for the sludge receiving station subproject. If it is determined that the TWRS EIS does not provide coverage, then the documentation required will have to be identified and provided.

6.9 PERMITS

The operating contractor will provide all permits.

6.10 PRELIMINARY SAFETY EVALUATION

A preliminary safety evaluation is currently being prepared.

6.11 RISK IDENTIFICATION AND ANALYSIS

The following items present a risk to the cost and schedule estimate of this conceptual design:

Concrete shielding - The shielding is sized for larger pipes than are in the current conceptual design. The pipe sizes are based on a preliminary analysis. The amount of shielding should decrease as a result of this. The concrete shielding cost will change for the better.

Piping - The size of pipe required may change. The pipe material may change if new waste characteristics are found. This is a low risk item.

Retention basin - The retention basin may require excessive ground preparation of function properly. This is unknown at this time.

Spill removal pump - A means to remove any liquid from the retention basin is needed. The size and permanency of the pump is still undecided.

Waste compatibility - A waste compatibility assessment was performed. Acceptance of K Basins sludge into DST 241-AW-105 is contingent upon satisfactory disposition of the issues identified in the compatibility assessment (Bacon 1996).

7.0 REFERENCES

10 CFR 835, *Occupational Radiation Protection*, Code of Federal Regulations.

40 CFR 61, *National Emission Standards for Hazardous Air Pollutants*, Code of Federal Regulations.

Alderman, C. J., 1995, *Westinghouse Hanford Company Recommended Strategy for K Basin Sludge Disposition*, WHC-SD-SNF-SP-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

ANSI 1996, *National Electrical Code*, NFPA 70, National Fire Protection Association, Batterymarch Park, Quincy, Ma.

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- Boyles, V. C., 1994, *Overground Receiving Line Safety Analysis Report Addendum*, WHC-SD-WM-SAR-034, Revision 0-A, Westinghouse Hanford Company, Richland, Washington.
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- DOE 1985, *Contractor Industrial Hygiene Program*, DOE Order 5480.10, U.S. Department of Energy, Washington, D.C.
- DOE 1986a, *Environment, Safety, and Health Program for Department of Energy Operations*, DOE Order 5480.1B, U.S. Department of Energy, Washington, D.C.
- DOE 1986b, *Safety Analysis and Review System*, DOE Order 5481.1B, U.S. Department of Energy, Washington, D.C.
- DOE 1987, *Project Management System*, DOE Order 4700.1, U.S. Department of Energy, Washington, D.C.
- DOE 1988a, *Double Shell Tank Interim Status Part A Permit*, DOE/RL 88-21, U.S. Department of Energy, Richland, Washington.
- DOE 1988b, *General Environmental Protection Program*, DOE Order 5400.1, U.S. Department of Energy, Washington, D.C.
- DOE 1988c, *Radioactive Waste Management*, DOE Order 5820.2A, U.S. Department of Energy, Washington, D.C.
- DOE 1989, *General Design Criteria*, DOE Order 6430.1A, U.S. Department of Energy, Washington, D.C.

- DOE 1990a, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, U.S. Department of Energy, Washington, D.C.
- DOE 1990b, *Conduct of Operations Requirements for DOE Facilities*, DOE Order 5480.19, U.S. Department of Energy, Washington, D.C.
- DOE 1992, *Nuclear Criticality Safety*, DOE Order 5480.24, U.S. Department of Energy, Washington, D.C.
- DOE 1993a, *Fire Protection*, DOE Order 5480.7A, U.S. Department of Energy, Washington, D.C.
- DOE 1993b, *Natural Phenomena Hazards Mitigation*, DOE Order 5480.28, U.S. Department of Energy, Washington, D.C.
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- Fowler, K. D., 1995, *K-Basin Sludge to TWRS: Transfer Feasibility*, Internal Memo, Westinghouse Hanford Company, Richland, Washington, dated January 25, 1995.
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- Short, S. M., 1995, *Spent Nuclear Fuel Project Technical Databook*, WHC-SD-SNF-TI-015, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Tollefson, K. S., 1995, *Environmental Requirements Checklist for Removal, Transport, and Storage of 105 KE and KW Basins Sludge*, Internal Memo, 95-POC-036, Westinghouse Hanford Company, Richland, Washington, dated November 2, 1995.
- Tomaszewski, T. A., 1996, *K East Basin Sludge Packaging Design Criteria*, WHC-SD-TP-PDC-035, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
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- WHC-CM-1-10, *Safety Manual*, Westinghouse Hanford Company, Richland, Washington.
- WHC-CM-1-11, *Industrial Hygiene*, Westinghouse Hanford Company, Richland, Washington.
- WHC-CM-4-40, *Industrial Hygiene Manual*, Westinghouse Hanford Company, Richland, Washington.
- WHC-CM-4-41, *Fire Protection*, Westinghouse Hanford Company, Richland, Washington.
- WHC-CM-4-46, *Safety Analysis Manual*, Westinghouse Hanford Company, Richland, Washington.
- WHC-CM-6-1, *Standard Engineering Practices*, Westinghouse Hanford Company, Richland, Washington.
- WHC-CM-7-5, *Environmental Compliance Manual*, Westinghouse Hanford Company, Richland, Washington.
- WHC-IP-1043, *Occupational ALARA Program*, Westinghouse Hanford Company, Richland, Washington.
- WHC 1995, *Pressure Testing of Pressure Vessels, Piping, and Components*, HS-BS-0090, Westinghouse Hanford Company, Richland, Washington.
- WHC 1996, *Flammable Gas/Slurry Growth Unreviewed Safety Question and Justification for Continued Operation for the Tank Farms at the Hanford Site*, WHC-SD-WM-JCO-007, Westinghouse Hanford Company, Richland, Washington.
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APPENDIX A COST ESTIMATE

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	TOTAL	TOTAL DOLLARS
=====	=====	=====	=====	=====	=====
020	TITLE II	320,000	15	50,000	370,000
030	TITLE III	30,000	25	10,000	40,000
	(ADJUSTED TO MEET DOE 5100.4)	-50,000		40,000	-10,000
=====					
TOTAL DESIGN & MANAGEMENT		300,000		100,000	400,000
=====					
550	OTHER STRUCTURES	90,000	25	20,000	110,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	240,000	25	60,000	300,000
	(ADJUSTED TO MEET DOE 5100.4)	-30,000		20,000	-10,000
=====					
TOTAL CONSTRUCTION COST		300,000		100,000	400,000
=====					
TOTAL ESTIMATED CONSTRUCTION COST (TECC)		600,000		200,000	800,000
=====					
900	OTHER PROJECT COSTS	290,000	10	30,000	320,000
	(ADJUSTED TO MEET DOE 5100.4)	10,000		-30,000	-20,000
=====					
TOTAL OTHER PROJECT COSTS (OPC)		300,000		0	300,000
=====					
TOTAL PROJECT COST (TPC)		900,000	17	300,000	1,100,000

TYPE OF
ESTIMATE STUDY AUGUST 27, 1996

ARCHITECT
ENGINEER
OPERATING
CONTRACTOR

A Chadwick

REMARKS:

THIS ESTIMATE HAS BEEN ISSUED BEFORE ON JULY 30, 1996
AS Z412BAA1.

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

MHC-SD-SNF-CDR-008, REV. 0

A2

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. 2412/E57993
FILE NO. 2412SAA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

PAGE 2 OF 8
DATE 08/27/96 13:34:17
BY SMF/LGH/DKH

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS
=====	=====	=====	=====	=====	=====	=====	=====	=====
110000	TWRS ENGINEERING FY96	33000	0	33000	0.00	0	15	37950
110001	TWRS DESIGN FY96	213000	0	213000	0.00	0	15	244950
110002	TWRS DESIGN FY98	73695	0	73695	4.54	3346	15	88597
	SUBTOTAL 11 WHC ENGR / DESIGN	319695	0	319695	1.05	3346	15	371497
121000	ENGINEERING/INSPECTION-ONSITE E/C	25956	0	25956	6.48	1682	25	34547
	SUBTOTAL 12 ENGINEERING/INSPECTION	25956	0	25956	6.48	1682	25	34547
	SUBTOTAL 1 ENGINEERING	345651	0	345651	1.45	5028	16	406044
310004	TRANSFER LINE, SUMP PUMP, FLUSH HS	69623	0	69623	6.48	4512	25	92669
310006	RETENTION PAD	16385	0	16385	6.48	1062	25	21809
310007	JUMPER (FAB & INSTALL)	17297	0	17297	6.48	1121	25	23022
310008	CONC SHIELDING BLOCKS OVER TR.LINE	30539	0	30539	6.48	1979	25	40647
310009	PUMP PIT COVER BLOCKS	37251	0	37251	6.48	2414	25	49581
310016	ELECTRICAL AND 'YELLOW JACKET'	117490	0	117490	6.48	7613	25	156379
	SUBTOTAL 310 TOTAL CONST-ONSITE W/O BURN	288585	0	288585	6.48	18701	25	384107
311017	BURNOUT AT PUMP PIT	24512	0	24512	6.48	1588	25	32625
	SUBTOTAL 31 FA CONST-ONSITE E/C	313097	0	313097	6.48	20289	25	416732
	SUBTOTAL 3 CONSTRUCTION	313097	0	313097	6.48	20289	25	416732
500001	TWRS CONSTRUCTION	115316	0	115316	6.89	7945	10	135587
500002	TWRS START-UP	151410	0	151410	7.84	11871	10	179609
	SUBTOTAL 5 OTHER PROJECT COST	266726	0	266726	7.43	19816	10	315196

PROJECT TOTAL		925,474	0	925,474	4.88	45,133	17	1,137,972

WHC-SD-SNF-COR-008, Rev. 0

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A-3

1. DOCUMENTS AND DRAWINGS

=====

DOCUMENTS: H-14-100727-1,2,3,4,5; H-14-100777; H-14-100778; H-14-100780-1,2; H-14-100782 (ALL UNAPPROVED)
DRAWINGS: DRAFT FOC WHC-SD-WM-FDC-052, REV. 0, JUNE 27, 96; L.O.I. F.J. MULLER TO FORREST DAY DATED JUNE 26, 1996.

2. MATERIAL PRICES

=====

UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL.

3. LABOR RATES

=====

- A.) ICF-KH HOURLY RATES ARE BASED ON THE 1996 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEH FINANCE (EFFECTIVE 03-08-96). SEE ALSO THE FY 1996 PLANNING RATES * (REPORT BGHB7012).
B.) WHC HOURLY RATES ARE BASED UPON THE FY 1996 PLANNING RATES * (REPORT BGHB2001).
C.) BASE CRAFT RATES ARE AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-95). RATES INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE, PER HANFORD SITE STABILIZATION AGREEMENT, APPENDIX A (EFFECTIVE 09-06-95).
* SEE HANFORD SOFT REPORTING, FDS BUDGET GUIDELINE HANDBOOK, SECTION 2 - COMPANY INFORMATION, FY 1996 PLANNING RATES.

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS

=====

(WHC FUNDED EXPENSE)

- A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS, TECHNICAL SERVICES AND CRAFT OVERHEAD COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE ICF-KH ESTIMATING FACTOR, REVISION 1, FY95, DATED 1/18/94. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR, FOR THIS PROJECT, IS 52% FOR SHOP WORK AND FIELD WORK, WHICH IS REFLECTED IN THE "OH&P&B/I" COLUMN OF THE ESTIMATE DETAIL.

5. ESCALATION

=====

ESCALATION PERCENTAGES WERE CALCULATED FROM THE MARCH 1996 UPDATE OF THE ECONOMIC ESCALATION PRICE CHANGE INDICES FOR DOE CONSTRUCTION PROJECTS AS PUBLISHED BY THE "OFFICE OF INFRASTRUCTURE ACQUISITION" FM-50.

6. ROUNDING

=====

U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE 1-32 SUBPARAGRAPH (H), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE 1-11, DATED 10-31-84.

7. REMARKS

=====

- A.) DESIGN, INSPECTION & CONSTRUCTION ARE BY ONSITE CONTRACTOR.
B.) ABOVE GROUND WORK IS GENERALLY CLEAN REQUIRING NO SWP.
C.) WORK ASSOCIATED WITH PUMP PIT WILL REQUIRE ASSAULT MASK BUT NO FRESH AIR.
D.) THE EXISTING COVER BLOCK THAT IS BEING REPLACED WILL BE LEFT IN THE FARM FOR LATER REUSE.
E.) SURFACE EXCAVATION FOR SUBGRADE WILL REQUIRE SWP (IN WHITES) BUT NOT BURIAL OF EXISTING DIRT.
F.) THE RETENTION BASIN LINER COMES WITH WELDED SEAMS.
G.) THE EXISTING GRADE IS RELATIVELY FLAT, AND LEVEL.
H.) THE TRANSFER LINE WAS ESTIMATED AS 1-1/2" EPDM HOSE IN BW 304L SST 3" PIPE SCH 40; CONTRARY TO DWGS WHICH CALLED OUT CSTL.
I.) ALLOWANCE FOR A SUMP PUMP AND A 20 FOOT UNENCASED 1-1/2" SCRD SST PIPE TYING TO TRANSFER LINE IN THE RETENTION BASIN WAS MADE.
J.) COST TO DATE FOR TWS ENGINEERING, DESIGN AND THE OPC WERE SUPPLIED BY WHC (FRANK MUELLER) FOR INCLUSION INTO THE ESTIMATE.
K.) THIS IS A STUDY ESTIMATE - NOT TO BE USED AS A BASELINE.

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. 2412/E57993
FILE NO. 2412SAA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R04 - COST CODE ACCOUNT SUMMARY

PAGE 4 OF 8
DATE 08/27/96 13:34:18
BY SMF/LGH/DKH

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS
020	TITLE II							
110000	TWRS ENGINEERING FY96	33000	0	33000	0.00	0	4950	37950
110001	TWRS DESIGN FY96	213000	0	213000	0.00	0	31950	244950
110002	TWRS DESIGN FY98	73695	0	73695	4.54	3346	11556	88597
TOTAL 020	TITLE II	319695	0	319695	1.05	3346	48456	371497
030	TITLE III							
121000	ENGINEERING/INSPECTION-ONSITE E/C	25956	0	25956	6.48	1682	6909	34547
TOTAL 030	TITLE III	25956	0	25956	6.48	1682	6909	34547
4-550	OTHER STRUCTURES							
310006	RETENTION PAD	16385	0	16385	6.48	1062	4362	21809
310008	CONC SHIELDING BLOCKS OVER TR.LINE	30539	0	30539	6.48	1979	8130	40647
310009	PUMP PIT COVER BLOCKS	37251	0	37251	6.48	2414	9916	49581
TOTAL 550	OTHER STRUCTURES	84175	0	84175	6.48	5455	22408	112037
700	SPECIAL EQUIP/PROCESS SYSTEMS							
310004	TRANSFER LINE, SUMP PUMP, FLUSH HS	69623	0	69623	6.48	4512	18534	92669
310007	JUMPER (FAB & INSTALL)	17297	0	17297	6.48	1121	4605	23022
310016	ELECTRICAL AND 'YELLOW JACKET'	117490	0	117490	6.48	7613	31276	156379
311017	BURNOUT AT PUMP PIT	24512	0	24512	6.48	1588	6525	32625
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	228922	0	228922	6.48	14834	60940	304695
900	OTHER PROJECT COSTS							
500001	TWRS CONSTRUCTION	115316	0	115316	6.89	7945	12326	135587
500002	TWRS START-UP	151410	0	151410	7.84	11871	16328	179609
TOTAL 900	OTHER PROJECT COSTS	266726	0	266726	7.43	19816	28654	315196

WHC-SJ-SNF-COR-008, Rev. 0

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 WESTINGHOUSE HANFORD COMPANY
 JOB NO. 2412/E57993
 FILE NO. 2412SAA1

** TEST - INTERACTIVE ESTIMATING **
 K- BASINS SLUDGE RECEIVING STATION
 STUDY ESTIMATE
 DOE_R04 - COST CODE ACCOUNT SUMMARY

PAGE 5 OF 8
 DATE 08/27/96 13:34:18
 BY SMF/LGH/DKH

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS
=====	=====	=====	=====	=====	=====	=====	=====	=====
=====								
PROJECT TOTAL		925,474	0	925,474	4.88	45,133	970,607 17	167,367 1,137,972

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. Z412/E57993
FILE NO. Z412SAA1

** IEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R05 - ESTIMATE SUMMARY BY CSI DIVISION

PAGE 6 OF 8
DATE 08/27/96 13:34:20
BY SMF/LGH/DKH

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS
=====	=====	=====	=====	=====	=====	=====	=====	=====
CONSTRUCTION								
00	TECHNICAL SERVICES	25956	0	25956	6.48	1682	27638	34547
02	SITEWORK	16385	0	16385	6.48	1062	17447	21809
03	CONCRETE	67790	0	67790	6.48	4393	72183	90228
15	MECHANICAL	86920	0	86920	6.48	5633	92553	115691
16	ELECTRICAL	117490	0	117490	6.48	7613	125103	156379
20	BURNOUT	24512	0	24512	6.48	1588	26100	32625
90	OTHER PROJECT COSTS	586421	0	586421	3.95	23162	609583	666693
	TOTAL CONSTRUCTION		0					
		925,474		925,474	4.88	45,133	970,607	1,137,972
=====								
	PROJECT TOTAL		0					
		925,474		925,474	4.88	45,133	970,607	1,137,972

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MFC-SJ-SNF-CDR-008, Rev. 0

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. Z412/E57993
FILE NO. Z412SAA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R06 - CONTINGENCY ANALYSIS BASIS SHEET

PAGE 7 OF 8
DATE 08/27/96
BY SMF/LGH/DKH

REFERENCE: ESTIMATE BASIS SHEET
COST CODE ACCOUNT SUMMARY

PAGE 3 OF 8
PAGE 4 OF 8

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A STUDY ESTIMATE SHOULD HAVE AN OVERALL RANGE OF 20 TO 30%.

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING

000	ENGINEERING		
11	TWRS ENGR & DESIGN	15%	CONTINGENCY WAS ADDED CONSISTENT WITH THE CONSTRUCTION IT SUPPORTS
121000	ENGINEERING/INSPECTION-ONSITE E/C	25	CONTINGENCY WAS ADDED - INSPECTION RISK IS SIMILAR TO CONSTRUCTION

AVERAGE ENGINEERING CONTINGENCY 16%

CONSTRUCTION

550	OTHER STRUCTURES		
310006	RETENTION PAD	25%	CONTINGENCY WAS ADDED, EXCAVATION REQUIRED COULD FIND CONTAMINATION
310008	CONC SHIELDING BLOCKS OVER TR.LINE	25	CONTINGENCY WAS ADDED AS BLOCK FABRICATION METHODS COULD VARY
310009	PUMP PIT COVER BLOCKS	25	CONTINGENCY WAS ADDED AS RADIATION & CONTAMINATION CHANGES WILL CHANGE COSTS
	TOTAL 550 OTHER STRUCTURES	25	
700	SPECIAL EQUIP/PROCESS SYSTEMS		
310004	TRANSFER LINE, SUMP PUMP, FLUSH HS	25%	CONTINGENCY WAS ADDED AS DETAILS OF DESIGN (ESPECIALLY MATERIAL REQUIREMENTS) ARE COMPLETED COST WILL VARY.
310007	JUMPER (FAB & INSTALL)	25	DITTO
310016	ELECTRICAL AND 'YELLOW JACKET'	25	DITTO
311017	BURNOUT AT PUMP PIT	25	CONTINGENCY WAS ADDED CONSISTENT WITH THE ITEMS BURNOUT IS APPLIED TO
	TOTAL 700 SPECIAL EQUIP/PROCESS SYSTEM	25	
900	OTHER PROJECT COSTS		
5	TWRS CONSTRUCTION & START-UP - OPC	10%	DITTO
	TOTAL 900 OTHER PROJECT COSTS	10	

AVERAGE CONSTRUCTION CONTINGENCY 25%

AVERAGE PROJECT CONTINGENCY 17%

MHC-SD-SMF-CDR-008, Rev. 0

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. Z412/ES7993
FILE NO. Z412SAA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

PAGE 8 OF 8
DATE 08/27/96 13:34:22
BY SMF/LGH/DKH

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
=====	=====	=====	=====	=====	=====	=====	=====
110000	TWRS ENGINEERING FY96	33000	0.00	0	0	0	0
110001	TWRS DESIGN FY96	213000	0.00	0	0	0	0
110002	TWRS DESIGN FY98	73695	0.00	0	0	0	0
121000	ENGINEERING/INSPECTION-ONSITE E/C	25956	0.00	0	0	0	0
310004	TRANSFER LINE, SUMP PUMP, FLUSH HS	69623	0.00	0	0	0	0
310006	RETENTION PAD	16385	0.00	0	0	0	0
310007	JUMPER (FAB & INSTALL)	17297	0.00	0	0	0	0
310008	CONC SHIELDING BLOCKS OVER TR.LINE	30539	0.00	0	0	0	0
310009	PUMP PIT COVER BLOCKS	37251	0.00	0	0	0	0
310016	ELECTRICAL AND 'YELLOW JACKET'	117490	0.00	0	0	0	0
311017	BURNOUT AT PUMP PIT	24512	0.00	0	0	0	0
500001	TWRS CONSTRUCTION	115316	0.00	0	0	0	0
500002	TWRS START-UP	151410	0.00	0	0	0	0
=====							
PROJECT TOTAL		925,474		0	0	0	0

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FILE NO. Z412SAA1

** IEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 1
DATE 08/27/96 13:34:23
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
110000	TWRS ENGINEERING FY96										
110000.9000005	TWRS ENGINEERING FY 96 COST TO DATE	020	1 LS	0	0	0	0	24000	0	0	24000
110000.9000006	TWRS ENGINEERING FY 96 ESTIMATE TO COMPLETE	020	1 LS	0	0	0	0	9000	0	0	9000
TOTAL WBS 110000 TWRS ENGINEERING FY96				0	0	0	0	33,000	0	0	33,000

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JOB NO. Z412/E57993
FILE NO. Z412SAA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 2
DATE 08/27/96 13:34:23
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
110001	TWRS DESIGN FY96										
110001.9000005	TWRS DESIGN FY 96 COST TO DATE	020	1 LS	0	0	0	0	97000	0	0	97000
110001.9000006	TWRS DESIGN FY 96 ESTIMATE TO COMPLETION	020	1 LS	0	0	0	0	116000	0	0	116000
TOTAL WBS 110001 TWRS DESIGN FY96				0	0	0	0	213,000	0	0	213,000

ALL

WHC-SD-SNF-CDR-008, Rev. 0

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FILE NO. 2412SAA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 3
DATE 08/27/96 13:34:24
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
110002	TWRS DESIGN FY98										
110002.9000006	TWRS DESIGN FY 98 SLUDGE ENGINEERING SUPPORT 2C50001 - 1/2 FTE DURATION OF 4 MONTHS (88 WORK DAYS)	020	88 WDY	352	21768	0	0	0	0	0	21768
110002.9000008	TWRS DESIGN FY 98 SLUDGE PROJECT MGMT SUPPORT 2A900 - 1/4 FTE DURATION OF 4 MONTHS (88 WORK DAYS)	020	88 WDY	176	10884	0	0	0	0	0	10884
110002.9000012	TWRS DESIGN FY 98 DESIGN REVIEW TANK FM ENGR 771C0001 - 8 FTE DURATION OF 2 WEEKS (10 WORK DAYS)	020	10 WDY	640	41043	0	0	0	0	0	41043
TOTAL WBS 110002 TWRS DESIGN FY98			1,168		73,695	0	0	0	0	0	73,695

A12

WHC-SD-SNF-CDR-008, Rev. 0

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** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 4
DATE 08/27/96 13:34:24
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
121000	ENGINEERING/INSPECTION-ONSITE E/C										
121000.00	TECHNICAL SERVICES										
121000.0000005	ENGINEERING/ INSPECTION BY ICF-KH 9% OF DIRECT CONSTRUCTION W/O BURNOUT	030	1 LS	0	0	0	0	25956	0	0	25956
SUBTOTAL	TECHNICAL SERVICES			0	0	0	0	25,956	0	0	25,956
TOTAL	COST CODE 03000 WBS 121000 (ESCALATION 6.48% - CONTINGENCY 25.00 %)			0	0	0	0	25,956	0	0	25,956
TOTAL WBS 121000	ENGINEERING/INSPECTION-ONSITE E/C			0	0	0	0	25,956	0	0	25,956

A13

WFC-SD-SMF-CDR-008, Rev. 0

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** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_ROB - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 5
DATE 08/27/96 13:34:24
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310004	TRANSFER LINE, SUMP PUMP, FLUSH HS										
310004.15	MECHANICAL										
310004.1500304	*****	700 F	0	0	0	0	0	0	0	0	0
310004.1500306	FIELD INSTALL MAIN XFER LINE, ETC. *****	700 F	0	0	0	0	0	0	0	0	0
310004.1500312	3" PIPE SPOOLS	700 F	50 LF	14	748	0	0	0	0	389	1137
310004.1500316	1-1/2" HOSE INSTALLATION	700 F	60 LF	5	267	0	0	0	0	139	406
310004.1500318	1-1/2" HOSE CONNECTION AT TRUCK, 3" HILTAP CONN., & BOLT UP SPLIT 6" PIPE - CONNECT EPDM HOSE	700 F	1 LS	4	214	0	0	0	0	111	325
310004.1500322	6" FLANGE BOLTUP INCLS BOLT SET & GASKT	700 F	2 EA	3	160	0	72	0	0	83	315
310004.1500326	3" FLANGE BOLTUP INCLS BOLT SET & GASKT	700 F	5 EA	4	214	0	75	0	0	111	400
310004.1500328	SETUP & ADJUST ADJUSTABLE SUPPORTS (PREFABBED IN SHOP SECTION OF ESTIMATE)	700 F	5 EA	5	267	0	0	0	0	139	406
310004.1500337	SETUP SUPPORT AT TRUCK	700 F	1 EA	4	214	0	4	0	0	111	329
310004.1500340	SAND BAGS	700 F	10 EA	3	160	0	20	0	0	83	263
310004.1500344	HYDRO & FLUSH 3" & 4" (60')	700 F	1 LS	8	427	0	0	0	0	222	649
310004.1500346	HYDRO & FLUSH 1-1/2" HOSE (60')	700 F	1 LS	4	214	0	0	0	0	111	325
310004.1500352	INSULATE 3" & 4" PIPE W/ 4" JG x 1-1/2" WALL INSULATION	700 F	60 LF	14	748	0	360	0	0	389	1497
310004.1500356	DITTO AT FITTINGS, ETC.	700 F	8 EA	2	107	0	84	0	0	56	247
310004.1500359	*****	700 F	0	0	0	0	0	0	0	0	0
310004.1500360	** SUMP P. PORTION (INSTALL) *****	700 F	0	0	0	0	0	0	0	0	0
310004.1500364	SET SUBMERSIBLE PUMP	700 F	1 EA	1	53	0	0	0	0	28	81
310004.1500366	1-1/2" PIPE SPOOL	700 F	20 LF	4	214	0	0	0	0	111	325
310004.1500368	ALLOW FOR PORTABLE PIPE SUP- PORT	700 F	2 EA	6	320	0	80	0	0	166	566
310004.1500372	CONNECTION TO TRANSFER LINE	700 F	1 LS	2	107	0	0	0	0	56	163
310004.1500376	SET UPP PIPE SUPPORTS	700 F	2 EA	1	53	0	0	0	0	28	81
310004.1500378	SAND BAGS AT SUPPORTS	700 F	4 EA	1	53	0	8	0	0	28	89
310004.1500382	HYDRO & FLUSH	700 F	1 EA	4	214	0	0	0	0	111	325
310004.1500386	1-1/2" SIZE x 1-1/2" WALL THK INSULATION ON PIPE	700 F	20 LF	4	214	0	100	0	0	111	425

WHC-SL-SNF-CDR-008, Rev. 0

A-74

ICF KAISER HANFORD
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** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 6
DATE 08/27/96 13:34:24
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310004.1500390	LABEL ALL TRANSFER PIPING	700 F	1 LS	4	214	0	30	0	0	111	355
310004.1500410	***FIELD INSTALL FLUSH HOSE	700 F	0	0	0	0	0	0	0	0	0
310004.1500413	1" HOSE	700 F	1 LS	8	427	0	0	0	0	222	649
310004.1500415	NOTE: SEE ELECTRICAL FOR YELLOW JACKET & HEAT TRACE (NO INSULATION CALLED FOR)	700 F	0	0	0	0	0	0	0	0	0
310004.1500500	SWP SUPPORT FOR ITEMS IN THIS WBS	700 F	16 MH	16	612	0	0	0	0	318	930
<hr/>											
SUBTOTAL	MECHANICAL		(FIELD)	121	6,221	0	833	0	0	3,234	10,288
	GENERAL FOREMAN 7.00 %			8	435				0		435
	CONSUMABLES 6.00 %						49				49
	SALES TAX 8.00 %						70		0		70
	WAREHOUSING 28.00 %						247				247
	OH&P (ON MARKUPS ONLY)									226	226
<hr/>											
TOTAL	COST CODE 70015			129		0		0	0	3,460	11,317
	WBS 310004				6,656		1,200		0		
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
<hr/>											
310004.15	MECHANICAL										
310004.1500308	1-1/2" IN 4" PIPE SPOOL	700 M	10 LF	5	267	0	0	0	0	139	406
310004.1500332	SETUP SUPPORT AT PIT WALL	700 M	1 EA	4	214	0	2	0	0	111	327
<hr/>											
SUBTOTAL	MECHANICAL		(MASK)	9		0		0	0	250	
	SWP 100.00%			9	481		2		0		733
	GENERAL FOREMAN 7.00 %			1	67						67
	CONSUMABLES 6.00 %						0				0
	SALES TAX 8.00 %						0		0		0
	WAREHOUSING 28.00 %						0				0
	OH&P (ON MARKUPS ONLY)									285	285
<hr/>											
TOTAL	COST CODE 70015			19		0		0	0	535	
	WBS 310004				1,029		2		0		
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
<hr/>											
310004.15	MECHANICAL										
310004.1500005	*****	700 S	0	0	0	0	0	0	0	0	0

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WHC-SD-SNF-CDR-008, Rev. 0

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. Z412/E57993
FILE NO. Z412SA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 7
DATE 08/27/96 13:34:24
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310004.1500006	SHOP FABRICATION H-2-14-100727 SHT 5 & H-14-100780 SHT 1 BOTH UNAPPROVED	700 S	0	0	0	0	0	0	0	0	0
310004.1500007	*****	700 S	0	0	0	0	0	0	0	0	0
310004.1500008	MAIN TRANSFER LINE *****	700 S	0	0	0	0	0	0	0	0	0
310004.1500012	3" MALE HILTAP FITTING (NPT END) PRICE PER MARK OF SPOKANE HOUSE OF HOSE	700 S	1 EA	1	0	0	6050	0	0	0	6050
310004.1500016	1" PIPE A312 304L SCH 40 SST (SST PIPE PRICES PER ESCO PRICE LIST LETTER)	700 S	2 LF	1	53	0	12	0	0	28	93
310004.1500019	1-1/2" PIPE A312 304L SCH 40	700 S	20 LF	2	107	0	260	0	0	56	423
310004.1500022	3" PIPE A312 304L SCH 40 SST	700 S	60 LF	10	534	0	1800	0	0	278	2612
310004.1500026	6" PIPE A312 304L SCH 40 SST	700 S	2 LF	1	53	0	240	0	0	28	321
310004.1500029	4" PIPE A312 304L SCH 40 SST	700 S	20 LF	4	214	0	720	0	0	111	1045
310004.1500032	MAKE 3" 45 DEG PIPE BEND SCH 40	700 S	2 EA	6	320	0	0	0	0	166	486
310004.1500036	SPRING 1-1/2" PIPE DURING FAB	700 S	1 EA	2	107	0	0	0	0	56	163
310004.1500039	1-1/2" ELB 90 DEG BW SST	700 S	2 EA	1	53	0	24	0	0	28	105
310004.1500042	4" ELB 90 DEG BW SST	700 S	1 EA	1	53	0	90	0	0	28	171
310004.1500046	4"x3" CONC RDCR SCH40 BW SST	700 S	1 EA	0	0	0	41	0	0	0	41
310004.1500050	1-1/2"x2 CONC RDCR SCH40 BW SST	700 S	1 EA	0	0	0	29	0	0	0	29
310004.1500052	1-1/2"x1 CONC RDCR SCH40 BW SST	700 S	1 EA	0	0	0	17	0	0	0	17
310004.1500056	6"x 3" CONC RDCR SCH40 BW SST	700 S	1 EA	1	53	0	114	0	0	28	195
310004.1500060	1" BALL VALVE SST BW MANUAL	700 S	2 EA	1	53	0	124	0	0	28	205
310004.1500064	1-1/2" BALL VALVE SST BW MANUAL OPERATOR	700 S	1 EA	1	53	0	124	0	0	28	205
310004.1500067	1" WELDOLET SST	700 S	2 EA	1	53	0	110	0	0	28	191
310004.1500069	1/2" THREADED SST (FOR LEAK DETECTOR PROBE)	700 S	1 EA	0	0	0	38	0	0	0	38
310004.1500071	CUT 1/2" PLATE 6" DIA W/ 2 HOLES	700 S	1 EA	3	160	0	44	0	0	83	287
310004.1500074	SPLIT 6" SST PIPE SCH 40	700 S	4 LF	2	107	0	0	0	0	56	163
310004.1500078	CUT OUT 1/4" PL SST 1" x 4'	700 S	1 LS	1	53	0	22	0	0	28	103
310004.1500080	DRILL 12 BOLT HOLES THRU 1/4" SST PLATE	700 S	1 LS	4	214	0	0	0	0	111	325

A16

MHC-SD-SNF-CDR-008, Rev. C

JCF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. 2412/E57993
FILE NO. 2412SAA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 8
DATE 08/27/96 13:34:24
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310004.1500082	CUT 6" SST BLIND FLG IN HALF (1" THK SST PL)	700 S	2 EA	1	53	0	0	0	0	28	81
310004.1500086	CUT HOLE FOR 6" PIPE IN 1" THK SST PL	700 S	2 EA	2	107	0	0	0	0	56	163
310004.1500088	CUT HOLE FOR 3" PIPE IN 1" THK SST PL	700 S	1 EA	1	53	0	0	0	0	28	81
310004.1500092	WELD BOLT FLANGES TO 6" PIPE SIDES SST	700 S	1 LS	2	107	0	2	0	0	56	165
310004.1500098	3" FLANGE SST WN 150#	700 S	10 EA	5	267	0	870	0	0	139	1276
310004.1500102	6" FLANGE SST WN 150#	700 S	1 EA	1	53	0	281	0	0	28	362
310004.1500104	6" FLANGE SST BLIND 150#	700 S	3 EA	2	107	0	606	0	0	56	769
310004.1500106	1" BW SST SCH 40	700 S	8 EA	24	1282	0	8	0	0	667	1957
310004.1500108	1-1/2" BW SST SCH 40	700 S	7 EA	26	1388	0	14	0	0	722	2124
310004.1500110	3" BW OR SEAL WELD SST	700 S	12 EA	72	3845	0	48	0	0	1999	5892
310004.1500114	4" BW OR SEAL WELD SST	700 S	4 EA	29	1549	0	24	0	0	805	2378
310004.1500116	6" BW OR SEAL WELD SST	700 S	3 EA	29	1549	0	24	0	0	805	2378
310004.1500118	2" BW SST	700 S	1 EA	5	267	0	3	0	0	139	409
310004.1500120	1" SADDLEWELD SST	700 S	2 EA	9	481	0	4	0	0	250	735
310004.1500122	1/2" SADDLEWELD SST	700 S	1 EA	5	267	0	2	0	0	139	408
310004.1500126	5% X-RAY WELD EXAM (REQ'D BY B31.3)	700 S	3 EA	11	572	0	30	0	0	297	899
310004.1500134	2" SST NOZZLE	700 S	1 EA	1	53	0	204	0	0	28	285
310004.1500136	FAB SST KICKPLATE FOR 2" NOZZLE	700 S	1 EA	4	214	0	40	0	0	111	365
310004.1500138	FAB SST BRACE FOR KICK PLATE	700 S	1 EA	1	53	0	10	0	0	28	91
310004.1500140	WELD KICKPLATE TO NOZZLE	700 S	1 EA	4	214	0	3	0	0	111	328
310004.1500148	FAB ADJUSTABLE PIPE SUPPORTS SEE BELOW FOR MTRL	700 S	5 EA	18	961	0	0	0	0	500	1461
310004.1500153	UNISTRUT P5543 'U' SHAPE FITTING	700 S	10 EA	0	0	0	60	0	0	0	60
310004.1500156	UNISTRUT P5500 CHANNEL 2-7/16" x 1-5/8"	700 S	20 LF	0	0	0	140	0	0	0	140
310004.1500158	UNISTRUT P1001 CHANNEL 3-1/4" x 1-5/8"	700 S	20 LF	0	0	0	140	0	0	0	140
310004.1500162	UNISTRUT P2558-30 PIPE/ CONDUIT CLAMP, 3"	700 S	5 EA	0	0	0	30	0	0	0	30
310004.1500166	MISC CHANNEL NUTS	700 S	30 EA	0	0	0	38	0	0	0	38
310004.1500168	MISC SCREWS 1/2" & 3/8" x 1-1/2" L UNC	700 S	40 EA	0	0	0	10	0	0	0	10
310004.1500172	1/4" PLATE, CSTL 1'-2" x 1'-0" X 5 EA	700 S	60 LB	0	0	0	30	0	0	0	30

AT7

A-17

MHC-SD-SNF-CDR-008, Rev. 0

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. 2412/E57993
FILE NO. 2412SAAT

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 9
DATE 08/27/96 13:34:24
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310004.1500178	FAB PIPE SUPPORT AT TIE-IN POINT WITH TRUCK (MTRL IN NEXT ITEM)	700 S	1 EA	8	427	0	0	0	0	222	649
310004.1500182	ANGLE 3" X 3" X 1/4" 40' LG SST (SST BECAUSE PIPE IS DESIGNATED SST)	700 S	200 LB	0	0	0	400	0	0	0	400
310004.1500195	3/4" FLEX HOSE EPDM	700 S	15 LF	1	53	0	75	0	0	28	156
310004.1500198	1-1/2" (I.D.) FLEX HOSE EPDM	700 S	60 LF	1	53	0	360	0	0	28	441
310004.1500204	1-1/2" HOSE CLAMP SST	700 S	3 EA	1	53	0	3	0	0	28	84
310004.1500207	3/4" HOSE CLAMP SST	700 S	1 EA	0	0	0	1	0	0	0	1
310004.1500230	FAB PIPE SUPPORT ASSY AT P. PIT WALL SST	700 S	1 EA	16	854	0	305	0	0	444	1603
310004.1500232	*****	700 S	0	0	0	0	0	0	0	0	0
310004.1500233	FAB SUMP PUMP PORTION *****	700 S	0	0	0	0	0	0	0	0	0
	THIS SECTION IS JUST AN ALLOWANCE!										
310004.1500234	NOTE: IT WAS ASSUMED SINCE THIS LINE WOULD ONLY BE USE AFTER A SPILL & WOULD BE CONTAINED WITHIN RETENTION BASIN THAT THIS LINE COULD BE UNENCASED - 1-1/2" SCRD SST PIPE WAS CHOSEN	700 S	0	0	0	0	0	0	0	0	0
310004.1500235	FDC REQUIRED A BACKFLOW PREVENTER - I COULD SEE NO PRACTICAL WAY TO ENCASE THAT ANYWAY.	700 S	0	0	0	0	0	0	0	0	0
310004.1500237	1/2 HP SUMP PUMP	700 S	1 EA	16	854	0	529	0	0	444	1827
310004.1500238	1-1/2" PIPE SCH 40 SST	700 S	20 LF	2	107	0	260	0	0	56	423
310004.1500240	1-1/2" x 3" PIPE NIPPLE SST	700 S	2 EA	1	53	0	12	0	0	28	93
310004.1500246	1-1/2" BACKFLOW PREVENTER	700 S	1 EA	2	107	0	509	0	0	56	672
310004.1500248	1-1/2" BALL VALVE SST SCRD	700 S	1 EA	1	53	0	124	0	0	28	205
310004.1500252	1-1/2" ELB SCRD SST	700 S	4 EA	3	160	0	100	0	0	83	343
310004.1500256	1-1/2" TEE SCRD SST	700 S	1 EA	1	53	0	34	0	0	28	115
310004.1500260	1-1/2" HOSE CLAMP SST	700 S	2 EA	1	53	0	2	0	0	28	83
310004.1500264	3" TEE SST BW	700 S	1 EA	1	53	0	76	0	0	28	157
310004.1500268	3" BW SST	700 S	1 EA	6	320	0	4	0	0	166	490
310004.1500272	FAB 3" DIA PLATE, 1/4" SST W/ 1-1/2" HOLE	700 S	1 EA	2	107	0	5	0	0	56	168

WHS-SD-SNF-CD3-008, Rev. 0

ICF KAISER HANFORD
 WESTINGHOUSE HANFORD COMPANY
 JOB NO. Z412/E57993
 FILE NO. Z412SAA1

** IEST - INTERACTIVE ESTIMATING **
 K - BASINS SLUDGE RECEIVING STATION
 STUDY ESTIMATE
 DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 10
 DATE 08/27/96 13:34:24
 BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310004.1500276	1-1/2" SEAL WELD SST	700 S	1 EA	2	107	0	2	0	0	56	165
310004.1500278	3" SEAL WELD SST	700 S	1 EA	3	160	0	4	0	0	83	247
310004.1500391	*** SHOP PURCH FLUSH HOSE **	700 S	0	0	0	0	0	0	0	0	0
310004.1500393	1" HOSE	700 S	320 LF	4	214	0	1760	0	0	111	2085
310004.1500397	QUICK CONNECTS AT HOSE ENDS DIXON G-11 & B-12 PIECES PRICE PER MARK HOUSE OF HOSE IN SPOKANE	700 S	2 EA	1	53	0	20	0	0	28	101
310004.1500402	ALLOWANCE FOR CONNECTIONS WITHIN HOSE LENGTH	700 S	4 SET	2	107	0	80	0	0	56	243
SUBTOTAL MECHANICAL		(SHOP)		370		0		0		10,246	
	GENERAL FOREMAN 7.00 %			25	19,683		17,145		0		47,974
	CONSUMABLES 6.00 %				1377				0		1377
	SALES TAX 8.00 %						1028		0		1028
	WAREHOUSING 28.00 %						1453		0		1453
	OH&P (ON MARKUPS ONLY)						5088		0		5088
										716	716
TOTAL	COST CODE 70015			395		0		0		10,962	
	WBS 310004				21,060		24,716		0		56,739
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
TOTAL WBS 310004 TRANSFER LINE, SUMP PUMP, FLUSH HS				544		0		0		14,958	
					28,746		25,919		0		69,624

A19

WBS-310004-008, REV. 0

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** IEST - INTERACTIVE ESTIMATING **
K - BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 11
DATE 08/27/96 13:34:24
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310006	RETENTION PAD										
310006.02	SITWORK										
310006.0234520	LEAK RETENTION MODUTANK SG 0313 SPILGARD MODEL 11'9" X 49'3" X 2' HIGH INCLS GEOTEXTILE	550	1 EA	40	1747	500	4340	0	0	908	7495
310006.0234524	HAUL OFF MATERIAL	550	40 CYS	10	441	0	0	0	0	229	670
310006.0234526	8" COMPACTED SUBGRADE	550	55 TON	33	1455	0	550	0	0	757	2762
<hr/>											
SUBTOTAL	SITWORK			83		500		0		1,894	
	GENERAL FOREMAN 7.00 %			5	3,643		4,890		0		10,927
	CONSUMABLES 6.00 %				255						255
	SALES TAX 8.00 %						293				293
	WAREHOUSING 28.00 %						414		0		414
	OH&P (ON MARKUPS ONLY)						1451				1451
<hr/>											
TOTAL	COST CODE 55002			88		500		0		2,026	
	WBS 310006				3,898		7,049		0		13,474
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
310006.02	SITWORK										
310006.0234522	EXCAVATION	550 W	40 CYS	20	765	0	0	0	0	398	1163
310006.0234523	SWP SUPPORT FOR ITEMS IN THIS WBS	550 W	16 MH	16	612	0	0	0	0	318	930
<hr/>											
SUBTOTAL	SITWORK		(SWP)	36		0		0		716	
	SWP 30.00%			10	1,377		0		0		2,093
	GENERAL FOREMAN 7.00 %				413						413
	OH&P (ON MARKUPS ONLY)			3	125						125
<hr/>											
TOTAL	COST CODE 55002			50		0		0		995	
	WBS 310006				1,915		0		0		2,911
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
<hr/>											
TOTAL WBS 310006	RETENTION PAD			138		500		0		3,022	
					5,813		7,049		0		16,385

A20

MHC-SD-SNF-CDR-008, Rev. 1

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FILE NO. Z412SAA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 12
DATE 08/27/96 13:34:25
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310007	JUMPER (FAB & INSTALL)										
310007.15	MECHANICAL										
310007.1500600	*****	700 M	0	0	0	0	0	0	0	0	0
310007.1500603	INSTALL JUMPER	700 M	0	0	0	0	0	0	0	0	0
310007.1500608	INSTALL JUMPER & SUPPORTS (ALLOWS FOR SOME RETROFIT)	700 M	1 LS	16	854	0	0	0	0	444	1298
310007.1500612	OPERATOR SUPPORT	700 M	1 LS	4	177	106	0	0	0	92	375
	SUBTOTAL MECHANICAL		(MASK)	20		106	0	0	0	536	
	SWP 100.00%			20	1,031		0		0		1,673
	GENERAL FOREMAN 7.00 %			2	144						1031
	OH&P (ON MARKUPS ONLY)									611	144
											611
	TOTAL	COST CODE 70015 WBS 310007 (ESCALATION 6.48% - CONTINGENCY 25.00 %)		42		106	0	0	0	1,147	3,459
310007.15	MECHANICAL										
310007.1500500	*****	700 S	0	0	0	0	0	0	0	0	0
310007.1500502	SHOP FAB JUMPER	700 S	0	0	0	0	0	0	0	0	0

	H-14-100727 SHT 3 RV 0 (UNAPPROVED)										
310007.1500506	2" FEMALE CONNECTOR, VERT. (PRICE ESCALATED FROM BILL'S LIST)	700 S	2 EA	4	214	0	2334	0	0	111	2659
310007.1500509	1-1/2" PIPE 304L SST	700 S	20 LF	2	107	0	360	0	0	56	523
310007.1500512	1-1/2" ELB 90 BW 304L SST	700 S	3 EA	1	53	0	36	0	0	28	117
310007.1500516	1-1/2"x 2" RDCR BW 304L SST	700 S	2 EA	1	53	0	34	0	0	28	115
310007.1500520	1-1/2" BW SST	700 S	10 EA	38	2029	0	20	0	0	1055	3104
310007.1500524	2" BW SST	700 S	2 EA	8	427	0	6	0	0	222	655
310007.1500528	STRUCTURAL SUPPORTING FRAME SST CHANNEL, NOT SHOWN ALLOWANCE	700 S	1 LS	6	320	0	200	0	0	166	686
310007.1500532	FLOOR STANDING PIPE SUPPORTS SST	700 S	2 EA	8	427	0	160	0	0	222	809
310007.1500536	HYDRO & FLUSH	700 S	1 EA	6	320	0	0	0	0	166	486
310007.1500538	COUNTERWEIGHT ALLOWANCE	700 S	1 EA	1	53	0	5	0	0	28	86
310007.1500540	LIFTING BAIL ASSEMBLY	700 S	1 EA	2	107	0	30	0	0	56	193

A21

WHC-SD-SNF-COR-008, REV. 0

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JOB NO. Z412/E57993
FILE NO. Z412SAA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 13
DATE 08/27/96 13:34:25
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310007.1500544	BALANCE WELD	700 S	1 EA	1	53	0	1	0	0	28	82
310007.1500546	DYE PEN BALANCE WELD	700 S	1 EA	1	53	0	1	0	0	28	82
310007.1500549	5% X-RAY OF BW'S PER B31.3	700 S	1 EA	4	208	0	10	0	0	108	326
310007.1500553	LABEL JUMPER	700 S	1 EA	1	53	0	0	5	0	28	86
<hr/>											
SUBTOTAL	MECHANICAL	(SHOP)		84		0	3,197	5	0	2,330	10,009
	GENERAL FOREMAN 7.00 %			5	4,477						313
	CONSUMABLES 6.00 %				313						191
	SALES TAX 8.00 %						191				271
	WAREHOUSING 28.00 %						271		0		948
	OH&P (ON MARKUPS ONLY)						948				162
<hr/>											
TOTAL	COST CODE 70015			89		0	4,608	5	0	2,492	11,897
	WBS 310007				4,790						
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
<hr/>											
310007.15	MECHANICAL										
310007.1500625	SWP SUPPORT FOR ITEMS IN THIS WBS	700 W	24 MH	24	918	0	0	0	0	477	1395
<hr/>											
SUBTOTAL	MECHANICAL	(SWP)		24		0	0	0	0	477	1,395
	SWP 30.00%			7	918		0		0		275
	GENERAL FOREMAN 7.00 %			2	275						83
	OH&P (ON MARKUPS ONLY)				83						186
<hr/>											
TOTAL	COST CODE 70015			33		0	0	0	0	663	1,940
	WBS 310007				1,276		0		0		
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
<hr/>											
TOTAL WBS 310007 JUMPER (FAB & INSTALL)				166		106	4,608	5	0	4,303	17,297
					8,273						

A22

WHS-SD-SNF-CDR-008, Rev. 0

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. 2412/E57993
FILE NO. 2412SAA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 14
DATE 08/27/96 13:34:25
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310008	CONC SHIELDING BLOCKS OVER TR.LINE										
310008.03	CONCRETE										
310008.0345604	FORM WALLS	550	757 SF	189	8254	0	946	0	0	4292	13492
310008.0345606	STRIP & OIL	550	757 SF	23	880	0	189	0	0	458	1527
310008.0345608	CONCRETE WALLS	550	23 CY	28	1220	207	1495	0	0	634	3556
310008.0345610	CURING	550	757 SF	5	191	0	11	0	0	99	301
310008.0345612	REBAR WALLS	550	1481 LBS	25	1214	0	444	0	0	631	2289
310008.0345614	TROWEL FINISH	550	194 SF	8	348	0	0	0	0	181	529
310008.0345616	LIFTING LUGS	550	8 EA	8	348	0	1760	0	0	181	2289
310008.0345618	SET 4 SECTIONS	550	1 JOB	16	707	0	0	0	0	368	1075
SUBTOTAL	CONCRETE			302		207		0		6,844	
	GENERAL FOREMAN 7.00 %			21	13,162		4,845		0		25,058
	CONSUMABLES 6.00 %				921						921
	SALES TAX 8.00 %						290				290
	WAREHOUSING 28.00 %						410		0		410
	OH&P (ON MARKUPS ONLY)						1437				1437
										479	479
TOTAL	COST CODE 55003			323		207		0		7,323	
	WBS 310008				14,083		6,984		0		28,597
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
310008.03	CONCRETE										
310008.0345602	GRADE & SCREED	550 W	1 JOB	16	612	0	0	0	0	318	930
310008.0345603	SWP SUPPORT FOR ITEMS IN THIS WBS	550 W	8 MH	8	306	0	0	0	0	159	465
SUBTOTAL	CONCRETE			24		0		0		477	
	SWP 30.00%			7	918		0		0		1,395
	GENERAL FOREMAN 7.00 %			2	275						275
	OH&P (ON MARKUPS ONLY)				83						83
										186	186
TOTAL	COST CODE 55003			33		0		0		663	
	WBS 310008				1,276		0		0		1,940
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
TOTAL WBS 310008 CONC SHIELDING BLOCKS OVER TR.LINE				356		207		0		7,986	
					15,360		6,984		0		30,538

A23

WH-C-SD-SMF-CDR-008, Rev. 1

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. 2412/E57993
FILE NO. 2412SAA1

** IEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 15
DATE 08/27/96 13:34:25
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310009	PUMP PIT COVER BLOCKS										
310009.03	CONCRETE										
310009.0345630	NEW COVER BLOCK	550	50 SF	300	13101	0	5000	0	0	6813	24914
	SUBTOTAL			300	13,101	0	5,000	0	0	6,813	24,914
	GENERAL FOREMAN 7.00 %			21	917						917
	CONSUMABLES 6.00 %						300				300
	SALES TAX 8.00 %						424		0		424
	WAREHOUSING 28.00 %						1484				1484
	OH&P (ON MARKUPS ONLY)									476	476
	TOTAL			321	14,018	0	7,208	0	0	7,289	28,515
	COST CODE 55003										
	WBS 310009										
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
310009.03	CONCRETE										
310009.0345632	REMOVE 3 COVER BLOCKS	550 W	160 SF	24	1061	1477	0	0	0	552	3090
310009.0345634	REPLACE 3 COVER BLOCKS	550 W	160 SF	24	1061	1477	0	0	0	552	3090
310009.0345635	SWP SUPPORT	550 W	16 MH	16	612	0	0	0	0	318	930
	SUBTOTAL			64	2,734	2,954	0	0	0	1,422	7,110
	SWP 30.00%			19	820						820
	GENERAL FOREMAN 7.00 %			5	248						248
	OH&P (ON MARKUPS ONLY)									555	555
	TOTAL			89	3,802	2,954	0	0	0	1,977	8,734
	COST CODE 55003										
	WBS 310009										
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
	TOTAL WBS 310009 PUMP PIT COVER BLOCKS			410	17,821	2,954	7,208	0	0	9,267	37,250

A24

WHC-SD-SNF-CDR-008, REV. 1

ICF KAISER HANFORD
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JOB NO. Z412/ES7993
FILE NO. Z412SAA1

** IEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 16
DATE 08/27/96 13:34:25
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310016	ELECTRICAL AND 'YELLOW JACKET'										
310016.16	ELECTRICAL										
310016.1611126	3/4"X 4"GRS NIPPLE	7060F	8 EA	6	316	0	7	0	0	164	487
310016.1611127	3/4"X 6"GRS NIPPLE	7060F	1 EA	1	53	0	1	0	0	28	82
310016.1611128	3/4"X 8"GRS NIPPLE	7060F	1 EA	1	53	0	2	0	0	28	83
310016.1611130	3/4"X 12"GRS NIPPLE	7060F	1 EA	1	53	0	3	0	0	28	84
310016.1611132	1"X 6"GRS NIPPLE	7060F	1 EA	1	53	0	2	0	0	28	83
310016.1611133	1"X 8"GRS NIPPLE	7060F	1 EA	1	53	0	3	0	0	28	84
310016.1611135	1"X 12"GRS NIPPLE	7060F	1 EA	1	53	0	4	0	0	28	85
310016.1611282	3/4" RGD CONDUIT HUB	7060F	2 EA	1	53	0	12	0	0	28	93
310016.1611283	1" RGD CONDUIT HUB	7060F	2 EA	1	53	0	15	0	0	28	96
310016.1611402	3/4" LB COND BODY & COVER	7060F	5 EA	4	211	0	55	0	0	110	376
310016.1611403	1" LB COND BODY & COVER	7060F	2 EA	2	105	0	32	0	0	55	192
310016.1611422	3/4" T COND BODY & CVR	7060F	3 EA	3	158	0	38	0	0	82	278
310016.1611850	CABLE PROTECTIVE COVER STANDARD YELLOW JACKET (1 SLOT SIZE 3")	7060F	136 EA	86	4527	0	44023	0	0	2354	50904
310016.1611852	CABLE PROTECTIVE COVER STANDARD YELLOW JACKET (3 SLOT SIZE 2.25")	7060F	20 EA	12	632	0	4660	0	0	329	5621
310016.1611854	CABLE PROTECTIVE COVER STANDARD YELLOW JACKET (4 SLOT SIZE 1.25")	7060F	24 EA	13	684	0	3888	0	0	356	4928
310016.1611856	CABLE PROTECTIVE COVER STANDARD YELLOW JACKET (3 SLOT SIZE 2.25")	7060F	4 EA	2	105	0	760	0	0	55	920
310016.1623112	#12/4 Type SO Cord	7060F	500 LF	7	368	0	1074	0	0	191	1633
310016.1637004	POWER Recp HUBBLEL 360M16W,ACM160 AND 360P6W INTERFACE	7060F	1 EA	3	158	0	1046	0	0	82	1286
310016.1637013	WP SpecRecp20A W/Box&Plt HUBBELL 2310A,7420 AND APPLETON FS-1-75L	7060F	4 EA	7	368	0	269	0	0	191	828
310016.1662228	EXST GCS PWR PNLBD 1 ADD 20A GFI	7060F	4 EA	9	474	0	255	0	0	246	975
310016.1662229	EXST GCS PWR PNLBD 1 ADD 40A2P C.B.	7060F	1 EA	2	105	0	43	0	0	55	203
310016.1668701	SUMP PUMP 1/2 HP CONNECTION	7060F	1 EA	1	53	0	17	0	0	28	98
310016.1683200	HT TRACE 1" HOSE	7060F	320 EA	58	3053	0	2080	0	0	1588	6721

A25

WHC-SD-SMF-CDR-008, Rev. 0

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
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** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 17
DATE 08/27/96 13:34:25
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
310016.1683205	HT TRACE 1-1/2" PIPE	7060F	20 EA	4	211	0	130	0	0	110	451
310016.1683210	HT TRACE 1-1/2" PIPE	7060F	55 EA	12	632	0	358	0	0	329	1319
SUBTOTAL ELECTRICAL		(FIELD)		239		0		0		6,549	
	GENERAL FOREMAN 7.00 %			16	12,584		58,777		0		77,910
	CONSUMABLES 6.00 %				880						880
	SALES TAX 8.00 %						3526				3526
	WAREHOUSING 28.00 %						4984		0		4984
	OH&P (ON MARKUPS ONLY)						17445				17445
										458	458
TOTAL				255		0		0		7,007	
	WBS 310016				13,464		84,732		0		105,204
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
310016.16	ELECTRICAL										
310016.1623112	#12/4 Type SO Cord	7065W	200 LF	3	158	0	430	0	0	82	670
310016.1682100	LEAK DET PROBE & RELAY	7065W	2 EA	38	2000	0	2272	0	0	1040	5312
310016.1682101	SWP SUPPORT	7065W	16 MH	29	1527	0	0	0	0	794	2321
SUBTOTAL ELECTRICAL		(SWP)		70		0		0		1,916	
	SWP 40.00%			28	3,685		2,702		0		8,303
	GENERAL FOREMAN 7.00 %			6	1474						1474
	CONSUMABLES 6.00 %				361						361
	SALES TAX 8.00 %						162				162
	WAREHOUSING 28.00 %						229		0		229
	OH&P (ON MARKUPS ONLY)						801				801
										954	954
TOTAL				104		0		0		2,870	
	WBS 310016				5,520		3,895		0		12,285
	(ESCALATION 6.48% - CONTINGENCY 25.00 %)										
TOTAL WBS 310016 ELECTRICAL AND 'YELLOW JACKET'				360		0		0		9,877	
					18,985		88,628		0		117,490

AS6

Rev. 0

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. Z412/E57993
FILE NO. Z412SAA1

** TEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 18
DATE 08/27/96 13:34:25
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
311017	BURNOUT AT PUMP PIT										
311017.20	BURNOUT										
311017.2000004	BURNOUT FOR JUMPER INSTALL'N IN PUMP PIT BASED ON 58MR GIVES A MULTIPLIER OF 8 20 COLD HRS x1.85 x 8= 296	700	296 mh	296	15806	0	0	0	0	0	15806
311017.2000009	BURNOUT FOR 4" SPOOL INSTL'N IN PUMP PIT BASED ON 58MR GIVES A MULTIPLIER OF 8 9 COLD HRS x1.85 x 8= 133	700	133 mh	133	7102	0	0	0	0	0	7102
SUBTOTAL	BURNOUT			429		0		0		0	
	GENERAL FOREMAN 7.00 %			30	22,908 1603		0		0		22,908 1603
TOTAL	COST CODE 70020 WBS 311017 (ESCALATION 6.48% - CONTINGENCY 25.00 %)			459	24,511	0	0	0	0	0	24,511
TOTAL WBS 311017	BURNOUT AT PUMP PIT			459	24,511	0	0	0	0	0	24,511

WHS-SD-SNF-CDR-008, Rev. 0

1CF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. 2412/E57993
FILE NO. 2412SAA1

** TEST - INTERACTIVE ESTIMATING **
K - BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 19
DATE 08/27/96 13:34:25
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
500001	TWRS CONSTRUCTION										
500001.9000005	TWRS CONSTRUCTION 771C0001 TANK FARM PLANT ENG WORK PKG PREP - 2 FTE DURAT. FOR 1 MONTH (22 WORK DAYS)	900	22 WDY	352	22574	0	0	0	0	0	22574
500001.9000008	TWRS CONSTRUCTION 2C50001 SLUDGE ENGR SUPP (TE CH. SUP CONST)- 1/2 FTE DURA FOR DURATION (181 WORK DAYS)	900	181 WDY	724	44772	0	0	0	0	0	44772
500001.9000010	TWRS CONSTRUCTION 29A0001 PROJECT ENGR SUPP 1/4 FTE FULL DURATION (181 WORK DAYS)	900	181 WDY	362	22386	0	0	0	0	0	22386
500001.9000012	TWRS CONSTRUCTION 33910006 HEALTH PHYSICS TECH 1/4 FTE FULL DURATION (181 WORK DAYS)	900	181 WDY	362	19124	0	0	0	0	0	19124
500001.9000015	TWRS CONSTRUCTION 771C006 TWRS NUC. OPERATORS 1/10 FTE FULL DURATION (181 WORK DAYS)	900	181 WDY	145	6460	0	0	0	0	0	6460
<hr/>											
TOTAL WBS 500001 TWRS CONSTRUCTION				1,945	115,316	0	0	0	0	0	115,316

A28

W-C-SD-SV-C03-008, Rev. C

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. Z412/E57993
FILE NO. Z412SAA1

** IEST - INTERACTIVE ESTIMATING **
K- BASINS SLUDGE RECEIVING STATION
STUDY ESTIMATE
DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 20
DATE 08/27/96 13:34:25
BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
500002	TWRS START-UP										
500002.9000005	TWRS STARTUP 771C0001 TANK FARM ENGRS OP- ERATIONAL READ. SUP.- 2 FTEs FOR DURATION (44 WORK DAYS)	900	44 WDY	704	45148	0	0	0	0	0	45148
500002.9000008	TWRS STARTUP 2C50001 SLUDGE ENGR SUPP 1/2 FTE FOR DURATION (44 WORK DAYS)	900	44 WDY	176	10884	0	0	0	0	0	10884
500002.9000012	TWRS STARTUP 2A90001 PROJECT ENGINEER 1/2 FTE FOR DURATION (44 WORK DAYS)	900	44 WDY	176	10884	0	0	0	0	0	10884
500002.9000014	TWRS STARTUP 771C0006 NUCLEAR PLANT OPER- ATORS (TRAINING) 4 FTEs FOR DURATION (44 WORK DAYS)	900	44 WDY	1408	62726	0	0	0	0	0	62726
500002.9000018	TWRS STARTUP 2A90001 SLUDGE PROJECT MANAGEMENT 1 FTE FOR DURATION (44 WORK DAYS)	900	44 WDY	352	21768	0	0	0	0	0	21768

TOTAL WBS 500002 TWRS START-UP				2,816	151,410	0	0	0	0	0	151,410

A29

WHC-SD-SNF-CDR-008, Rev. C

ICF KAISER HANFORD
 WESTINGHOUSE HANFORD COMPANY
 JOB NO. Z412/E57993
 FILE NO. Z412SAA1

** TEST - INTERACTIVE ESTIMATING **
 K- BASINS SLUDGE RECEIVING STATION
 STUDY ESTIMATE
 DOE_R08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 21
 DATE 08/27/96 13:34:26
 BY SMF/LGH/DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB- CONTRACT	EQUIP- MENT	OH&P / B & I	TOTAL DOLLARS
=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
REPORT TOTAL				8,364	459,932	3,767	140,398	271,961	0	49,416	925,475

BY PERCENT

1/2/96

COMPOSITE LABOR & MATERIALS
USE FOR AUG-96

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996									0.23	0.44	0.64	0.85
1997	1.06	1.27	1.48	1.69	1.89	2.10	2.31	2.53	2.74	2.95	3.16	3.37
1998	3.59	3.80	4.01	4.23	4.44	4.66	4.87	5.09	5.31	5.54	5.77	6.01
1999	6.24	6.48	6.72	6.95	7.19	7.43	7.67	7.91	8.15	8.41	8.66	8.92
2000	9.18	9.44	9.71	9.97	10.23	10.49	10.76	11.02	11.28	11.56	11.83	12.11
2001	12.39	12.66	12.94	13.22	13.50	13.78	14.06	14.34	14.62	14.91	15.19	15.47
2002	15.76	16.04	16.33	16.62	16.90	17.19	17.48	17.77	18.06	18.35	18.64	18.94
2003	19.23	19.52	19.82	20.12	20.41	20.71	21.01	21.30	21.60	21.90	22.20	22.51
2004	22.81	23.11	23.41	23.72	24.02	24.33	24.64	24.94	25.25	25.56	25.87	26.18
2005	26.49	26.80	27.12	27.43	27.74	28.06	28.38	28.69	29.01	29.33	29.65	29.97

WHC-SD-SW-038-038 Rev. 0

A21

A-31

OPC ESCALATION RATES
USE FOR AUG-96

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996										0.22	0.45	0.67
1997	0.89	1.12	1.34	1.57	1.79	2.02	2.25	2.47	2.70	2.93	3.16	3.39
1998	3.62	3.85	4.08	4.31	4.54	4.77	5.01	5.24	5.47	5.71	5.94	6.18
1999	6.41	6.65	6.89	7.13	7.36	7.60	7.84	8.08	8.32	8.56	8.80	9.05
2000	9.29	9.53	9.77	10.02	10.26	10.51	10.75	11.00	11.25	11.49	11.74	11.99
2001	12.24	12.49	12.74	12.99	13.24	13.49	13.74	14.00	14.25	14.50	14.76	15.01
2002	15.27	15.53	15.78	16.04	16.30	16.56	16.81	17.07	17.33	17.60	17.86	18.12
2003	18.38	18.64	18.91	19.17	19.44	19.70	19.97	20.24	20.50	20.77	21.04	21.31
2004	21.58	21.85	22.12	22.39	22.66	22.93	23.21	23.48	23.76	24.03	24.31	24.58
2005	24.86	25.14	25.42	25.69	25.97	26.25	26.53	26.82	27.10	27.38	27.66	27.95

ESCALATION ANALYSIS SCHEDULE

PROJECT NO./WORK ORDER NO. 2412 / 657993
 TITLE K-BASINS SLUDGE RECEIVING
STATION
 REQUESTED BY F. MUELLER

PREPARED BY STEVE FLETCHER DATE 7/29/96
 APPROVED BY _____ DATE _____

Tasks are shown as forecasted work and do not represent approved schedules nor manpower assignments.

FISCAL YEAR	F996												F998												F999														
CALENDAR YEAR																																							
MONTHS	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
1.1 DEFINITIVE DESIGN WHC																																							
1.2 ENGRG/INSPECTION ICF-KH																																							
OTHER ENGRG/OPERATING																																							
PROCUREMENT (2)																																							
3.1 CONSTRUCTION																																							
5.0 OPC STARTUP																																							

APPENDIX B SCHEDULE

Activity ID	Activity Description	Early start	Early finish	Activity ID	Activity Description	Early start	Early finish
SLUDGE REMOVAL SYSTEM - 141040203							
TWRS OFFLOAD							
SLUDGE RECEIVING STATION							
ENGINEERING							
EDW1701125	Develop FDC "002", Rev. 0	07-17-96A	07-26-96A				
EDW1701130	WHC Review FDC	07-29-96A	08-02-96A				
EDW1701135	Incorporate Comments FDC	08-05-96A	08-08-96A				
EDW1701137	RL Approve FDC "007", Rev 0	08-08-96A	09-12-96				
CONCEPTUAL DESIGN							
EDW17021	 TWRS OFFLOAD CONCEPTUAL DESIGN	11-06-96A	09-03-96				
EDW1702110	Prepare TWRS Offload Conceptual Design	11-06-96A	01-15-96A				
EDW1702111	Prepare Preliminary Design	01-18-96A	04-15-96A				
EDW1702112	Design Review Briefing	04-18-96A	04-18-96A				
EDW1702114	Initial Conceptual Design Review	04-17-96A	07-17-96A				
EDW1702115	CDR	07-01-96A	08-21-96A				
EDW1702116	Review	08-22-96A	08-23-96A				
EDW1702117	Incorporate Comments	08-26-96A	08-29-96				
EDW1702118	Issue CDR		09-03-96*				
SRS DEFINITIVE DESIGN							
EDW1702	 TWRS OFFLOAD DESIGN	11-06-96A	09-30-96				
EDW17022	 DEFINITIVE DESIGN (F-198)	09-04-96	09-30-96				
EDW1702210	Prepare Definitive Design	09-04-96	09-12-96				
EDW1702211	90% Design Briefing	09-13-96	09-13-96				
EDW1702212	90% Design Review	09-13-96	09-13-96				
EDW1702213	Design Review Meeting	09-25-96*	09-25-96				
EDW1702214	Incorporate Design Review Comments	09-26-96	09-30-96				
EDW1702219	Issue 90% Design Review Report		09-30-96				
EDW1803	TWRS Final Design (F-198)	06-01-98*	09-30-98				
TWRS CONSTRUCTION							
EDW1804	Sludge Receiving Station Construction Meet's	10-11-98	08-07-99				
TWRS START-UP							
EDW1805	Sludge Receiving Station Start-Up	05-08-99	05-04-99				

Project Start: 10-01-98
 Project End: 08-04-99
 Project Start: 08-04-99
 Project End: 08-04-99
 Project Start: 08-04-99
 Project End: 08-04-99

Project Start: 10-01-98
 Project End: 08-07-99
 Project Start: 08-07-99
 Project End: 08-07-99

TWRS SRS DESIGN
 SPENT NUCLEAR FUELS PROJECTS
 Sludge Removal System - Target ED01

Sheet 1 of 1

DATE: 08/29/96
 TIME: 13:53
 USER: 509 376 8277

APPENDIX C PRELIMINARY DESIGN REVIEW REPORT

JUN 06 1996

ENGINEERING DATA TRANSMITTAL

Page 1 of 1
1. EDT 000000

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Engineering Support	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: Spent Nuclear Fuel Project	6. Cog. Engr.: L. M. McWethy	7. Purchase Order No.: N/A
8. Originator Remarks: FOR RELEASE		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: N/A
11. Receiver Remarks:		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date:

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designer	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	WHC-SD-SNF-DRR-008		0	Preliminary Design Review Report - Sludge Offload System	<i>ESD/PA</i> <i>GRS 5/24/96</i>	1, 2		

16. KEY

Approval Designer (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, O, D or N/A (see WHC-CM-3-5, Sec. 12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designer for required signatures)										(G)	(H)
Reason	Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	Reason	Disp.
1,2	1	Cog. Eng. L. M. McWethy	<i>L. M. McWethy</i>	5/21/96	R3-48	P. L. Smith	<i>P. L. Smith</i>	5/21/96	R3-08	1,2	1
1,2	1	Cog. Mgr. C. J. Alderman	<i>C. J. Alderman</i>	5/22/96	R3-48	J. R. Thielges	<i>J. R. Thielges</i>	5/21/96	L6-38	1,2	1
1,2	1	V. C. Boyles	<i>V. C. Boyles</i>	5/22/96	R1-43						
1,2	1	J. D. Guberski	<i>J. D. Guberski</i>	5-22-96	R1-43						
1,2	1	D. M. Holgado	<i>D. M. Holgado</i>	5-26-96	S7-41						
1,2	1	C. A. Sams	<i>C. A. Sams</i>	5/22/96	S5-13						
1,2	1	C. P. Shaw	<i>C. P. Shaw</i>	5/23/96	H5-09						

18. L. M. McWethy Signature of EDT Originator 5/21/96	19. C. J. Alderman Authorized Representative 5/22/96	20. C. J. Alderman Cognizant Manager 5/22/96	21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments
---	--	--	---

Preliminary Design Review Report - Sludge Offload System

L. M. McWethy

WHC, Richland, WA 99352

U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: 615837

UC: 600

Org Code: 2C500

Charge Code: LD098

B&R Code: EW3135040

Total Pages: 39

Key Words: Spent Nuclear Fuel Project, sludge offload system, conceptual design review

Abstract: This report documents the conceptual design review of the sludge offload system for the Spent Nuclear Fuel Project. The design description, drawings, available analysis, and safety analysis were reviewed by a peer group. The design review comments and resolutions are documented.

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Kara J. Brown
Release Approval

4/5/96
Date

Approved for Public Release

Table of Content

PRELIMINARY DESIGN REVIEW REPORT - SLUDGE OFFLOAD SYSTEM	1
1.0 Introduction	1
2.0 Scope	1
3.0 Summary	1

APPENDIX A

Design Review Committee Members	A-1
---	-----

APPENDIX B

Attendees List for the Preliminary Design Review	B-1
--	-----

APPENDIX C

Design Review Checklist	C-1
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APPENDIX D

Action Item List	D-1
----------------------------	-----

APPENDIX E

Review Comment Record	E-1
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APPENDIX F

Design Review Briefing for K Basin Sludge Offload System	F-1
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APPENDIX G

Agenda of the Design Review	G-3
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PRELIMINARY DESIGN REVIEW REPORT - SLUDGE OFFLOAD SYSTEM

1.0 Introduction

The scope of the project is the design of a non-permanent offload system for transferring sludge from a transport system into a selected double-shell tank (DST) system. Modifications required for the installation include the addition of a shielded transfer line, a spill retention basin, and support instrumentation for leak monitoring during transfer operations.

2.0 Scope

The committee reviewed the available documentation for the design of the sludge offload system. In particular, the following were reviewed:

- WHC-SD-WM-FDS-052, Rev. 13, Functional Design Criteria for the Sludge Offload System, April 1996.
- Draft document, K Basin Sludge Study Assessment - Preliminary Hazards Identification and Analysis, April 1996.
- Draft drawing, H-14-100727, 4 sheets, Tank AW-103 Temporary Transfer Line Interface Control, January 1996.
- WHC-SD-WM-ES-383, Rev. 0, Shielding Requirements for K Basin Waste Transfer Line, March 8, 1996.

3.0 Summary

The scope of the design review included the Functional Design Criteria document, the conceptual design drawings, the draft PHA for offloading sludge, and the shielding analysis.

After opening remarks, Jim Thielges turned the meeting over to Sherri Brisbin for discussions on the design review comments received. All comments were dispositioned by acceptance, rejection or identifying necessary actions to close the comments. The completed Review Comment Data Base is attached to document this review process.

Jim Thielges then led the discussion of the design review checklist. The approved checklist is attached. The action items identified for the

APPENDIX A

Design Review Committee Members

DESIGN REVIEW COMMITTEE MEMBERS

Chairman	J.R. Thielges
Secretary	L.M. McWethy
QA	C.A. Sams
Safety	P.L. Smith
Environmental	J.D. Guberski
Facility Rep	V.C. Boyles
Mechanical	C.P. Shaw
DOE Rep	O.M. Holgado

APPENDIX B

Attendees List for the Preliminary Design Review

ATTENDEES LIST FOR THE PRELIMINARY DESIGN REVIEW - APRIL 30, 1996

<u>Name</u>	<u>Telephone</u>	<u>Organization</u>
C.J. Alderman	376-1796	SNF Engr. Support
V.C. Boyles	373-1321	Evaporator Support
S.A. Brisbin	376-9180	SNF Engr. Support
D.W. Crass	372-2034	TWRS/TSI
O.M. Holgado	373-0598	DOE RL/SFD
L.M. McWethy	376-9507	SNF Engr. Support
F.W. Moore	373-4079	SNF K Basins Projects
K.L. Pearce	376-3782	SNF Engr. Support
D.R. Precechtel	376-3329	SNF Engr. Support
J.R. Thielges	376-9029	ETTP-ED
C.A. Sams	373-9618	TWRS QA
C.P. Shaw	376-0814	TWRS DBEE
P.L. Smith	372-2471	TWRS-NSS
A.F. Wellner	372-1101	Engr. Support
H.H. Ziada	376-0910	TWRS D.A.

APPENDIX C

Design Review Checklist

WHC-SD-SNF-CDR-008, Rev. 0
WHC-SD-SNF-DRR-008, Rev. 0
K-BASINS SLUDGE OFFLOAD SYSTEM
CONCEPTUAL DESIGN REVIEW CHECKLIST

Documents Reviewed:

- "Functional Design Criteria for the K-Basins Sludge Offload System,"
Draft SD-WM-FDC-052, Rev. B.
- Draft Shielding calculations
- Preliminary Hazards Analysis
- Interface drawing H-14-100727, "Tank AW-103 Temporary Transfer Line
Interface Control"

<u>Yes</u>	<u>No</u>	<u>NA</u>	
[X]	[]	[]	Were the design inputs correctly selected?
[X]	[]	[]	Are assumptions necessary to perform the design activity adequately described and reasonable?

Assumptions changing tank to AW-105

[X]	[]	[]	Where necessary, are the assumptions identified for subsequent reverifications when the detailed design activities are completed?
-----	-----	-----	---

Will be entered into data base and tracked

[X]	[]	[]	Was an appropriate design method used?
-----	-----	-----	--

In accordanced with WHC Engineering Practices

[]	[]	[X]	Were the design inputs correctly incorporated into the design?
[]	[]	[X]	Is the design output reasonable compared to design inputs?
[X]	[]	[]	Are the necessary design input and verification requirements for interfacing organizations specified in the design documents or in supporting procedures or instructions?

With incorporation of RCR comments

[X]	[]	[]	Does the design meet established requirements for associated system physical and functional interfaces?
-----	-----	-----	---

With incorporation of RCR comments and tank change assumption.

JL Thielges, Chairman
Checklist Completed By

4/30/96
Date

APPENDIX D

Action Item List

Action Item List

<u>Action Item</u>	<u>Due Date</u>
• Dennis Crass will talk to John Strelow on the natural forces requirements identified in GC-LOAD-01.	May 15
• Hassan Ziada will determine the classification of the offload project as a major project subject to restrictive dose rate requirements or not.	May 15
• The Design Review Committee will document the change from the reference tank being AW-103 to it being AW-105 (99% confidence).	May 15
• Kathleen Pearce will report the Safety Class of the Offload System equipment as soon as identified by the ongoing safety analysis study.	May 15
• Kathleen Pearce will identify the TWRS DOE person responsibility for approval of the FDC.	May 15
• Hassan Ziada will identify the detailed requirements appropriate for inclusion in the initial release of the FDC and provide them for inclusion as soon as possible.	May 17

APPENDIX E

Review Comment Record

REVIEW COMMENT RECORD (RCR)	1. Date	2. Review No.
	4/24/96	1
	3. Project No.	4. Page
	A.13	1 of 1

5. Document Number(s)/Title(s) Dwg. H-14-100727	6. Program/Project/ Building Number Spent Nuclear Fuels/Proj.A.13/AW	7. Reviewer V. C. Boyles	8. Organization/Group Evaporator Project	9. Location/Phone 2750E/373-1321
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17. Comment Submittal Approval:	10. Agreement with indicated comment disposition(s)	11. CLOSED
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Organization Manager (Optional)

5/22/96
Date

VC Boyles
Reviewer/Print of Contact

Date

Reviewer/Print of Contact

Author/Originator

Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1	Tank AW-105 is now the receiver tank.		Accept.	
2	Move the leak retention pad to AW-105 similar to current dwg. except rotate pad 180 degrees. Bring truck in from the eastern gate south to the end of farm and turn north on the west side of AW-105.		Accept.	
3	For water supply activate the abandoned water line near the flush pit that runs south through the middle of the tank farm. See drawing H-2-70407 zone E/5 and H-2-70401 (EQ22104). The cut and capped portion near the flush pit will need to be reattached. A short section of overground pipe would be needed adjacent to AW-105. Heat trace the overground portion.		Not Accepted. A hose with freeze protection will be provided.	
4	Use prior design of overground system. Suggest reducing proposed line size (sludge distributor nozzle is only 1" dia.). Look at existing design on ECN's 626427, 618349 and 626429, drawing H-2-818284 (shielding) and pit entry spool pieces and mods. on ECN's 620379, 622123, 622514 and 624949.		Accept.	
5	Do not tie into the blank nozzle into the pit as currently proposed. Cut a slot in the pit cover and using a flex tie directly to pump. This will simplify design and minimize removal costs as well as ALARA.		This alternative will be evaluated by the design agent and the reviewer.	

the distributor
VCB
5/22/96

rigid jumper
VCB
5/22/96

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REVIEW COMMENT RECORD (RCR)	1. Date 4/24/96	2. Review No. 1
	3. Project No. A.13	4. Page 1 of 1

5. Document Number(s)/Title(s) WHC-SD-WM-FDC-052, Rev. B Functional Design Criteria For The Sludge Offload System	6. Program/Project/ Building Number Spent Nuclear Fuels/Proj.A.13/AW	7. Reviewer V. C. Boyles	8. Organization/Group Evaporator Project	9. Location/Phone 2750E/373-1321
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17. Comment Submittal Approval:	10. Agreement with Indicated comment disposition(s)	11. CLOSED
Organization Manager (Optional) Date <u>5/22/96</u>	Reviewer/Point of Contact <u>VC Boyles</u> Date _____	Reviewer/Point of Contact Date _____
Author/Originator _____		Author/Originator _____

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1	Pg.9,Sec.3.2.1. Add Leak Detectors will be installed and operable		Accept.	
2	Pg.9,Sec.3.2.1 Delete last bullet. Not needed		Accept.	
3	Pg.9,Sec.3.2.2 first bullet. Reduce flow to minimize life cycle costs. Suggest 50gpm or less. Piping would also be downsized.		Accept.	
4	Pg.10,Sec.3.2.2 Add bullet. Transfer system shall have the capability to be water flushed.		Accept.	
5	Pg.15,Sec.5.1.4 Consider raising the 0.5m/hr reqmt. Seems low if we are transferring 100 gpm. (Transfer would only take 10 minutes if it was a 1000 gallon transfer).		Accept.	
6	Pg.26,Sec.7.0 Add SAR SD-WM-SAR-034, Rev.0-A Addendum		Accept.	

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REVIEW COMMENT RECORD (RCR)	1. Date 4/24/96	2. Review No. 1
	3. Project No. A.13	4. Page 1 of 1

5. Document Number(s)/Title(s) K-Basin Sludge Assessment-April 1996	6. Program/Project/ Building Number Spent Nuclear Fuels/Proj.A.13/AW	7. Reviewer V. C. Boyles	8. Organization/Group Evaporator Project	9. Location/Phone 2750E/373-1321
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17. Comment Submittal Approval:	10. Agreement with Indicated comment disposition(s)	11. CLOSED
Organization Manager (Optional)	Date <u>5/22/96</u> Reviewer/Point of Contact <u>V.C. Boyles</u>	Reviewer/Point of Contact _____ Date _____ Author/Originator _____

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1	Pg.1,2nd par. Tank selection is now tank AW-105 instead of AW-103		Accept.	
2	Pg.9,first par. below bullets. Line size and flowrate may change. Check with Engrg.		Accept.	
3	Pg.10,first par. Refers to a 3" line but page 9 mentions a 2" line. Note also that engrg. may change line sizes to minimize life cycle costs.		Accept.	

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REVIEW COMMENT RECORD (RCR)

1. Date April 26, 1996	2. Review No.
3. Project No. A.13	4. Page 1 of 4

5. Document Number(s)/Title(s) WHC-SD-WM-FDC-052, Rev. B Functional Design Criteria for the Sludge Off-load System.	6. Program/Project/ Building Number K-Basin Sludge Transfer to Tank Farms	7. Reviewer H. H. Ziada	8. Organization/Group TWRS Facility Operations Design Authority	9. Location/Phone H5-52, ETC-2, Rm 212 376-0910
17. Comment Submittal Approval:	10. Agreement with indicated comment disposition(s)	11. CLOSED		

Organization Manager (Optional)

5-24-96

Hassan H. Ziada
Reviewer/Point of Contact

Reviewer/Point of Contact

Date

Date

Author/Originator

Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1	Title Page: Shafik Rifaey, manager of TWRS Facility Operations Design Authority Should be included in the WHC Approval.	y	Partially Accept. Will add to EDT. Title page will be deleted.	
2	Contents: Table of contents is not consistent with the text page numbers. The Table should be consistent with the text.	y	Accept.	
3	Sec. 1, general: A system overall description is not provided. A system description should be provided for components, functions of components and systems, and interfaces from beginning to end of the process with other systems. This is important to understand the applicability of the FDC.	y	Accept.	
4	Sec.1.1, Pg. 2, third paragraph, replace: An alternative study, with: Alternative studies.		Accept.	
5	Sec. 1.3, first paragraph: the sentence indicates that the system will in close proximity to the selected DST. Any additional loads on the tanks should be within the tank load capacity. Add to the sentence that the system should be within the tank dome load capacity.	y	Accept.	
6	Sec. 1.4, first sentence: The offload system will interface directly with the selected DST, add: and the transportation system.	y	Accept.	

REVIEW COMMENT RECORD (RCR)

1. Date April 26, 1996	2. Review No.
3. Project No. A.13	4. Page 2 of 4

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	14. Hold-Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
7.	Sec. 1.4, general: this section does not provide details of the interface components, which is helpful in determining the bounds of the offload system. This section should include the description of the interface components such as the connections with the transportation system, the connections with the selected tank riser, etc.	y	Accept.	
8	Sections 2, 3, and 4, general: the FDC does not provide sufficient details to guide the design and analysis of the system. This may result in costly designs and inefficient process. The FDC should provide guidelines for the capacities, dimensions or sizes of the components; applied loads; applicable sections of the code; etc. Some of the needed details appear in the following items.		Accept. Document author will work with reviewer to ensure adequate detail is provided.	
9	Sec. 2.1: first bullet, provide capacity of spill retention basin and the pump associated with it. Second bullet, specify number of manpower and qualifications. Fifth bullet, shall provide information on flushing system, instrumentation for leak detection that provided by the transportation system. Seventh bullet, piping requirements need not to be here, the proper place is in section 3.2 (piping and vessels).	y	Accept. Not accepted. This is an operational requirement. Manpower and qualification requirements will be identified in operating procedures. Accept.	
10	Sec. 3.1: provide details on range and sensitivity of instrumentation. Identify applicable sections of DOE 6430.1a and other codes, if possible.	y	Not accepted. Instrument range and sensitivity will be provided in the procurement specification for the transport system.	
11	Sec. 3.0: this section should specify the characteristic of the transferred waste (e.g., concentration of the sludge, viscosity, max. particle size, etc.). This information is essential in designing the system.	y	Accept.	
12 "	Sec. 3.2.1: fourth bullet states that the transfer line shall discharge into the selected DST via a nozzle or riser. This is wide open, indicating the discharge can be via any opening regardless of size or location, which may lead to a complicated design. Specify that the transfer should be via the central riser, if not feasible should be via a riser close to the center. Also specify the minimum diameter of the riser to be used.		Accept.	y

4-S-37-SV-023-005, Rev. 0

REVIEW COMMENT RECORD (RCR)

1. Date April 26, 1996	2. Review No.
3. Project No. A.13	4. Page 3 of 4

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	14. Hold-Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
13	Sec. 3.2.2: second bullet, the piping requirement is insufficient. Specify the max. or min. piping size and type. Third bullet, specify what are the criticality conditions. Fourth bullet does not provide enough information for design analysis to comply with ASME B31.3. The FDC should provide loading conditions (pressure, seismic, vibration, shock, temperature, etc.) and system requirements (relief systems, isolation, etc.). It also should refer to a structural design criteria, in which the structural requirements and applicable codes will be specified.	y	Accept.	
14	Sec. 3.4.1: the FDC should provide the required capacity of the spill retention basin.	y	Accept.	
15	Sec. 3.4.2: first bullet, the FDC should specify the loads imposed on the basin (truck load and location, seismic, etc.) and specify what is the design code to be used (e.g. AISC or other codes). Third bullet, the FDC should specify the pump capacity, discharge volume, etc. This will help in the design and selection of the pump type, and inlet and outlet piping connections.		Accept.	
16	Sec. 4.3.2: specify capacity of water supply for flushing. Sec. 4.3.6, lighting: the FDC should provide solution if lighting is not sufficient for night operations at tank site.	y	Accept.	
17	Sec. 5.1.1, general: the FDC does not provide safety class at this time. However, the design and analysis cannot proceed without safety class definition. The FDC should provide the safety class of the systems and components as soon as possible in order to proceed in a timely manner.	y	Not accepted. Safety class will be determined and documented by PNNL. A reference will be provided to that document.	
18	Sec. 5.1.4: specify normal and abnormal events.		Not accepted. This will be defined by PNNL.	

E-C-17A

KHC-SD-SNF-DRR-008, Rev. 0

REVIEW COMMENT RECORD (RCR)

1. Date April 26, 1996	2. Review No.
3. Project No. A.13	4. Page 4 of 4

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	14. Hold-Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
19	Sec. 5.4: specify natural loads to be considered and the design codes to be applied (SDC 4.1, AISC, etc.). Also the safety class has to be known before any evaluation can be done. A structural design criteria should be referred to in this section.	y	Not accepted. Since SDC 4.1 was replaced by GC-LOAD-01 and DOE 6430.1A, criteria is already there.	

C18

W-C-SD-SNF-CDF-009, Rev. 1

REVIEW COMMENT RECORD (RCR)

1. Date April 29, 1996	2. Review No. TBD
3. Project No. A.13	4. Page 1 of 1

5. Document Number(s)/Title(s) Sludge Offload System	6. Program/Project/ Building Number K Basin	7. Reviewer Craig Shaw	8. Organization/Group 74F10 TWRS DB Eq. Eng.	9. Location/Phone 2920 GWW 376-0814
17. Comment Submittal Approval:	10. Agreement with indicated comment disposition(s)	11. CLOSED		

Organization Manager (Optional)

5/23/96
Date

Craig Shaw
Reviewer/Point of Contact

Date

Reviewer/Point of Contact

Author/Originator

Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1	General: Because of the very conceptual stage of this design no detailed design comments can be given.		Accept.	
2	FDC Sec 2.1 & 2.2 The capabilities to unplug a transfer line need to be added. Probably a high pressure water source which could direct the plug to either the tank or transport container. The pressure required to remove a plug will likely set the design pressure of the transfer pipe.		Accept.	
3	The rheology of the sludge must be at least approximated, i.e viscosity and solids settling etc. to design the pump and transfer line.		Accept. Will provide or reference rheology information.	
4	Safety Assessment: 3.1.2 Container. The baffles to mitigate sloshing will make internal decontamination much harder. Will the benefit of the baffles be greater than their harm?		Baffles will not be provided. Sloshing will be administratively controlled by limiting speed.	
5	The SA contains "After the sludge is loaded into the container, the container contents will be sampled and chemically adjusted to meet AW tank farm acceptance criteria." No way to do this is mentioned in the drawings or FDC.		Sampling and chemical adjustment will be performed at the K Basin prior to shipment.	
6	Make sure the HEPA filters for the container vent have their effectiveness rated at "zero" flow.		This comment will be included in the procurement specification for the transport system.	
7	SA sec 3.2 Be careful in how the acceptance criteria for the "helium leak test" is worded. When checked with helium almost nothing is zero leak. You will need to specify a leak rate and a method of checking		The container will be designed with the capability of being leak tested; however, helium leak testing is not planned due to ALARA considerations.	
8	H-14-100727 What is the leak retention pad made from, steel, concrete, wood?		The liner is a commercially available poly liner designed specifically for a tanker truck.	

REVIEW COMMENT RECORD (RCR)	1. Date 4/29/96	2. Review No. 451.96
	3. Project No. A.13	4. Page 1 of 3

5. Document Number(s)/Title(s) K-BASINS SLUDGE OFFLOAD SYSTEM CONCEPTUAL DESIGN REVIEW	6. Program/Project/ Building Number A.13	7. Reviewer PETER L. SMITH	8. Organization/Group TWRS-NSS	9. Location/Phone BLDG. 2751. D111 372-2471
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17. Comment Submittal Approval: Organization Manager (Optional) _____ Date <u>5/23/96</u>	10. Agreement with indicated comment disposition(s) <u>Peter L. Smith</u> Reviewer/Point of Contact Date _____	11. CLOSED Date _____ Reviewer/Point of Contact Date _____
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12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1	In the FDC on Page 1 a paragraph on the KW fuel storage basin seems to have been inadvertently deleted.		Not accepted. This section was intentionally removed as requested by other reviewers.	
2	In the FDC on Page 7, Paragraph 2.2, add DOE Order 6430.1A to the second bullet to be consistent with Paragraph 5.4, and to be more inclusive of requirements.		Accept.	
3	In the FDC on Page 16, as a minimum a paragraph on Industrial Hygiene must be added with their manual CM-1-11. Also, the fire protection manual should be added, CM-4-41. Since the Nuclear Safety group is the key group in coordinating the review of all documents, it would be appropriate to include a paragraph on Nuclear Safety. We are included in Paragraph 5.1.1 in a loose manner, and you could expand this paragraph.		Accept.	
4	In the FDC on Pages 22 thru 26, some redundancy exists; i.e. documents are listed in both Paragraph 6.0 and 7.0. ASME B31.3 is not listed and other documents could be added. I would suggest a review of the Replacement Cross-Site Transfer System(W-058 Project) FDC to aid in developing a complete list of documents.		Accept.	
5	All of the following comments are applicable to the PHA. Figure 2.1 is written in hieroglyphics, please make it intelligible.		Accept.	
6	In Table 2.1 on Page 4 please add reverse flow, high temperature, and wrong material added.		Will review to determine if these elements need to be added. Temperature is already in the table.	

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REVIEW COMMENT RECORD (RCR)

1. Date 4/29/96	2. Review No. 451.96
3. Project No. A.13	4. Page 2 of 3

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	14. Hold-Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
7	In the introduction on Page 1 the scope of this PHA is specified as the transfer of the sludge from the truck to the DST, and flushing out the pipe and the tank on the truck. However, in the subsequent paragraphs the truck and trailer and the tank on the truck are included in the PHA. This discrepancy needs to be resolved.		Accept.	
8	On Page 12, a flexible metal transfer line is descibed, but there is no such line in the design.		Accept. Will correct.	
9	In Table 4.2, a crane falling over on the line should be considered and a backhoe digging up the line should also be considered.		Accept.	
10	On Page 44, Paragraph 6.2.1, provide references and say no possible flood in 200 Area, and delete all the rest of the paragraph. It is of no interest.		Accept.	
11	On Page 45, Paragraph 6.2.2, you need to reference your wind data and recheck your values. In 1990 there were wind gusts up to 91 mph on the Hanford Reservation per a telecon with the PNNL weather station.		Accept.	
12	It would be a good idea to talk with the TWRS FSAR authors concerning their findings for the Hazards analysis. I can provide the names of these people, if this idea appeals to you. A review of the Cross-Site Transfer System PSAR could also be instructive.		This is being done. The TWRS Authorization Basis point-of-contact interfaces directly with PNNL.	

E-10 C-19A

MHC-SD-SNF-DRR-008, Rev. 0

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REVIEW COMMENT RECORD (RCR)

1. Date April 29, 1996		2. Review No. 451.96	
3. Project No. FDC-052		4. Page 1 of 3	

5. Document Number(s)/Title(s) FDC-052, K Basin Sludge Offload System	6. Program/Project/ Building Number FDC-052	7. Reviewer J. E. Pieper	8. Organization/Group ETP Rad. Con. Tech. Support	9. Location/Phone 200E/MO393 376-4174
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17. Comment Submittal Approval:

10. Agreement with indicated comment disposition(s)

11. CLOSED

Organization Manager (Optional)

Date

5/27/96

Reviewer/Point of Contact

Date

Reviewer/Point of Contact

Author/Originator

Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1	<p>Section 1.4, second paragraph : I agree Tank Safety Assurance should provide general safety (department) guidance and coordinate all required safety (department) reviews, (Industrial Hygiene, Industrial Safety, Nuclear Safety, and Fire Protection), the functions within the safety department.</p> <p>There is another department within WHC called Radiological Safety that advises on the implementation of the Hanford Site Radiological Control Manual and 10 CFR 0835 Occupational Radiation Protection. I request that additional wording be added to this last paragraph:</p> <p>"... all required safety reviews. General radiological safety guidance and reviews will be provided and coordinated through each facility's Radiological Control Organization. Pacific Northwest National Laboratory....."</p> <p>Due to the extensive Radiological Regulations (to which the company is continually being audited), it is requested that a Radiological Control Department signature (separate from the Safety department signature) be on documents that address personnel working with radioactive material.</p>		Accept.	

REVIEW COMMENT RECORD (RCR)

1. Date April 29, 1996	2. Review No. 451.96
3. Project No. FDC-052	4. Page 2 of 3

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
2	Section 2.1 : I recommend deleting the last bullet as it is currently worded and replacing it with : "The sludge offload system life-cycle Man-Rem, including removal and disposal, shall be minimized by engineering design."		Accept.	
3	Section 3.0, second paragraph : I recommend that the word "recovery" be removed from the last sentence. An additional sentence could be added "The fail-safe upon power loss shall include the minimization of personnel radiation exposure during recovery."		Accept.	
4	Section 3.4 : I recommend adding additional wording to elaborate on "safe condition" such as -- "...establish a safe condition (unpressurized and with retention of radioactive minimized)."		Accept.	
5	Section 3.4.2, last bullet : I recommend adding to the end of the sentence "...prevention into the sump pump line"		Accept.	
6	Section 4.2 : Please review, isn't this the section where the "heat trace" shown on drawing 100727 should be mentioned ?		Accept. Will review.	
7	Section 4.7: I recommend modifying the wording in the last sentence to "...paid to minimization of liquid retention and ease (containment and speed) of replacement of pumps, valves..."		Accept.	
8	Section 5.1, last paragraph : I recommend rewording "...collective dose (including D&D (section 5.7)) shall be \$30,000."		Accept.	
9	Section 5.8 : Please change the words "health physics" to "radiological control".		Accept.	
10	PHA, page 10, Radiation levels : DOT does not require 2 mrem to the occupant of the tow vehicle if the occupant is on a Radiation Dosimetry program. You may wish to review this requirement if is going to impact the shield design.		Accept.	
11	PHA, section 3.1.4 : Remember that venting of the container will be required during unloading, please review the wording of the third line.		Accept.	

MHC-SD-SNF-DRR-008, Rev. 0

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REVIEW COMMENT RECORD (RCR)		1. Date April 29, 1996	2. Review No. 451.96
		3. Project No. FDC-052	4. Page 3 of 3
12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/ resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)
12	<p>Section 3.2, fifth bullet: I recommend rewording to delete the words "a berm over it to provide"</p> <p>eight bullet : Though the AW farm is a RBA, not requiring Protective clothing, the RWP for personnel performing the transfer of the waste from the transport trailer has not been written yet. For the operations of connecting and disconnecting the potentially contaminated couplings personnel will be required to wear PPE. I recommend that this information be added so as to not mislead the reader.</p>		Accept.

120-021

WFO-SO-SM-CO-005, 00V

REVIEW COMMENT RECORD (RCR)

1. Date 04/17/96	2. Review No. 1
3. Project No. K-Basin	4. Page 1 of 7

5. Document Number(s)/Title(s) WHC-SD-WM-FDC-052, Rev. B Functional Design Criteria for the Sludge Offload System	6. Program/Project/ Building Number K-Basis Sludge Transfer to AW-103	7. Reviewer S. M. Stahl	8. Organization/Group TWRS Authorization Basis/Authorization Basis Integration	9. Location/Phone A2-34 Fed. Bldg. Rm 235/ 376-8022
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17. Comment Submittal Approval: Organization Manager (Optional) _____	10. Agreement with indicated comment disposition(s) 5/20/96 Date Reviewer/Point of Contact per telecon	11. CLOSED Date Reviewer/Point of Contact
Author/Originator _____		Author/Originator _____

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1	General: Per WHC-CM-6-2, Project Management, Section 1.0, "Project Management:" "The functional design criteria define the project scope and technical requirements, including regulatory guidelines and requirements. The functional design criteria document is the technical baseline document for the project. The functional design criteria document is prepared by the user/sponsor organization in accordance with WHC-IP-1026, Appendix D, 'Functional Design Criteria' and is submitted to RL for review and approval before ..." WHC-SD-WM-FDC-052, Revision B follows the outline and format of WHC-IP-1026, Appendix D, but does not include the required level of detail as specified in the comments that follow.	Y	Not accepted. WHC-IP-1026 is a guidance document.	
2	Title Pg.: WHC Approval must include Shifik Rifaey who is the manager of TWRS Facility Operations Design Authority.	Y	Accept. Will add name to EDT. Approval page to be deleted.	

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REVIEW COMMENT RECORD (RCR)		1. Date 04/17/96	2. Review No. 1
		3. Project No. K-Basin	4. Page 2 of 7

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
3	<p>General: Per WHC-IP-1026, <i>Engineering Practice Guidelines</i>, Appendix D, "Functional Design Criteria:"</p> <ol style="list-style-type: none"> The FDC is to be processed as a supporting document in accordance with WHC-CM-6-1, EP-1.12. Fig. 1 from Appendix D is the DOE approval page format to be used for FDCs. Other approvals are to be obtained on an EDT in accordance with WHC-CM-6-1, EP-1.6. <p>The Draft FDC is not consistent with these requirements as follows:</p> <ol style="list-style-type: none"> The FDC approval page is not consistent with Fig. 1 from WHC-IP-1026, App. D and: The FDC does not include and EDT with the appropriate approval signatures required per WHC-CM-6-1, EP-1.6 and WHC-CM-3-5, section 12.7. 	Y*	The approval page will be deleted. Approval will be via EDT.	
4	<p>General: Applicable design criteria and analysis criteria that are to be included in the Functional Design Criteria are dependent on formal safety classification for the sludge offload system. The safety class designation for the system has not been specified as required per WHC-CM-1-3, MRP 5.46, "Safety Classification of Systems, Components, and Structures."</p>	Y	MRP 5.46 is obsolete. Agree that safety classification needs to be formally done--it will be performed prior to definitive design.	
5	<p>General: A system overview has not been provided that defines the elements of the system being designed, their functions, the starting and endpoints of the systems as well as interface connections. A system description should be provided to facilitate understanding of the scope and applicability of the requirements.</p>	Y	Accept.	
6	<p>Page 3, section 1.3, "Site Location," 1st bullet: The item notes that portions of the sludge offload system could be located directly over the selected DST. This should not be part of the FDC unless it can be demonstrated by analysis that applicable tank dome load requirements would not be exceeded. I recommend that the FDC specifically exclude the design from being located such that it has an effect on tank dome load.</p>	Y	Will change wording per Hussan Ziada comment 5.	

REVIEW COMMENT RECORD (RCR)

1. Date	2. Review No.
04/17/96	1
3. Project No.	4. Page
K-Basin	3 of 7

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold-Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
7	Page 3, section 1.4, "Project Interfaces." This section does not provide an adequate level of detail consistent with WMC-IP-1026, App. D. It notes that the offload system will interface directly with the selected DST. It should specify the interface components such as applicable DST Tank Farm and unit, DST pump pit, riser, etc. It should specify power supply needs and fresh water supply needs as known at this stage of the project. Possible affects on road and rail access should also be specified.	Y	Partially accept. Because of uncertainty associated with which tank will be used, the FDC will be left general--this was recommended during an earlier review. Specific info will be controlled via interface drawing. Power and water needs are identified in later sections of the document.	
8	Page 4, section 1.4, "Project Interfaces." 2nd sentence: It is stated that there may be a marginal increase in demand for electric power and supply water due to operation of the transportation system. This is inadequate. The power requirements should be specified (e.g., 240 volts AC) as well as minimum fresh water supply needs.	Y	Not accepted. Detailed information will be provided on the interface drawing.	
9	Page 6, section 2.1, "Project Criteria, Functional Requirements." The offload system functional requirements do not provide sufficient detail to permit detailed design, consistent with WMC-IP-1026, Appendix D requirements. The following information is not specified in sufficient detail: <ul style="list-style-type: none"> o Sump Pump and Spill Retention Basis performance requirements e.g., capacity. o Operational requirements e.g., redundancy, reliability, cyclic duty, 90 day storage limit. o Personnel requirements such as number and type. It only states that manned support needs to be provided for operation. o Identification of any high risk issues/assumptions that could impact the technical baseline such as the K-Basin waste source term determination. o Process piping requirements are stated which should not be in this section, instead they should be in the "Piping and Vessels" section. 	Y	Accept. Capacity information will be provided. Not accepted. Availability factor already identified. Not accepted. Specific manpower requirements will be identified in operating procedures. Not accepted. Issues will be documented and statuses via interface control documents. Accept.	
10	Page 8, section 3.0, "Process Criteria." 2nd sentence: The sentence states that the project shall be designed to handle waste streams that are considered to be ... above the DOE radionuclide requirements for secondary containment. The meaning of this is not clear as stated. It could be interpreted that the design of the secondary containment does not meet DOE requirements for the K-Basin sludge waste.	Y	Accept.	

MHC-SN-SNF-DRR-008, Rev. 0

REVIEW COMMENT RECORD (RCR)

1. Date

04/17/96

2. Review No.

1

3. Project No.

K-Basin

4. Page

4 of 7

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold. Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
11	Page 8, section 3.1, "Instrumentation and Control," 1st sentence: The sentence states that instrumentation shall be provided for early detection of leakage. This is not sufficient to direct detailed design. The requirements specified should include: system response time, minimum volume of leakage expected to be detected, applicable alarm and shutdown system interlocks, range and accuracy requirements, seismic requirements, reliability, maintenance requirements, power requirements, fail safe criteria, etc.	Y-	Partially accept. Additional detail will be provided as currently available.	
12	Page 8, section 3.2, "Piping and Vessels:" ASME B31.3 requirements are identified as applicable, but this has not been confirmed with safety class determination for the piping.	Y	Not accepted. ANSI B31.3 will be used. The applicable sections will be determined by the safety classification.	
13	Pages 8 - 10, section 3.2, "Piping and Vessels:" The piping and vessel requirements are insufficient to direct detailed design. Addition requirements should include: seismic, pressure, temperature, vibration, stress, shock, isolation requirements, relief systems, etc.	Y	Accept.	
14	Pages 8 - 10, section 3.2, "Piping and Vessels:" Additional applicable requirements from DOE 6430.1A should be specified such as that tank and piping systems shall be of welded construction to the fullest extent practical. Materials of construction shall be selected to minimize all form of corrosion (1323-5.2)		Accept.	
15	Page 9, section 3.2.1, "Piping and Vessels Functional Requirements," 3rd bullet: It is stated that the transfer line shall discharge into the selected DST via a nozzle or riser. This mandates that the design would accommodate either connection and could lead to unnecessary design complications. The expected tank inlet should be specified.		Partially accept. More specific criteria will be called out (a connection in the central pump pit which utilizes a slurry distributor); however, a specific inlet will not be identified.	
16	Page 9, section 3.2.1, "Piping and Vessels Functional Requirements," 6th bullet: It states that cathodic protection shall be provided. This may not be necessary considering limited design life and anticipated corrosion rates.		Accepted.	

REVIEW COMMENT RECORD (RCR)	1. Date 04/17/96	2. Review No. 1
	3. Project No. K-Basin	4. Page 5 of 7

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold-Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
17	Page 10, section 3.4.1, "General Mechanical Process, Functional Requirements:" It states that a spill retention basin shall be provided to contain the entire contents of the transportation container in the event of a spill. This needs to be more specific to identify the maximum volume that the spill container must hold (i.e., gallons of waste). Additionally, per DOE 6430.1A, for outdoor confinement structures such as the spill retention basin, the capacity must also include maximum predicted precipitation (1323-5-1). Applicable seismic criteria have not been specified either.	Y*	Partially Accept. TWRS Environmental Compliance will review to determine if maximum predicted precipitation is required.	
18	Page 11, section 3.4.2, "General Mechanical Process, Performance Requirements," 1st bullet: It states that a sump pump for removing spills from the spill retention basin is to be included. This is not sufficient information for detailed design development. Applicable safety class requirements, performance characteristics, power source (e.g. oil or electric), operating environment, maintenance and surveillance characteristics, availability and reliability, pump operation logistics (e.g., control panel, shutoff switches, instrumentation), etc. have not been specified.	Y	Partially accept. Additional information will be provided as known today.	
19	Page 12, section 4.3.2, "Utilities, Water:" It is stated that raw water for flushing shall be provided. Minimum flow, pressure, and availability of the water supply should be specified as well as location limitations if any. It must also state that backflow prevention devices are required for the raw water connection system. Raw water addition must also be metered to determine volume of water added to the tank farm waste stream.	Y	Accept.	
20	Page 12, section 4.3.2, "Utilities, Water:" No water provisions for fire protection have been specified. Fire fighting capability for postulated tanker truck fires needs to be available and specified as a requirement.	Y	Not accepted. Such requirements will be determined by the SA.	
21	Page 12, section 4.3.4, "Utilities, Electrical:" A requirement for one 240 VAC single phase power supply is made. Additional provisions should be specified such as availability, backup, grounding, insulation, loads, etc.	Y	Not accepted. Specific requirements are identified in the National Electrical Code.	

MHC-SO-SNF-DRR-008, Rev. 0

REVIEW COMMENT RECORD (RCR)

1. Date 04/17/96	2. Review No. 1
3. Project No. K-Basin	4. Page 6 of 7

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold-Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
22	Page 13, section 4.4, "Communication Systems:" Standard issue radio communication devices are to be provided. This may not be adequate for appropriate action and response to postulated accidents. Depending on results of accident analysis, this requirement may need to be more specific.	Y	Not accepted. Unless required by the SA or ops, radios will be used.	
23	Page 13, section 4.7, "Maintenance:" Insufficient requirements are specified. Other maintenance considerations should include ALARA practices, protection from environment, decontamination, access requirements, material selection, and level of documentation necessary to support maintenance.	Y	Not accepted. This is an O&M requirement--not to be covered in the FDC.	
24	Page 15, section 5.1.1, "Safety Analysis/Safety Assessment," 2nd paragraph: It states that a safety assessment will be prepared in accordance with a Letter of instruction. It should also state that the safety assessment should be in accordance with DOE-STD-3011-94 and a graded approach application of DOE-STD-3009-94. DOE-STD-1027-92 should be noted as applicable for hazards analysis.	Y	Accept.	
25	Page 15, section 5.1.1, "Safety Analysis/Safety Assessment," 2nd paragraph: It states that a safety assessment will be completed and approved prior to operation of the sludge system. An Unreviewed Safety Question Evaluation must be performed PRIOR to start of any construction or field modification activities in the Tank Farms. The results of this USO Evaluation will likely determine that DOE approval of the safety assessment is required PRIOR to conduct of these activities, not prior to operation.	Y	Accept.	
26	Page 15, section 5.1.3, "Contamination Control:" This section should specify that the criteria and guidance to ensure radioactive contamination control measures are incorporated during facility design are included in WHC-CM-4.9, Section 3.		Not Accepted. WHC-CM-4-9 is obsolete. It was replaced by WHC-SD-GN-DGS-30011.	
27	Page 15, section 5.1.4, "Shielding:" The requirement should state that the shielding design must be adequate to ensure the maximum dose to individuals does not exceed the occupational exposure limits of WHC-CM-4-9, Section 8.0. DOE 6430.1A states: "Specifically, the shielding shall be designed with the objective of limiting the total EDE to less than 1 rem per year to workers, based on their predicted exposure time in the normally occupied area" (1300-6.2). This requirement should also be added.	Y	See comment disposition 26. Limits are defined in HSRCM-1.	

REVIEW COMMENT RECORD (RCR)

1. Date 04/17/96	2. Review No. 1
3. Project No. K-Basin	4. Page 7 of 7

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold-Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
28	Page 16, section 5.1.6, "Fire Protection:" This states that fire protection will be defined during the design process and that a Fire Hazards Analysis is required as part of the safety documentation. The FHA should be deemed to be particularly important for this project. It should be completed as early as practical to permit appropriate design considerations.		Accept.	
29	Page 17, section 5.2.1, "Dangerous Waste Requirements:" This section should also refer to applicable requirements from DOE 6430.1A, section 1300-8.2, "Hazardous Waste Requirements."		TWRS Environmental Compliance will review and determine if reference to DOE 6430.1A is required.	
30	Page 18, section 5.2.2, "Airborne Release Requirements:" This section should also refer to applicable requirements from DOE 6430.1A, section 1300-9, "Effluent Control and Monitoring."		See comment 29.	
31	Page 18, section 5.4, "Natural Forces:" This section should also refer to the design considerations on natural forces from SDC 4.1.		Not accepted. SDC-4.1 is obsolete. It was replaced by GC-LOAD-01 and 6430.1A.	
32	Page 18, section 5.5, "Design Format:" This section includes a requirement for two way traceability between project drawings and reference drawings. This implies that reference drawings would require revision to refer back to project drawings. This appears to be an unnecessary expense and may be difficult to implement considering the number of outstanding ECNs to existing drawings.		Accept.	
33	Page 19, section 5.6, "Quality Assurance:" This section should also state that DOE 5700.6C requirements apply to all participants in development, design, procurement, construction, or testing.		Not Accepted. 5700.6C is applicable to non-nuclear facilities. AW tank farm is a nuclear facility.	
34	Page 20, section 5.7.1, "DOE Regulations:" WHC-IP-1026, App. D recommends that DOE 5820.2A, Chapter V also be referred to.		Accept.	
35	Page 20, section 5.7.2, "Miscellaneous Design Features:" WHC-IP-1026, App. D recommends that additional requirements and design features that simplify ultimate decontamination and decommissioning are specified in WHC-CM-7-5, Section 6.4.		Not accepted. Section 6.4 applies to surplus facilities going to BHI for D&D, not D&D performed during operations.	

WHC-SD-SNF-DRR-008, Rev. 0

APPENDIX F

Design Review Briefing for K Basin Sludge Offload System

DESIGN REVIEW BRIEFING FOR K BASIN SLUDGE OFFLOAD SYSTEM

LOCATION: 2752/C101

TIME: 9am April 16, 1996

The briefing for the K Basin sludge offload system was conducted as scheduled. The attendee list is attached. After introductions by Jim Thielges, Review Chairman, Sherri Brisbin discussed the documents to be reviewed, and Dennis Crass reviewed the system layout at tank farms and took questions on the interfaces, design aspects at tank farms, and limiting conditions of interest. The following notes were taken to remind the reviewers of areas of interest.

1. The tentative location of sludge disposal was given as AW-103, but that was immediately changed to indicate a more likely location of AW-105.
2. The Off Load system consists of the spill retention basin, double piping to connect the transport truck to the central pump pit, shielding, leak detection, water supply and power supply. The conceptual design is a 3" pipe inside a 6" outer pipe, mostly on the ground, with a half shell concrete shield. The connection to the central pit is through a 3" nozzle, which connects by a 2" transfer connector to a slurry slinger in the tank. The system will include heat tracing on the line to permit winter transfers. Cathodic protection may also be provided. Pump motor size will dictate power requirements. The transport package will furnish the sludge transfer pump and may include independent power supply. The tank farms has water sources for flush water for the transport package and the transfer line.
3. Considerations for sizing the connecting line include:
 - line slope (normally 1/4" per foot)
 - slurry velocity to maintain suspension
 - pumping pressure required (safety implications)
 - rheological properties of sludge (due May 1)
 - Reynolds number of the flow
 - Disposal favors a 1" flex line which can be coiled into a barrel for final disposal without contaminating the outer piping

ATTENDEES AT THE April 16, 1996 BRIEFING

NAME	TELE.	MISN	RESPONSIBILITY
J.R. (Jim) Thielges	376-9029	L6-38	Review Chairman
L.M. (Mike) McWethy	376-9507	R3-48	Review Secretary
S.A. (Sherri) Brisbin	376-9180	R3-48	Sludge Transport Cog.
K.L. (Kathleen) Pearce	376-3782	R3-48	Sludge TWRS Cog.
V.C. (Vic) Boyles	373-1321	R1-43	Evaporator Project
C.A. (Chuck) Sams	373-9618	S5-13	TWRS QA
D.W. (Dennis) Crass	372-2034	H5-68	TWRS/TSI
A.F. (Ann) Wellner	372-1101	H5-70	TWRS/TSI
S.H. (Shafik) Rifaey	373-2108	S1-57	D.A.
C.J. (Carol) Alderman	376-1796	R3-48	SNF Eng. Support
F.J. (Frank) Muller	376-2619	X3-85	Sludge Proj. Eng.
D.R. (Don) Precechtel	376-3329	R3-48	Sludge D.A.
C.P. (Craig) Shaw	376-0814	H5-09	TWRS-Safety Eq.
S.M. (Sheldon) Stahl	376-8022	A2-34	TWRS SAR Eng.
S.H. (Hassan) Ziada	376-0910	H5-52	TWRS D.A.
F.W. (Frank) Moore	373-4079	X3-85	K Basins Projects
P.M. (Phil) Daling	372-4239	K8-07	Safety Assessment
P.L. (Peter) Smith	372-2471	R3-08	TWRS-Nuc. Saf. Sup.

APPENDIX G

Agenda of the Design Review

K Basins Sludge Offload System

Preliminary Design Review

April 30, 1996

Conference room C101, Building 2752E

The purpose of this design review is to review the design of the K Basins Sludge Offload System at the conceptual stage. Items being reviewed include the draft Functional Design Criteria, draft interface drawing, draft shielding calculations, and draft hazards analysis.

AGENDA

Welcome	Jim Thielges
Review Briefing Minutes	Mike McWethy
Dispositions RCRs	All
Other Comments	All
Design Review Checklist	Jim Thielges
Summarize Action Items	Mike McWethy

APPENDIX D PRELIMINARY DESIGN REVIEW PACKAGE

SLUDGE OFFLOAD SYSTEM PRELIMINARY DESIGN REVIEW BRIEFING

April 16, 1996

K-BASINS SLUDGE OFFLOAD SYSTEM
CONCEPTUAL DESIGN REVIEW BRIEFING

APRIL 16, 1996, 9:00AM

AGENDA

Welcome	Jim Thielges
Introductions	All
Briefing Scope	Jim Thielges
Design Presentation	
• Draft FDC	Sherri Brisbin
• Draft Shielding Calculations	Dennis Crass
• Draft Hazards Analysis	Sherri Brisbin
• Draft Interface Drawings	Dennis Crass
Summary	

K-BASINS SLUDGE OFFLOAD SYSTEM
CONCEPTUAL DESIGN REVIEW COMMITTEE ASSIGNMENTS

Chairman - Jim Thielges

- Preside over and conduct design review briefing and formal design review
- Schedule design review briefing and formal design review meeting

Secretary - Mike McWethy

- Prepare briefing meeting minutes
- Prepare and issue design review report

Design Review Committee Members -

- Review design and provide written comments in area of expertise
 - QA Chuck Sams
 - Safety Peter Smith
 - Environmental John Guberski
 - Facility Representative Vic Boyles
 - Mechanical Craig Shaw
 - DOE Representative Oscar Holgado

K-BASINS SLUDGE OFFLOAD SYSTEM

CONCEPTUAL DESIGN REVIEW

APRIL 30, 1996

Conference Room C101, Building 2752E

The purpose of this design review is to review the design of the K-Basins Sludge Offload System at the conceptual stage. Items being reviewed include the draft Functional Design Criteria, draft interface drawing, draft shielding calculations, and draft hazards analysis.

AGENDA

Welcome	Jim Thielges
Review Briefing Minutes	Mike McWethy
Disposition RCR's	All
Other Comments	All
Design Review Checklist	Jim Thielges
Summarize Action Items	Mike McWethy

K-BASINS SLUDGE OFFLOAD SYSTEM CONCEPTUAL DESIGN REVIEW CHECKLIST

Documents Reviewed:

- "Functional Design Criteria for the K-Basins Sludge Offload System," Draft SD-WM-FDC-052, Rev. B.
- Draft Shielding calculations
- Preliminary Hazards Analysis
- Interface drawing H-14-100727, "Tank AW-103 Temporary Transfer Line Interface Control"

<u>Yes</u>	<u>No</u>	<u>NA</u>	
[]	[]	[]	Were the design inputs correctly selected?
[]	[]	[]	Are assumptions necessary to perform the design activity adequately described and reasonable?
[]	[]	[]	Where necessary, are the assumptions identified for subsequent reverifications when the detailed design activities are completed?
[]	[]	[]	Was an appropriate design method used?
[]	[]	[]	Were the design inputs correctly incorporated into the design?
[]	[]	[]	Is the design output reasonable compared to design inputs?
[]	[]	[]	Are the necessary design input and verification requirements for interfacing organizations specified in the design documents or in supporting procedures or instructions?
[]	[]	[]	Does the design meet established requirements for associated system physical and functional interfaces?

Checklist Completed By _____

Date _____

WHC-SD-WM-FDC-052, Revision B

FUNCTIONAL DESIGN CRITERIA
FOR THE
SLUDGE OFFLOAD SYSTEM

Issued by:

WESTINGHOUSE HANFORD COMPANY

April 1996

for the
U.S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
RICHLAND, WASHINGTON

PREPARED BY:

S. A. Brisbin, Engineering Support

Date

WHC APPROVALS:

D. R. Precechtel, Design Authority

Date

F. W. Moore, K Basins Projects

Date

J. E. Geary, Manager, Evaporator Project

Date

DEPARTMENT OF ENERGY APPROVAL:

U. S. Department of Energy
Spent Nuclear Fuel Project Office

Date

WHC-SD-WM-FDC-052, Rev. B

CONTENTS

1.0	INTRODUCTION	1
1.1	BACKGROUND	1
1.2	SCOPE	3
1.3	SITE LOCATION	3
1.4	PROJECT INTERFACES	4
2.0	PROJECT CRITERIA	5
2.1	FUNCTIONAL REQUIREMENTS	5
2.2	PERFORMANCE REQUIREMENTS	5
3.0	PROCESS CRITERIA	7
3.1	INSTRUMENTATION AND CONTROL	7
3.2	PIPING AND VESSELS	7
3.2.1	Functional Requirements	7
3.2.2	Performance Requirements	8
3.3	GENERAL CHEMICAL PROCESS	8
3.4	GENERAL MECHANICAL PROCESS	9
3.4.1	Functional Requirements	9
3.4.2	Performance Requirements	9
4.0	FACILITY CRITERIA	10
4.1	ARCHITECTURAL, CIVIL/STRUCTURAL	10
4.2	HEATING, VENTILATION, AND AIR CONDITIONING	10
4.3	UTILITIES	10
4.3.1	Steam	10
4.3.2	Water	10
4.3.3	Sewage	10
4.3.5	Air	10
4.3.6	Lighting	11
4.4	COMMUNICATIONS SYSTEMS	11
4.5	AUTOMATIC DATA PROCESSING	11
4.6	ENERGY CONSERVATION	11
4.7	MAINTENANCE	11
4.7.1	Facility	11
4.7.2	Equipment	11
4.7.3	Materials	11

WHC-SD-WM-FDC-052, Rev. B

CONTENTS

5.0	GENERAL REQUIREMENTS	12
5.1	SAFETY	12
5.1.1	Safety Analysis/Safety Assessment	12
5.1.2	Criticality	12
5.1.3	Contamination Control	12
5.1.4	Shielding	12
5.1.5	Industrial Safety	13
5.1.6	Fire Protection	13
5.1.7	Traffic Safety	13
5.1.8	ALARA	13
5.2	ENVIRONMENTAL PROTECTION AND COMPLIANCE	14
5.2.1	Dangerous Waste Requirements	14
5.2.2	Airborne Release Requirements	14
5.3	SAFEGUARDS AND SECURITY	15
5.4	NATURAL FORCES	15
5.5	DESIGN FORMAT	15
5.6	QUALITY ASSURANCE	15
5.7	DECONTAMINATION AND DECOMMISSIONING	16
5.7.1	DOE Regulations	16
5.7.2	Miscellaneous Design Features	16
5.8	OPERATING PERSONNEL AND SERVICES	16
5.9	TESTING	17
6.0	CODES, STANDARDS, AND DOE ORDERS	18
7.0	REFERENCES	19

WHC-SD-WM-FDC-052, Rev. B

FUNCTIONAL DESIGN CRITERIA FOR SLUDGE OFFLOAD SYSTEM

1.0 INTRODUCTION

Project A.13 shall¹ provide systems for retrieving sludge from the K Basin floor and pits, removing the sludge from the basin, transporting the sludge to the selected Tank Waste Remediation System (TWRS) facility, and offloading the sludge into a double shell tank (DST). The purpose of this document is to provide the design requirements for the sludge offload system.

1.1 BACKGROUND

The 105 K fuel storage basins were built in the early 1950s. Although the basins originally served the K Reactors in the 1950s and 1960s, N Reactor fuel was accumulated from 1978 through 1987. Storage at K Basins was intended to be only as needed to sustain operation of N Reactor while the PUREX Plant was refurbished and restarted. Although much of the N Reactor fuel was processed as planned, the decision in 1992 to deactivate the PUREX Plant left approximately 2,100 metric tons of N Reactor spent fuel in the K Basins with no means for near term processing. A significant fraction of the Spent Nuclear Fuel (SNF) has become degraded due to cladding breaches during reactor discharge and corrosion is continuing during underwater storage. Degradation of aluminum canisters and breached fuel appears to be significant.

The 105 K East fuel storage basin was not epoxy coated and the fuel is stored in open top canisters, some which have closed bottoms and others which have screened bottoms. The open canisters in KE basin allow release of fission products into the basin water.

¹In this criteria document, the terms "shall" and/or "must" reflect critical requirements; while "should" is reserved for highly desirable traits or features that, while strongly recommended for consideration, are not essential.

WHC-SD-WM-FDC-052, Rev. B

Significant quantities of sludge are visible in the KE basin. There is also a minimal amount of sludge on the floor of the KW basin. It is assumed that there is some volume of sludge within the canisters stored in the KW basin; however, there have been no depth measurements to date.

The Project A.13 is responsible for removing the sludge from the K Basins to reduce the potential of releasing the stored material into the environment. A systems engineering approach was used to establish the baseline disposition path.

An alternative study was performed in late 1994 to evaluate the regulatory and technical options for managing K Basin sludges. The results of that study are documented in (PNL 1995). Various disposition options were evaluated on the basis of cost, schedule, acceptability of the waste form, and technical uncertainties that could impact implementation. Tank farm disposal was identified as the favored option.

Based on the alternative study, a decision was made to evaluate the feasibility of transferring K Basin sludge to a TWRS DST. TWRS Process Engineering was requested to perform an initial feasibility review to determine if there were chemical compatibility problems between the K Basin sludges and the prospective receiving DSTs. The feasibility review (Fowler 1995), based on the existing sludge data, did not indicate chemical incompatibility problems with the prospective DSTs.

The recommended sludge disposition strategy (WHC 1995a) supports managing the sludge as waste upon removal from the basins sending them to TWRS for disposition.

The Department of Energy (DOE), Richland Operations Office, agreed with the recommendation to classify sludge as waste upon removal from the basin (Hansen 1995a) and with the WHC recommended sludge disposition (Hansen 1995b).

In 1995, a study was performed to recommend a system to transport the K Basin sludge to the TWRS (WHC 1995b). The study included an evaluation to determine the feasibility of transferring the sludge through the existing 204-AR facility. The evaluation concluded that sludge could not be transferred through the existing 204-AR facility without upgrading the pumping capacity.

WHC-SD-WM-FDC-052, Rev. B

as a minimum. Since there is only one transfer line between the 204-AR facility and the 241-AW tank farm, a decision was made to directly transfer the sludge into the selected DST.

During retrieval and loadout, KE basin canister sludge containing fuel particles and fuel corrosion products will be separated from the SNF and combined with sludge collected from the basin floor. Fuel particles and debris greater than 6 mm (0.25 inch), or as otherwise defined by TWRS waste acceptance criteria, will be separated from the sludge. Following separation at the K Basins, the resultant sludge will be loaded into a transportation system for transfer to a DST. The number of shipments to transfer sludge from the K Basins to a DST is estimated to be from 70 to 160.

1.2 SCOPE

The scope of this document is the design of a non-permanent offload system for transferring sludge from a transport system into a selected DST. Modifications required for the installation include the addition of a shielded transfer line, a spill retention basin, and support instrumentation for leak monitoring during transfer operations.

1.3 SITE LOCATION

The sludge offload system shall consist of a non-permanent transfer line and a spill retention basin installed in close proximity to the selected DST.

The system shall be located in accordance with guidelines in DOE Order 6430.1A. The site integration criteria are listed below.

- Portions of the sludge offload system not placed directly over the selected DST shall be located to permit convenient access to existing roadways and utilities.
- The sludge transfer line and spill retention basin shall be located to have the least impact on routine tank farm operations.

WHC-SD-WM-FDC-052, Rev. B

- The sludge offload system shall be located to minimize interference with existing underground and above grade encasement and piping.
- Specific factors to be evaluated in locating hardware, software, or support systems are:
 - Utilities/site services
 - Site interferences
 - Environmental and safety considerations (including onsite and offsite exposure)
 - Natural forces
 - Cost
 - Minimal operator exposure to radioactive and chemical hazards resulting from installation, operation, maintenance, calibration, and surveillance of the offload system.
 - Minimal disruption of contaminated soil
 - Static and dynamic loading imposed on the DST, the transfer line, and the spill retention basin
 - Riser loads

1.4 PROJECT INTERFACES

The offload system will interface directly with the selected DST. There shall be no residual impact on personnel support facilities (e.g., offices). There may be a marginal increase in demand for electric power and supply water due to the operation of the transportation system. There is also a need to demonstrate that ancillary equipment complies with Resource Conservation and Recovery Act (RCRA) requirements.

WHC-SD-WM-FDC-052, Rev. B

K Basins Projects is coordinating the overall project, including acquiring, distributing, and monitoring the needed resources. Tank Systems Integration will provide engineering services necessary to perform equipment development and definitive design for the sludge offload system. Regulatory Program Integration has prepared the environmental checklist. TWRS Environmental Compliance will obtain necessary permits, or revised permits, and interface with the regulators. Tank Safety Assurance will provide general safety guidance and coordinate all required safety reviews. Pacific Northwest National Laboratory (PNNL) will prepare the safety assessment. Quality Assurance, Purchasing, etc. will also be involved at various stages of the project. The engineering work plan contains a detailed outline of all of the interfaces and associated work scopes.

2.0 PROJECT CRITERIA

Project A.13 will retrieve and remove sludge from the K Basins and transport the sludge to the TWRS for disposition; thus, reducing the potential for releasing contamination to the environment.

2.1 FUNCTIONAL REQUIREMENTS

The functional requirements of the offload system are:

- The sludge offload system shall be capable of carrying K Basins sludge into the selected DST. The system shall provide a non-permanent, intra-farm transfer line and a spill retention basin which are compatible with the tank farm facility and the K Basin sludge transportation system (provided by others).
- Manned support shall be provided for operation of the transportation system offload equipment.
- The sludge offload system shall be designed to accommodate currently accepted decontamination, removal, and disposal practices.
- The sludge offload system life-cycle cost, including removal and disposal, shall be minimized by engineering design.
- The transportation system offload equipment and the sludge offload system shall comply with all safety and environmental assessment requirements and shall incorporate Operations' comments unless documented agreement can be made to do otherwise.
- Radiation dose to workers shall be minimized and comply with 10 CFR 835, *Occupational Radiation Protection*, as implemented by HSRM-1 (WHC 1994a). The guidance provided in (WHC 1994b) shall be considered.

WHC-SD-WM-FDC-052, Rev. B

- Process piping serving as primary confinement barriers shall have a secondary barrier provision so that failure of the primary barrier does not result in the release of radioactive material in excess of DOE Guidelines.
- Administrative controls for personnel radiation protection shall be as provided in HSRM-1 (WHC 1994a).

2.2 PERFORMANCE REQUIREMENTS

- The design life of the sludge offload system shall be 10 years. Replaceable equipment and components may have a design life of less than 10 years, but generally not less than 5 years.
- All equipment exposed to ambient conditions outside the DST shall be designed to operate under adverse open field conditions as defined in GC-LOAD-01 (ICFKH 1996).
- Components and assemblies which come into contact with K Basins sludge shall be radiologically, physically, and chemically compatible with the sludge. K Basin sludge characterization information is provided in *Spent Nuclear Fuel Project Technical Databook* (WHC 1995c). Updated characterization may be provided by the Sludge Removal Project design authority.
- The sludge offload system shall have a minimum availability factor of 70 percent.

3.0 PROCESS CRITERIA

This section covers the general instrumentation and mechanical process systems. The project shall be designed to handle waste streams that are considered to: require secondary containment, contain RCRA hazardous constituents, and be above the DOE radionuclide requirements for secondary containment.

All selected equipment should be commercially available and include sufficient vendor documentation to support safe operation and maintenance. Equipment requiring special handling features should be avoided. All systems shall be configured to permit fail-safe recovery upon power loss.

3.1 INSTRUMENTATION AND CONTROL

Instrumentation shall be provided for the early detection of leakage from the primary confinement system. Instrumentation for monitoring and controlling offloading operations will be provided by the sludge transportation system. Sensors provided by the offload system shall interface with monitoring and control systems provided by the sludge transportation system.

Instrumentation shall conform to NFPA 70, *The National Electrical Code*, applicable sections of DOE 6430.1A, and applicable American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE), and Instrument Society of America (ISA) standards.

The instrumentation should demonstrate proven industrial application as field process equipment, suitable for the anticipated operating conditions.

3.2 PIPING AND VESSELS

3.2.1 Functional Requirements

- Piping materials shall be compatible with the characteristics of the DST environment and K Basins sludge.

- Shielding and secondary containment shall be provided for the transfer line extending from the spill retention basin to a nozzle or riser into the selected DST.
- Piping connections shall be self sealing, no drip, quick disconnect.
- The transfer line shall discharge into the selected DST via a nozzle or riser.
- There shall be no bypasses or drains by which waste may be released directly into the environment. The system shall be designed so that the transfer line drains back to the DST head space.
- The transfer line shall include provisions for flushing.
- Cathodic protection shall be provided, as required.

3.2.2 Performance Requirements

- The transfer line shall be designed to handle the routine flow capacities up to 6 L/sec (100 gal/min).
- Double-wall pipes shall be provided for the transfer line.
- Piping and vessel design shall address criticality considerations.
- All piping shall comply with ASME B31.3.
- The transfer line shall have adequate slope to prevent solid settling or liquid pooling (minimum average slope of 1.0%). The slope shall be such that liquids will not separate from the solids.
- The transfer line shall be clearly marked/identified.

WHC-SD-WM-FDC-052, Rev. B

- The routing of the transfer line shall conform to any restrictions established by the Evaporator Projects Manager.
- Freeze protection shall be provided for pipes and valves, as necessary.
- To facilitate decontamination, piping bends shall be minimized and inside pipe materials shall be capable of being decontaminated. Installation of access ports for decontamination shall be considered.

3.3 GENERAL CHEMICAL PROCESS

Not applicable.

3.4 GENERAL MECHANICAL PROCESS

Equipment shall be designed such that no single failure of equipment will cause a loss of control that will result in an unrecoverable condition. Features shall be provided which will facilitate placement of the equipment in the appropriate position to establish a safe configuration.

3.4.1 Functional Requirements

A spill retention basin shall be provided to contain the entire contents of the transportation container in the event of a spill.

3.4.2 Performance Requirements

The spill retention basin shall:

- Be constructed of a material which is compatible with the K Basin sludge.
- Be capable of supporting the sludge transportation system which consists of a tractor and trailer. The maximum trailer size will be 12 m (40 feet) in length, 3 m (8 feet) in width, and 4 m (12 feet) in height. The maximum gross vehicle weight for the trailer will be 50,000 Kg (100,000 pounds).

- Include a sump pump for removing spills from the spill retention basin. The output of the sump pump shall be routed to a point in the transfer line such that the contents will be directed into the selected DST. The sump pump does not need to be sized for a rapid sump draw-down. Provisions shall be included for backflow prevention.

4.0 FACILITY CRITERIA

4.1 ARCHITECTURAL, CIVIL/STRUCTURAL

Not applicable.

4.2 HEATING, VENTILATION, AND AIR CONDITIONING

Not applicable.

4.3 UTILITIES

The utilities to service the sludge offload system shall be extended from the selected tank farm, as required and feasible. Water services required for process applications shall be protected from potential back-flows and contaminations from the offload system.

4.3.1 Steam

Not applicable.

4.3.2 Water

Raw water for flushing the transportation system and transfer line shall be provided from an existing supply located in the tank farm. The transportation system will provide the required hose and connector for interfacing with the water supply.

4.3.3 Sewage

Not applicable.

4.3.4 Electrical

At least one 240 VAC, single phase power supply shall be provided to service the offload equipment located on the transportation system.

WHC-SD-WM-FDC-052, Rev. B

The electrical systems shall comply NFPA 70, *The National Electrical Code* (ANSI 1996) with applicable sections of DOE Order 6430.1A, *General Design Criteria*.

4.3.5 Air

Not applicable. If compressed air is required for transportation offload equipment, a compressed air supply will be provided by the transportation system.

4.3.6 Lighting

Installation, operation and removal of the offload system are planned to occur during daylight hours. Existing tank farm lighting should be sufficient if night operations are performed.

4.4 COMMUNICATIONS SYSTEMS

Standard issue radio communication devices shall be provided for use during operation of the offload system to coordinate operations between 242-A Evaporator and the sludge transportation/offload system.

4.5 AUTOMATIC DATA PROCESSING

Not applicable.

4.6 ENERGY CONSERVATION

Not applicable.

4.7 MAINTENANCE

The design and material selection shall include features that facilitate maintenance of the equipment and the facility [10 CFR 835.1002(d)]. Particular attention shall be paid to pumps, valves, and any equipment in high or very high radiation areas.

WHC-SD-WM-FDC-052, Rev. B

4.7.1 Facility

Not applicable.

4.7.2 Equipment

The offload system shall be designed to permit routine maintenance activities with minimum operator exposure to hazardous or radioactive environments or to industrial hazards. As low as reasonably achievable (ALARA) practices shall be used in all maintenance activities. The system shall be designed to be operated and maintained in a radiation zone and operated under contaminated conditions.

4.7.3 Materials

Materials required for maintenance of the offload system shall be identified and supplied prior to operation.

WHC-SD-WM-FDC-052, Rev. B

5.0 GENERAL REQUIREMENTS

5.1 SAFETY

5.1.1 Safety Analysis/Safety Assessment

Safety classification of systems, components, and structures shall meet the requirements of WHC-CM-4-46, *Safety Analysis Manual*, Section 9.0 (WHC 1988b). On the basis of Section 9.0 requirements and a safety assessment, the relevant safety classification anticipated for any system, component, or structure shall be determined and applied to this project.

A safety assessment will be prepared in accordance with a Letter of Instruction. The safety assessment will be completed and approved prior to operation of the sludge offload system.

5.1.2 Criticality

Criticality requirements will be identified during the design process. A Criticality Safety Evaluation Report (CSER) will be generated for the offload system. Requirements identified in the CSER shall be incorporated into the design.

5.1.3 Contamination Control

The offload system shall be designed to confine contaminants within the combination of boundaries defined by the existing DST, the confinement surfaces of the offload system, and any other barriers that may be required. A double confinement system shall be employed to control contamination due to a failure of the primary confinement, or other off-normal situation.

5.1.4 Shielding

Shielding of the sludge offload system shall be provided to reduce worker exposure to ALARA goals. Shielding may be fixed or moveable. Engineering calculations to define specific shielding needs shall be made during the design process. Dose rates in areas requiring routine personnel access shall not exceed 0.5 mR/hr. Consideration shall be given to normal operation, abnormal events, and maintenance activities.

WHC-SD-WM-FDC-052, Rev. B

Shielding design shall be based on life-cycle cost, to include the ease of removal of shielding for subsequent removal of the transfer line at the end of the project.

Guidance provided in WHC-SD-GN-DGS-30011, *Radiological Design Guide*, Section 7.0 (WHC 1994b), shall be considered.

5.1.5 Industrial Safety

Routine construction hazards will exist while the offload system is under construction and during installation of the system at the tank farm. Field operations shall be conducted in conformance with WHC-CM-1-10, *Safety Manual* (WHC 1995d) in addition to applicable OSHA standards to ensure a safe working environment. The probability of a system failure resulting in a fatality to operating personnel must be less than one chance in a million at the 95% confidence level.

5.1.6 Fire Protection

Fire protection requirements will be defined during the design process. A Fire Hazards Analysis (FHA) is required as part of the safety documentation. Requirements identified in the FHA shall be incorporated into the design.

5.1.7 Traffic Safety

The offload system will be located within an established tank farm facility, not subjected to through traffic.

5.1.8 ALARA

The applicable requirements of the following documents shall be met:

- 10 CFR 835, *Occupational Radiation Protection*
- HSRM-1, *Hanford Site Radiological Control Manual*
- DOE 6430.1A, *General Design Criteria*

WHC-SD-WM-FDC-052, Rev. B

- WHC-IP-1043, *Occupational ALARA Program*
- DOE 5400.5, *Radiation Protection of the Public and the Environment*
- DOE 5820.2A, *Radioactive Waste Management*

In particular, the requirements of 10 CFR 835, Subpart K, Design and Control, shall be satisfied. The design objective for external exposure for the sludge offload system shall be that no individual worker will receive an annual dose equivalent in excess of 1 rem/year from all sources.

All (design agent) actions and decisions taken to maintain occupational exposures as low as reasonably achievable shall be documented [10 CFR 835.704(b)]. These records shall be retained until final disposition is authorized by DOE [10 CFR 830.701(b)].

For any cost-benefit analyses, the monetary value of 1 rem of collective dose shall be \$30,000.

5.2 ENVIRONMENTAL PROTECTION AND COMPLIANCE

An environmental requirements checklist covering removal, transport, and storage of K Basin sludge has been prepared by Environmental Services (Tollefson 1995), through the SNF Regulatory Integration/Public Involvement group. All environmental permits, reviews, and approvals related to waste acceptance and construction shall be obtained by TWRS Environmental Compliance.

5.2.1 Dangerous Waste Requirements

The sludge offload system shall comply with hazardous waste requirements as described within WHC-CM-7-5, *Environmental Compliance Manual*, Section 3.7, WAC 173-303, *Dangerous Waste Regulations*, and Section 4.2.2.2 of DOE/RL 88-21, *Double Shell Tank Interim Status Part A Permit* (DOE 1988).

- Assure waste compatibility with waste handling and retention systems.

- Assure that adequate secondary containment of hazardous waste exists.
- Assure that systems are tested and inspected for continued compliance with standards developed to prohibit unnecessary release of hazardous materials to the environment.

5.2.2 Airborne Release Requirements

The sludge offload system shall comply with regulations governing airborne release of toxic and radioactive materials. As all air flows from the proposed operation will have been in contact with the sludge, each potential emission point must comply with the following standards:

- Airborne release requirements for toxic material releases are embodied within WAC 173-400, *General Regulations for Air Pollution Sources*, and WAC 173-460, *Controls for New Sources of Toxic Air Pollutants*. These regulations place requirements upon the extent of air pollution abatement.
- Airborne release requirements for radioactive materials are embodied within Federal requirements of the National Emission Standards for Hazardous Air Pollutant (NESHAP), Subpart H, and Washington State requirements under WAC 173-480 and WAC 246-247. The functionality of these regulations is the assurance of sufficient pollution abatement.

5.3 SAFEGUARDS AND SECURITY

No special safeguard and security requirements are needed beyond those currently in force.

5.4 NATURAL FORCES

All new or modified offload structures, equipment, and piping shall be designed and analyzed in accordance with natural phenomena loading criteria of DOE 6430.1A and GC-LOAD-01 (ICFKH 1996). The loading of components and equipment shall be a function of the safety class listed in the Project safety assessment.

WHC-SD-WM-FDC-052, Rev. B

New structures, equipment, and components shall be designed to withstand the design criteria for natural phenomena such that the system can be rendered to a safe status without undue risk to public health and safety. The sludge offload system is not required to operate during or immediately following a safe shutdown earthquake.

5.5 DESIGN FORMAT

Two-way traceability shall be provided between project drawings and the reference drawings from which they were developed. Project drawings shall identify existing drawings that will be affected by the project.

Design drawing formats shall be in accordance with WHC-CM-6-1, *Standard Engineering Practices*, EP-1.3, "Preparation of Engineering Drawings".

5.6 QUALITY ASSURANCE

Quality Assurance (QA) activities for all contractors involved in the design, construction, testing, and inspection of the offload system are defined in 10 CFR 830.120 and WHC-SP-1131, *WHC Quality Assurance Program and Implementation Plan*. Implementation of these requirements will provide the following assurances:

- Design data and design decisions are documented and traceable.
- The design and design criteria are adequately supported by the prepared plans, specifications, and analyses.
- The design meets baseline design criteria.
- Construction is performed in accordance with definitive design documents.
- Testing confirms the adequacy of design, the quality of construction and manufactured components, operability and maintainability, and reliability.

WHC-SD-WM-FDC-052, Rev. B

5.7 DECONTAMINATION AND DECOMMISSIONING

All equipment and/or facilities provided by this project shall be designed and constructed to facilitate periodic decontamination, as well as eventual, final decontamination and decommissioning (D&D). Some of the equipment and/or facilities may require disposal as dangerous or mixed waste.

5.7.1 DOE Regulations

Refer to DOE 6430.1A, Sections 0205 and 1300-11 for D&D requirements.

5.7.2 Miscellaneous Design Features

Particular care must be exercised to ensure that modular components do not create crevices that will trap contamination (i.e., sludge). It is essential to eliminate inaccessible pockets, crevices, blind holes, and rough surfaces that could trap contamination. All equipment used in contaminated areas must be able to withstand decontamination when wiped with cloths dampened by water, soap, alcohol, or other non-hazardous materials.

The design shall minimize the creation of dangerous waste. In addition, care shall be taken to ensure the ability to fill void spaces and avoid trapping liquids, to assist in complying with dangerous waste disposal regulations.

The design and material selection shall include features that facilitate decommissioning of equipment and the facility [10 CFR 835.1002(d)]. Particular attention shall be paid to any equipment in high and very high radiation areas that will exist at the end of the facility's life.

5.8 OPERATING PERSONNEL AND SERVICES

Operation of the offload system will require tank farm operators and health physics service support.

The design and material selection shall include features that facilitate the operation of equipment and the facility [10 CFR 835.1002 (d)].

5.9 TESTING

The Project Acceptance Test Procedure (ATP) and Operational Test Procedure (OTP) will address testing requirements: at a minimum covering the verification of adequacy with regard to secondary containment, specified waste transfer capabilities, monitoring provisions, ease of equipment servicing, and functioning of controls and alarms. Design and specification reviews, followed by QA checks during equipment procurement, construction, and installation, should validate proper layout and material selection.

6.0 CODES, STANDARDS, AND DOE ORDERS

The sludge offload system shall be designed and constructed to the codes and standards described in ANSI/ANS-57.7, Section 6.3, with exception that 10 CFR 50 is not applicable.

"National Consensus" codes and standards and pertinent state and local codes and standards shall be used. The latest edition/revision of all codes, standards, and manuals shall be used.

The following DOE Orders shall be considered, as applicable.

- DOE 4700.1, *Project Management System*
- DOE 5400.1, *General Environmental Protection Program*
- DOE 5400.5, *Radiation Protection of the Public and the Environment*
- DOE 5480.1B, *Environment, Safety, and Health Program for Department of Energy Operations*
- DOE 5480.4, *Environmental Protection, Safety, and Health Protection Standards*
- DOE 5480.7A, *Fire Protection*
- DOE 5480.10, *Contractor Industrial Hygiene Program*
- DOE 5480.11, *Radiation Protection for Occupational Workers*
- DOE 5480.19, *Conduct of Operations Requirements for DOE Facilities*
- DOE 5480.24, *Nuclear Criticality Safety*
- DOE 5480.28, *Natural Phenomena Hazards Mitigation*
- DOE 5481.1B, *Safety Analysis and Review System*

- DOE 5820.2A, *Radioactive Waste Management*
- DOE 6430.1A, *General Design Criteria*

WHC-SD-WM-FDC-052, Rev. B

7.0 REFERENCES

- 10 CFR 835. *Occupational Radiation Protection*, Code of Federal Regulations.
- ANSI 1996, *National Electrical Code*, NFPA 70, National Fire Protection Association, Batterymarch Park, Quincy, Ma.
- DOE 1984, *Environmental Protection, Safety, and Health Protection Standards*, DOE Order 5480.1B, U.S. Department of Energy, Washington, D.C.
- DOE 1985, *Contractor Industrial Hygiene Program*, DOE Order 5480.10, U.S. Department of Energy, Washington, D.C.
- DOE 1986a, *Environment, Safety, and Health Program for Department of Energy Operations*, DOE Order 5480.1B, U.S. Department of Energy, Washington, D.C.
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- Hansen 1995b, *Approval of K Basins Sludge Disposition Strategy*, Letter, Department of Energy, Richland, Washington, dated June 13, 1995.
- ICFKH 1996, *Design Loads for Facilities*, GC-LOAD-01, ICF Kaiser Hanford Company, Richland, Washington.
- PNL 1995, *K Basin Spent Fuel Sludge Treatment Alternatives Study*, PNL-10398, Volumes 1 and 2, Pacific Northwest Laboratory, Richland, Washington.
- Tollefson 1995, *Environmental Requirements Checklist for Removal, Transport, and Storage of 105 KE and KW Basins Sludge*, Internal Memo, 95-POC-036, Westinghouse Hanford Company, Richland, Washington, dated November 2, 1995.
- WHC 1988a, *Safety Analysis Manual*, WHC-CM-4-46, Westinghouse Hanford Company, Richland, Washington.
- WHC 1988b, *Standard Engineering Practices*, WHC-CM-6-1, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-WM-FDC-052, Rev. B

- WHC 1988c, *Environmental Compliance Manual*, WHC-CM-7-5, Westinghouse Hanford Company, Richland, Washington.
- WHC 1989, *Double-Shell Tank Farm Facility Safety Analysis Report*, WHC-SD-WM-SAR-016, Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- WHC 1994a, *Hanford Site Radiological Control Manual*, HSRCM-1, Westinghouse Hanford Company, Richland, Washington.
- WHC 1994b, *Radiological Design Guide*, WHC-SD-GN-DGS-30011, Westinghouse Hanford Company, Richland, Washington.
- WHC 1995a, *Westinghouse Hanford Company Recommended Strategy for K Basin Sludge Disposition*, WHC-SD-SNF-SP-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC 1995b, *Recommended Transport System for K Basin Sludge Transfer to the Tank Waste Remediation System*, WHC-SD-SNF-PD-010, Westinghouse Hanford Company, Richland, Washington.
- WHC 1995c, *Spent Nuclear Fuel Project Technical Databook*, WHC-SD-SNF-TI-015, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- WHC 1995d, *Safety Manual*, WHC-CM-1-10, Westinghouse Hanford Company, Richland, Washington.
- WHC 1995e, *Occupational ALARA Program*, WHC-IP-1043, Westinghouse Hanford Company, Richland, Washington.

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**K-BASIN SLUDGE SAFETY ASSESSMENT -
PRELIMINARY HAZARDS IDENTIFICATION AND ANALYSIS**

APRIL 1996

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Working Draft

CONTENTS

1.0 INTRODUCTION	1
2.0 APPROACH	2
2.2 OVERALL SAFETY ASSESSMENT APPROACH	2
2.2 HAZARDS IDENTIFICATION AND ANALYSIS	2
3.0 SYSTEM DESCRIPTION	8
3.1 SLUDGE TRANSPORTATION SYSTEM	8
3.1.1 General	8
3.1.2 Container	8
3.1.3 Transport Trailer	10
3.1.4 Support Equipment	11
3.2 AW FARM OFF-LOAD SYSTEM	12
3.3 DOUBLE-SHELL STORAGE TANK AW-103	14
4.0 HAZARD IDENTIFICATION	15
5.0 PRELIMINARY HAZARDS ANALYSIS	26
6.0 NATURAL PHENOMENA AND EXTRINSIC HAZARDS	42
6.1 PRELIMINARY ASSESSMENT OF EXTRINSIC HAZARDS	42
6.1.1 Aircraft Impact from Richland Airport	42
6.1.2 Aircraft Impact from Tri-Cities Airport	43
6.2 PRELIMINARY ASSESSMENT OF NATURAL PHENOMENA HAZARDS ...	44
6.2.1 Flood	44
6.2.2 Wind	45
6.2.3 Earthquake	46
6.2.4 Volcanic Activity	47
6.2.5 Tornadoes	49
6.2.6 Lightning (With subsequent Fire)	50
7.0 SELECTION OF EVALUATION-BASIS ACCIDENT SCENARIOS	51
7.1 DEVELOPMENT OF COMPREHENSIVE LIST OF ACCIDENT SCENARIOS .	51
7.2 SELECTION OF EVALUATION-BASIS ACCIDENT SCENARIOS	55
8.0 REFERENCES	56

DRAFT

Working Draft

TABLES

2.1. "Generic" Hazard Source Checklist	4
2.2. Frequency Categories Used in PHA	5
2.3. Consequence Categories Used in the PHA	5
4.1 Hazard Checklist for Sludge Container Receipt and Transport	16
4.2. Hazard Checklist for Connection and Transfer Operations	19
4.3. Hazard Checklist for Transfer Operations	21
4.4. Checklist for Storage of K-Basin Sludge in a DST	23
5.1. PHA for Receipt and Onsite Transport	27
5.2 PHA for Connection and Transfer	33
5.3. PHA for Storage Operations	40
5.4. PHA for Retrieval Activities	41

FIGURES

2.1. Illustration of K-Basin Sludge Safety Assessment Approach	3
2.2. PHA Format Definition	7

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Working Draft

1.0 INTRODUCTION

The objective of this study is to develop a safety assessment for the activities associated with the transfer of K-Basin sludge from a shipping container to a storage tank in the Hanford Site's tank farms. The activities to be considered in this study begin when the shipping container is received at tank farms and end after the emptied shipping container is released from tank farms to return to K-Basins, and includes all activities necessary to transfer the sludge from the shipping container to the storage tank. The safety assessment will address the health and safety aspects of all phases of this activity, including construction and installation of any necessary equipment and facilities, conducting the actual transfer operations, long-term storage, and subsequent retrieval from the tank. The format and content of the safety assessment will be in accordance with the requirements specified in WHC-CM-4-46, *Safety Analysis Manual*.

This draft report documents the first main step in the safety analysis, the identification and evaluation of potential hazards and hazardous conditions associated with the transfer of K-Basin sludge into tank 241-AW-103, a double-shell tank (DST) in the 200 East Area of the Hanford Site. A systematic approach involving development of hazard source checklists and Preliminary Hazards Analyses (PHA) was applied to the conceptual processing scenario and transfer equipment. The resulting information formed the basis for development of potential accident scenarios and selection of evaluation-basis accidents for subsequent detailed analysis in other tasks of this study.

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2.0 APPROACH

This chapter describes the approach taken in this safety assessment to identify and evaluate potential accidents associated with transferring K-Basin sludge into double-shell tank 241-AW-103. Section 2.1 briefly describes the overall approach to this safety assessment and Section 2.2 describes in more detail the approach taken to identify hazards and hazardous conditions as well as select the design-basis and evaluation-basis accident scenarios for detailed evaluation.

2.2 OVERALL SAFETY ASSESSMENT APPROACH

The overall approach to the K-Basin sludge safety assessment is illustrated in Figure 2.1. The first step in the assessment was to perform a comprehensive analysis to identify hazards and hazardous conditions associated with transferring K-Basin sludge. A safety analysis technique referred to as Preliminary Hazards Analysis (PHA) was applied to identify and perform a qualitative evaluation of potential hazards. The next step is to select the evaluation-basis or design-basis accident scenarios. This will be done based on a number of criteria, including a binning process based on the qualitative evaluation of accident frequencies and consequences provided in the PHA as well as other factors. A list of design-basis accidents will then be developed based on the results of the selection process. Each of these design-basis accidents will be subjected to a detailed analysis to determine their frequencies and consequences. The accident prevention and mitigation information contained in the PHA is used here to assist in the development of accident frequencies. The frequency and consequence information is developed in parallel and then comes together to allow a comparison to the risk guidelines contained in WHC-CM-4-46. If the "risks" (frequency-consequence pairs) are below guidelines, the accident scenario would be determined to be "acceptable" and the analysis is documented. If the risks are above the guidelines, further analysis is performed, often involving the postulated addition of new controls and/or design features intended to reduce either the frequencies or consequences of the accidents. These design features and control measures taken credit for in the accident analysis may be the subject of Technical Safety Requirements (TSRs), as defined in DOE Order 5480.22. After the frequencies and consequences of each accident scenario are demonstrated to be below guidelines, the accident scenario analyses are documented and will form the safety envelope for the transfer operations and equipment.

2.2 HAZARDS IDENTIFICATION AND ANALYSIS

The hazards identification and analysis activity was accomplished through application of a safety analysis technique referred to as Preliminary Hazards Analysis (PHA). The PHA technique was used to identify the potential hazardous conditions associated with transfer into and storage of K-Basin sludge in a double-shell tank storage system and to determine the significance of potential accidents. The PHA for the sludge transfer activities was performed using the "hazardous energy" concept in which potential accidents or abnormal events are represented as flows of unwanted energy between a source and receptor. Barriers between the source and receptor may be present to prevent or restrict the flow of unwanted energy. For example, the sludge shipping container's walls are barriers because they restrict or prevent radioactive materials from "flowing" between the internal

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Figure 2.1. Illustration of K-Basin Sludge Safety Assessment Approach

volume of the shipping container and the environment. Administrative controls (e.g., operating procedures) may also be barriers as they are intended to either prevent the occurrence of an accident or reduce/control the consequences of an accident should one occur.

A checklist approach was used to identify potential hazards associated with the transfer activities. A "generic" checklist taken from Hammer (1972) was used to guide the identification of hazards and ensure that a comprehensive identification of hazards was performed. This generic hazard checklist is shown in Table 2.1. Each activity involved in transferring sludge into a DST was reviewed to determine the presence or absence of each hazard on the checklist. These checklists ensured that all of the hazards associated with the transfer activities are appropriately identified and documented in the PHA.

The PHA documents the following preliminary information: 1) hazard or energy source; 2) event description; 3) causes; 4) mitigating features, including engineering and administrative barriers (present or potential mitigation options); 5) a semi-quantitative assessment of accident frequency; and 6) a qualitative assessment of accident consequences for potentially-exposed workers, onsite receptors,

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Table 2.1. "Generic" Hazard Source Checklist

ACTIVITY: _____

Hazard	Present (Y/N)	Example(s)
Acceleration		

Other Hazards Considered		
Contamination	Chemical reaction	Corrosion
Electrical	Explosion	Fire
Heat and Temperature	Low Temperature	Temperature change
Impact and Shock	Leakage	Moisture-High humidity
Moisture-Low humidity	Power source failure	Pressure-High
Pressure - Low	Radiation - Infrared	Radiation-Electromagnetic
Ionizing	Radiation - Ultraviolet	Structural damage/failure
Toxicity	Vibration and noise	Weather and environment

and offsite receptors. The preliminary assessment of accident scenario frequencies and consequences was performed by assigning each scenario to categories representing ranges of frequencies and consequences. The categories used in this assessment are presented in Tables 2.2 and 2.3. The preliminary assignments of the scenarios to these ranges were based on process knowledge, knowledge of similar types of activities, types and numbers of barriers, types and numbers of component failures, and engineering judgement. Detailed analyses to refine the accident scenario frequency and consequence estimates are performed later in the assessment, as illustrated in Figure 2.1.

The PHA addresses hazards encountered during receipt and onsite transport of the shipping container at tank farms, connection of the shipping container to the tank farm offloading station currently being designed, the actual transfer operations, long-term storage, and subsequent retrieval of the wastes from the tank. Potential accident sequences initiated internally (i.e., initiated by failures of process equipment or systems and operators) as well as externally (such as earthquakes, floods, tornadoes, and aircraft) were addressed in the PHA. Events considered included, but were not limited to, dome failure/collapse, transfer line leaks, spray leaks, criticality, waste compatibility, elevated temperatures, tank overfill, tank overpressure, loss/reduction in shielding, and plugging/failure of transfer lines and the tank ventilation system.

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Table 2.2. Frequency Categories Used in PHA

Accident Frequency Category	Frequency Category Description	Nominal Frequency Range (events per year)
Anticipated (A)	An off normal condition that individually may be expected to occur once or more during facility operation.	1 E-02 to 1
Unlikely (U)	Individually, the condition is not expected to occur during facility operation, but collectively events in this category may occur several times.	1 E-04 to 1 E-02
Extremely Unlikely (EU)	Extremely low-probability conditions that are not expected during facility operation but that present extreme or limiting cases of faults identified as possible. This category includes design basis accidents.	1 E-06 to 1 E-04
Less than Extremely Unlikely (<EU)	Accidents for which no credible scenario can be identified.	< 1 E-06

Table 2.3. Consequence Categories Used in the PHA

Consequence categories	Description of Consequences to the Public, Onsite Personnel, or Environment
Category I	May cause deaths onsite or loss of the facility/operation, major injuries or illness offsite, radiation exposure to offsite individuals in excess of annual limits, or severe impact to the environment
Category II	May cause severe injuries or severe occupational illness onsite, exposure to onsite individuals in excess of annual limits, major damage to a facility/operation, minor illness or injury offsite, exposure to offsite, exposure to offsite individuals to radiation below annual limits, or major impacts to the environment.
Category III	May cause minor injury or minor occupational illness onsite, or exposure of onsite individuals to radiation below annual limits, negligible impact offsite, or minor impact to the environment.
Category IV	Will not result in injury, occupational illness, or exposure onsite or offsite, or result in a significant impact to the environment.

Two formats were used to record the PHA; one for recording the hazards analysis of "storage" activities and another for recording hazards identified during receipt, onsite transport, connection, transfer, and retrieval activities. The first format was derived from the PHA format used in the tank farm Final Safety Analysis Report under preparation and was used for consistency with that effort. This format, illustrated in Figure 2.2, was applied to storage operations, only. For the most part, the PHA for storage operations was developed by asking the question, "Does this hazard increase/decrease the likelihood or consequences of accidents already addressed in the tank farm PHA?" If so, the

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hazard and associated accident scenarios were retained in this PHA. The hazard checklist that was developed for storage operations was consulted to identify unique hazards represented by the transfer of K-Basin sludge into a DST and as a check on the comprehensiveness of the completed PHA. The second format, developed for this study to more-easily define and identify hazards during the more active, operator-involved activities, was developed by combining the key features of several formats, including the tank farm FSAR format.

This activity supports the selection of the evaluation-basis accidents that will be analyzed in detail in subsequent tasks. A binning process was used to document the accident scenario selection process. This involved assigning the accident scenarios identified in the PHA into bins based on the preliminary assessments of the frequencies and consequences of each accident scenario. One or more representative accident scenarios were then selected from each cell of the matrix for detailed evaluation. The accident scenarios selected are, in general, the highest-consequence or bounding scenarios from each cell of the matrix. In some cases, more than one scenario is selected from a single cell, due to the uncertainties in the composition of the materials involved in the accident, release quantities, and accident frequencies. The rationale for selecting each potential accident sequence, and for not selecting the others, is documented in this report.

Figure 2.2. PHA Format Definition

HAZARD	PHENOMENA	CAUSES	CAUSE FREQ.	CONSEQUENCES		PREVENTION/MITIGATION		SCENARIO FREQUEN- CY
				OCC.	SEV.	ENGINEERING	ADMINISTRATIVE	
List the identified hazards and hazard sources from checklist(s).	Describe the result of applying the hazard to the system or activity under analysis.	XX. List potential failure or error that leads to the occurrence of the phenomena. This column briefly describes the accident scenario. Also assign unique identification number.	Estimate the frequency of encountering cause "XX" (see Table 2.2).	Does this scenario affect workers, Y/N?	Estimate accident scenario severity (see Table 2.3)	List equipment and hardware features that prevent the occurrence of the accident scenario (cause) or mitigate the consequences should the scenario occur.	List non-hardware measures taken to prevent the occurrence of the accident scenario (cause) or mitigate the consequences should the scenario occur. Examples include procedures, training, process variable monitoring/limits,	Estimate the frequency of encountering cause "XX" and simultaneous failure of prevention and mitigation systems.
		YY. List other potential failure or error ...						
		ZZ. List other potential failure or error ...						

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3.0 SYSTEM DESCRIPTION

This chapter describes the shipping and offloading systems to be used to move the sludge from K-Basins to the AW tank farm and transfer the sludge into tank AW-103.

3.1 SLUDGE TRANSPORTATION SYSTEM

The K-Basin sludge will be loaded into a specially-designed packaging system to transport to the AW tank farm. The packaging system consists of a trailer mounted, high-integrity container or ASME pressure vessel, designed to meet Type B transportation packaging requirements. This section provides the characteristics of the packaging system that are to be used in the safety assessment. Note that the packaging system is currently under development and some of the characteristics and operating parameters may change as the design evolves. This information was extracted from the design criteria package for the transportation system.

3.1.1 General

The container and trailer are to be designed and delivered as an integral system. The functional requirements for the packaging and transport system are:

- Interface with and fit within the K Basin Loadout facility
- Receive and contain K Basin Sludge and water
- Travel to the TWRS DST-AW-103 while loaded with sludge and water
- Interface with and fit within the TWRS Off-load Facility
- Travel to the K Basin after bulk sludge is offloaded at the TWRS
- Weigh no more than 100,000 lb with a fully loaded container and all support hardware
- Provide for safe shutdown of equipment during sludge removal activities in the event of equipment failure (i.e., leakage).
- Provide equipment to interface with TWRS provided utilities (i.e., electrical, compressed air, flush water).
- Meet ALARA objectives

3.1.2 Container

The container may be a high integrity container or an ASME pressure vessel meeting Type B performance criteria. The container is planned to have a minimum capacity of 3m³ and fit within the

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sides of an 8 ft wide, 40 ft long, single drop, flatbed trailer. Some key features of the container include the following:

- Materials used will be compatible with the pH range and mixture of chemical constituents contained in the sludge.
- Include features to load and remove the sludge. A pump mounted on the trailer is the probable sludge transfer mechanism.
- Include features to localize and minimize the size of the sludge heel (such as would be provided by a sloped bottom).
- Include features to monitor and obtain the sludge level.
- Include features to obtain sludge samples for laboratory analyses.
- Include features to install non-destructive assay instrumentation.
- Include features to mix container contents.
- Include features to mitigate the effects of water sloshing (such as baffles).
- Include features to sluice the residual sludge and heel from the container following unloading.
- Provide redundant, sealable, passive HEPA filtered vents.
- Survive an engulfing fire of 1475 °F, for 15 minutes, with containment boundary seals remaining functional.

The maximum container fill rate is anticipated to be 100 gal/minute, through a 2 inch fill line. The fill line shall connect to the container fill port using a dry disconnect coupler. Air displaced from the container during fill operations shall be vented through at least two passive, high-efficiency particulate air (HEPA) filtered vents, which are capable of being sealed during transport. During loading, the container will be monitored to control sludge volume and fissile content using level detectors and non-destructive assay instrumentation features which will be interlocked with the Loadout System.

After the sludge is loaded into the container, the container contents will be sampled and chemically adjusted to meet AW Tank Farm acceptance criteria.

At the time of removal from the basin, the sludge characteristics shall be compared to the operational safety limits established in the SARP using Non Destructive Assay (NDA) or actual laboratory analyses of samples. Safety limits in terms of maximum allowable heat load, maximum dose rate, criticality prevention, and gas generation were assumed to be established.

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The packaging system will be provided with a pumping system to provide the capability to transfer sludge from the container to the tank. The container pumping system mates to a 3 inch transfer line via a dry disconnect coupler. Controls for the pumping system will be interlocked with the tank farm's Sludge Off-load System leak detection equipment. Connections and equipment will also be provided for the TWRS supplied utilities (i.e., electrical, air, flush water).

Shielding for the container will be based on the highest specific activity sludge, with the sludge settled to the bottom of the container. Shielding may be integral with the container or be provided as an overpack.

Radiation levels shall not exceed:

- 1) 100 mrem/hr at 2 cm from any external surface point of the package
- 2) 10 mrem/hr at 2 meters from the package (exclusive use limit)
- 3) 2 mrem/hr in any normally occupied position of the tow vehicle

Container ports and closures are sealed from the atmosphere during transport with positive closure devices which are designed to not be able to be opened unintentionally. Seals and sealing surfaces are protected during equipment handling processes.

The container is currently planned to have at least two passive, high-efficiency particulate air (HEPA) filtered vents. The size, number, and location shall be determined by the gas generation studies to be conducted and the filling and discharge rates. The filter system will be sealed from the atmosphere while the container is under transport.

The container will be designed to minimize the size of the sludge heel to minimize radiation exposures during handling and transport of the "empty" cask. The container interior is to be designed to allow for removal of the majority of sludge heel, including particles as large as ¼ inch.

3.1.3 Transport Trailer

The design requirements for the trailer include the following:

- 1) be a National Highway Traffic Safety Administration (NHTSA) registered trailer.
- 2) be an open lowboy, single drop, 40 ft overall length, and 8 ft wide
- 3) have a minimum concentrated load capacity of 60,000 lbs
- 4) have container attachment cross-members meeting the securement systems requirements of 49 CFR 393.102 (d)

The container will be attached to the trailer either with a tiedown and/or blocking and bracing system with sufficient strength to preclude yielding of material in the system, the container, the

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container lifting/tiedown attachments, the tiedown devices, the blocking and bracing devices, the trailer attachment points, and the trailer itself, when subjected to:

A static force, positioned at the center of gravity of the container, having a vertical component of 2g, a horizontal component along the direction of vehicle travel of 10g, and a horizontal component perpendicular to the direction of vehicle travel of 5g, with the g factor applied to the weight of a fully loaded container with attached support hardware.

The trailer landing gear will be provided with a two-speed, manual crank with sand pads capable of accommodating a fully loaded trailer.

3.1.4 Support Equipment

Support equipment includes equipment to pump the sludge, operate and monitor loading and offloading operations, obtain samples for laboratory analyses, perform nondestructive radioactive assay, mix container contents, vent displaced air during loading operations, and flush the container and piping following loading and unloading operations. Support equipment is anticipated to include:

- HEPA filtered vents, capable of being sealed during transport
- Level indicators
- Equipment for sluicing the container interior
- Sample port to obtain samples for laboratory analyses
- Dry well or other specified interface for nondestructive assay instrumentation
- Console to monitor and control offloading operations
- Equipment for removing container contents
- Equipment for removing residual sludge heel
- Equipment for neutron detection which does not breach containment
- System to mix container contents
- Chemical-addition port to adjust container contents to meet AW Tank Farm chemical acceptance criteria
- Hose reel and hose for connecting to flush water supply
- Equipment necessary to interface with TWRS supplied electrical power and offloading piping

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3.2 AW FARM OFF-LOAD SYSTEM

This chapter is under development. Key features of the system used in the hazards identification and analysis are:

- The off-load system consists of four main elements: 1) offloading pad; 2) flexible metal transfer line; 3) valve station; and 4) fixed transfer line from valve station to sludge distribution system connection.
- The **offloading pad** is located adjacent to AW-103 and functions primarily as a leak collection system in the event that connection or line ruptures or otherwise leaks. It was assumed that any leakage would be collected in a sump which would then be pumped or drained back into the DST.
- The **flexible metal transfer line** would form the connection between the shipping container and the offloading valve station at the tank farm. The flexible metal line was assumed to provide double containment (pipe in pipe configuration), leak detection capabilities between the inner and outer lines, automatic pump shutoff upon detection of a leak. The exact mechanism for containing and draining any material leaked to the annulus is not known.
- The **valve station** at AW-103 contains the necessary connections to mate to the flexible metal transfer line and provides the terminus for the permanent transfer line from the tank.
- The **permanent transfer line** connects the valve station to the tank and provides the flowpath for sludge to be placed in the tank. The permanent transfer line is double-contained (pipe-in-pipe) with leak detection capabilities between the inner and outer line. The leak detectors are interlocked to the pump on the shipping container to automatically stop the pump upon detection of leakage. The line is planned to be installed aboveground with a berm over it to provide shielding.

Additional information relative to the transfer operations are as follows:

- A helium leak check is anticipated to be performed at K-Basins to ensure the cask is properly sealed before it leaves.
- The HEPA filters on the cask will be sealed before transport. This will allow the hydrogen gas to build up within the container during transport. However, preliminary calculations indicate it will take 4 or 5 days to generate an explosive concentration of hydrogen ($>4\%$).
- AW Farm is relatively clean on the surface. Workers allowed in with street clothes.
- A temporary radiation zone will be established around the transfer station in tank farms. The temporary radiation zone will be removed after each transfer is complete.

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- The air compressor shown on drawings of the trailer is not a final detail. It was shown tentatively on the drawings and is intended for pump motive force and, if needed, to bubble air into the cask to help in the pumping process.
 - The main power source for the transfer equipment will be tank farm power. The truck will also be provided with a small generator to use in case normal power is lost. The generator will be either gasoline or diesel powered (not yet decided).
 - The mixer is optional during transport. A pressure excursion could be caused if the mixer is used during transport. Operations are currently envisioned to include a period of time to allow the sludge to be mixed after the trailer has been positioned on the unloading pad at tank farms. The operating scenario was envisioned to first start the mixer pump and then let the sludge mix while operators are performing the connection activities.
 - No specifications are available for the connections to the cask outlet valves. A quick-connect system is hoped for in the procurement process to minimize the time operators spend on top of the cask connecting the hose. The LR56 truck tanker has such a system but this would not work here without modification.
 - Automatic pump shutoff capabilities will be provided; auto-shutoff will occur if a leak is detected or if low-level is sensed in the container. Also, depending upon pump design, a pump overpressure shutoff will be provided.
 - There are currently no plans to provide gravity-drain capabilities for the cask. Pumping will be the only way to remove the sludge from the cask.
 - Portable shielding, such as leaded blankets or lead bricks, will be provided for the flexible transfer hose to reduce dose rates. These shields will be placed over the flexible line before the transfer occurs. Operator stay time will also be limited in this area. Since the transfers will be performed from a control panel on the truck, there will be no need for the operators to remain near the flexible line for any length of time, except during the connection process.
 - Current goals for the cask include a maximum allowable dose rate at the cask surface is 100 mrem/hr as opposed to 200 mrem/hr for transportation authorization purposes. The lower limit is being specified to minimize K-Basin operator dose but will also reduce exposures to tank farm operations staff.
 - The cover gas in the cask is air. There appears to be no need to place an inert cover gas in the cask to minimize the likelihood of a pyrophoric reaction. This is already prevented due to the moisture level in the cask.
 - Aboveground portions of the tank farm transfer system include only the cask/vehicle, flexible line, and unloading station (tank farm end of the connection system).
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- A spill pad with secondary containment and leak detection will be provided in tank farms. The truck will drive onto this permanent structure, the tractor will be uncoupled and moved away, and the trailer chocked.

3.3 DOUBLE-SHELL STORAGE TANK AW-103

INSERT MATERIAL UNDER DEVELOPMENT.
NEED TO RE-NUMBER SECTIONS, HEADINGS, etc.

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4.0 HAZARD IDENTIFICATION

The first step in the analysis was to identify hazards and hazardous conditions associated with transfer of sludge into the storage tank. This includes hazards associated with the transfer operations and equipment as well as hazards intrinsic to AW tank farm that could affect the transfer operations or the operators conducting the transfers. This was accomplished using the Hazard Checklist presented in Table 2.1. The analysts reviewed each activity and each processing step for transferring material from a truck container into the tank for the hazards listed in the Hazard Checklist. Input to this process included the previous tank farms SARs, system description information from the tank farm FSAR now in preparation, functional design criteria for the shipping container, preliminary information from the designers of the transfer station, and tank farm drawings.

The hazard checklists for the K-Basin sludge transfer operations are presented in Tables 4.1 to 4.3. Table 4.1 addresses hazards during receipt and onsite transport of the sludge container within tank farms, Table 4.2 addresses connection of the container to the transfer station at tank farms, Table 4.3 addresses the sludge transfer into the tank, and Table 4.4 addresses storage operations.

A fair amount of information was obtained from this exercise and much of it was recorded in the "Example" sections of the checklists. The information recorded in the Examples section often included a brief description of potential accident scenarios that could readily be incorporated into the PHA.

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Table 4.1 Hazard Checklist for Sludge Container Receipt and Transport

ACTIVITY: Receipt and Onsite Transport of Sludge Container to Unloading Station

Hazard	Example(s)
Hazards Identified During Activity	
Acceleration/ deceleration	Load dislodged from truck due to truck striking object, truck rollover (loss of vehicle control, liquid sloshing, operator error, etc.)
Contamination	Receipt of externally-contaminated container. Tank farm chemical inventories may affects the truck/container and ancillaries. Operators exposed to tank farm surface contamination.
Chemical reaction	Diesel fuel, hydraulic fluid, compressor lube oil, vehicle lube oil, tank farm chemicals.
Corrosion	Container corrosion (internal) by sludge if not unloaded quickly.
Electrical	Power lines, transformers, electrical outlets in tank farm. Mixer pump in container. Air compressor (electric-driven?) Instrumentation/control system.
Explosion	Diesel fuel, lube oil. Welding operations and equipment in tank farm. Hydrogen, flammable gas generation in container.
Fire	Diesel fuel, lube oil. Welding operations and equipment in tank farm. Hydrogen, flammable gas generation in container. Hot brakes could start grass fires. Pyrophoric material (U metal) in transport container. Engine fires.
Heat and Temperature	Solar heating of container causes overpressure or deforms/distorts seals. Welding equipment/materials. Lead slump (shielding material).
Low Temperature	Liquid freezes, expands, cracks container. Cold embrittles gaskets. Materials susceptible to brittle fracture.
Temperature change	Thermal stress (day/night temperature change) deforms seals, fatigues structural members, differential thermal expansion.

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Hazard	Example(s)
Impact and Shock	Truck strikes object (pump pit, diversion box, riser, vent system equipment, etc.). Truck struck by missile (tornado/wind driven, explosion driven). Aircraft impact. Impact of radiation-embrittled container. Mishandled truck drives over/parks on tank (dome load).
Leakage/spills (gas, vapor, liquid)	Mishandling or loading error results in improper seal (overtorque, undertorque, failure to install seals). Failure to close container valves, valve failure. Vapor leak through improperly installed HEPAs on the container.
Power source failure	Address during hookup. No external power sources needed during receipt and in-farm transport.
Pressure - High	Overpressure from chemical reaction, sloshing, hot spot in sludge. Air compressor on truck.
Radiation - Ionizing	Excessive surface dose rate. External contamination. Inhalation of vapors, gases released through openings. Settled sludge increases dose rates. Tank farm (land) surface contamination.
Structural damage/failure	Container failure. Trailer/tie-down failure causes container to fall to ground, break open.
Toxicity	Materials in sludge. Chemicals in pump, compressor.
Vibration and noise	Road vibration during transport loosens seals, valve, tie-down. Vibration could increase volatilization of sludge material. Activities nearby that vibrate the ground.
Weather and environment	Inclement weather (ice, snow) causes vehicle accident. Seismic event. Flood. High wind and tornado. Snowfall. Ashfall. Heavy rain, hail. Brush fire. Aircraft impact.

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Hazard	Example(s)
Hazards NOT Identified During Activity	
Moisture - High Humidity	Moisture - Low Humidity
Pressure - Low	Radiation - Infrared
Radiation - Electromagnetic	Radiation - Ultraviolet

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Table 4.2. Hazard Checklist for Connection and Transfer Operations

ACTIVITY: Connect Sludge Container to Unloading Station

Hazard	Example(s)
Hazards Identified During Activity	
Acceleration/ deceleration	Trailer slips during hookup and breaks connection, ruptures valve or line. See also "receipt" activity.
Contamination	Residual material in valves, lines. Sand in pump oil, compressor oil. See also "receipt" activity.
Chemical reaction	Residuals in line, valves, covers. Air/oxygen contacts sludge (vapor passes through HEPA filtered vents or through opened valve). See also "receipt" activity.
Corrosion	External components corroded. Galvanic corrosion (dissimilar metal-to-metal contact such as line to truck, line to unloading station). See also "receipt" activity.
Electrical	Loss of lighting leads to improper connection. Loss of truck power leads to mixer failure. See also "receipt" activity.
Explosion	Fuel, oil in truck and transfer equipment (pump, air compressor). Hydrogen, methane gas generated inside container. Welding in tank farms. See also "receipt" activity.
Fire	Pyrophoric material fire. Spark source for hydrogen gas generated in tank. See also "receipt" activity.
Heat and Temperature	Same as for "receipt" activity.
Low Temperature	Freezing (plugs lines, valves).
Temperature change	Same as for "receipt" activity.

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Hazard	Example(s)
Impact and Shock	Vehicle struck by another (breaks connections). See also "receipt" activity.
Leakage, Spills	Same as for "receipt" activity.
Power source failure	Loss of instrument air. See also "receipt" activity.
Pressure - High	Same as for "receipt" activity.
Radiation - Ionizing	Same as for "receipt" activity.
Structural damage/failure	Same as for "receipt" activity.
Toxicity	Same as for "receipt" activity.
Vibration and noise	Same as for "receipt" activity.
Weather and environment	Same as for "receipt" activity. Events could cause connection to be broken.
Hazards NOT Identified During Activity	
Moisture - High Humidity	Moisture - Low Humidity
Pressure - Low	Radiation - Infrared
Radiation - Electromagnetic	Radiation - Ultraviolet

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Table 4.3. Hazard Checklist for Transfer Operations

ACTIVITY: Transferring Container Contents to Tank

Hazard	Example(s)
Hazards Identified During Activity	
Acceleration/ deceleration	Trailer slips during pumping and breaks connection, ruptures valve or line. See also "receipt" activity.
Contamination	Same as for "receipt" activity.
Chemical reaction	Chemical reaction occurs between sludge and tank contents (chemical incompatibility); increases temperature and pressure in tank. Residuals in lines, valves, etc., react and produce heat and pressure. Mistransfers. See also "receipt" activity.
Corrosion	Same as for "receipt" activity.
Electrical	Electric-driven pump, control systems. See also "receipt" activity.
Explosion	Chemical incompatibilities (sludge, tank contents). Mistransfers. See also "receipt" activity.
Fire	AW-101 is nearby flammable gas tank; connected on common header to AW-103. Mistransfers. See also "receipt" activity.
Heat and Temperature	Solar radiation embrittles lines, overheats shipping container.
Low Temperature	Freezing conditions could freeze (plug) lines, valves, etc.
Temperature change	Same as for "receipt" activity.
Impact and Shock	Fatigue failure of transfer line, connections. Trailer struck by moving vehicle.
Leakage	Transfer line rupture. Valve rupture.

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Hazard	Example(s)
Power source failure	Instrument failure (tank level, shipping container level, pump flow, etc.) Loss of lighting. Loss of mixing in shipping container. Failure of sludge distribution system in tank.
Pressure - High	Pump pressure (normal). Pump dead-heads against closed/plugged valve. Chemical incompatibility causes tank to pressurize.
Pressure - Low	Rapid overcooling of tank vapor.
Radiation - Ionizing	Exposures to leakage through connectors, ruptured lines and valves. See also "receipt" activity.
Structural damage/failure	Same as for "receipt" activity.
Toxicity	Same as for "receipt" activity.
Vibration and noise	Same as for "receipt" activity.
Weather and environment	Same as for "receipt" activity.
Hazards NOT Identified During Activity	
Moisture - High Humidity Radiation - Infrared Radiation - Ultraviolet	Moisture - Low Humidity Radiation - Electromagnetic

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Table 4.4. Checklist for Storage of K-Basin Sludge in a DST

ACTIVITY: Storage

Hazard	Example(s)
Hazards Identified During Activity	
Acceleration/ deceleration	Fluid (sludge or supernate) splashes. Damage to or pipe dislodges from sludge distributor. Waste additions causes gas release by disturbing sludge layer in tank (gas pocket); high rad, chemical reaction.
Contamination	Inadequate flush of container; residual contamination in container. Same as hazards during "receipt" activity.
Chemical reaction	Incompatible waste. Mistransfer (wrong receiver tank). Pyrophoric reaction. Transfer waste not in compliance with acceptance specifications (chemical reaction, fire, explosion). Inadequate flush of container leads to mixing incompatible chemicals.
Corrosion	Out-of-spec. waste accelerates tank liner, tank internal equipment corrosion.
Electrical	Spark source. HVAC system. Sludge distributor. Communications system. Instrumentation, controls, alarms. Lighting system.
Explosion	Incompatible waste. Hydrogen gas exhausted from tank. Pyrophoric, organic materials in sludge. AW-101 is flammable gas tank.
Fire	Electrical instrumentation in tanks are spark source; could ignite flammable vapors. Welding in vicinity of tank. External fire ignites flammable gas. Pyrophoric and organic material in Basin sludge.

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Hazard	Example(s)
Heat and Temperature	Overheat sludge distributor. Sludge is heat source. Tank bump. Differential thermal expansion (basin sludge strikes tank surfaces). Incompatible sludge temp. causes chemical reaction. Hot spots in sludge.
Low Temperature	Relatively cold sludge strikes warmer tank sludge; increases vaporization.
Temperature change	Same as hazards during "receipt" activity.
Impact and Shock	Foreign object in Basin sludge strikes tank wall or internal equipment.
Leakage	Tank failure causes leakage to soil. Vapor leakage (failed HEPAs, failed/leaking HVAC duct or other barrier)
Moisture - High humidity	Increasing water content of tank affects vaporization rate, tank pressure. Contributes to instrument failure. Enhanced corrosion.
Power source failure	Loss of HVAC, instrumentation, controls, alarms. See also "electrical"
Pressure - High	Basin sludge/tank sludge temperature differences; flashes to steam. Gas/air pockets in sludge released. Chemical reaction (incompatibility). Pump increases tank pressure.
Pressure - Low	HVAC inlets to tank plug, exhaust fans continue running. Rapid overcooling of tank vapor.
Radiation - Ionizing	Sludge in tank. Vapors in HVAC system. External exposure rates.
Structural damage/failure	Hazards to tank structures include overpressurization, chemical reaction/corrosion, tank bump, criticality, etc. Tank structure failure. HVAC component failure.
Toxicity	Toxic materials in sludge, vapors.
Vibration and noise	Nearby workers operating heavy equipment, machinery.
Weather and environment	Same as hazards identified in "receipt" activity.

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Hazard	Example(s)
Hazards NOT Identified During Activity	
Moisture - High Humidity Radiation - Infrared Radiation - Ultraviolet	Moisture - Low Humidity Radiation - Electromagnetic

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5.0 PRELIMINARY HAZARDS ANALYSIS

This chapter presents the PHA tables developed for this assessment. The PHA forms the basis for the identification of accident scenarios and subsequent selection of evaluation-basis accident scenarios. The PHA is presented in four tables: Table 5.1 presents the PHA for receipt and onsite transport of the K-Basin sludge shipping container at the AW tank farm; Table 5.2 is for the connection and transfer operations at tank AW-103; the PHA for storage activities is presented in Table 5.3; and Table 5.4 is for retrieval activities. Note that Table 5.3 is divided into four sub-sections: Table 5.3a addresses hazards associated with the storage tank structures and contents; Table 5.3b addresses the AW tank farm ventilation system; Table 5.3c addresses the central pump pit, sluice pit, and other dome penetrations; and Table 5.3d addresses piping, the annulus pump pit, and leak detection pit.

Table 5.1. PHA for Receipt and Onsite Transport

HAZARD	PHENOMENA	CAUSES	CAUSE FREQ.	CONSE- QUENCES		PREVENTION/MITIGATION		SCENARIO FREQUENCY
				OCC.	SEV.	ENGINEERING	ADMINISTRATIVE	
Acceleration/ Deceleration	Sludge cask dislodged and breached	A1. Truck collision	Unlikely	Y	1	Cask tiedown, cask structural integrity, crash barriers, marked roadway	Vehicle spotter, cask tiedown procedure, driver qualification, speed limit	Extremely unlikely
		A2. Severe driving error	Unlikely	Y	1			Extremely unlikely
		A3. Liquid sloshing	Unlikely	Y	1			Extremely unlikely
	Other object(s) dislodged	A4. Truck collision	Unlikely	Y	NA	Crash barriers, marked roadway		Unlikely
		A5. Driving error	Anticipated	Y	NA			Unlikely
Contamination	Exposure from sludge cask contents	A6. Externally contaminated cask received	Unlikely	N	3	None	Health physics inspections at K-Basin and tank farm	Extremely unlikely
		A7. Tank farm chemicals corrode cask	Unlikely	N	3	Cask material	Tank farm chemical storage requirements, routine inspection, expeditious scheduling of sludge transfer	Extremely unlikely
	Exposure from tank farm contents	A8. Tank farm surface contamination	Anticipated	N	3	None		Unlikely
Chemical Reaction (see Explosion and Fire)	Hazardous vapor release	A9. Tank farm chemicals	Unlikely	Y	3	Liquid containment/ confinement	Chemical storage requirements, "good housekeeping"	Extremely unlikely
Corrosion	Sludge-wall internal reaction	A10. Improperly neutralized sludge loaded at K-Basin	Unlikely	N	2	Cask material	Cask inspection, neutralization procedures, sludge sampling, expeditious scheduling of sludge transfer	Extremely unlikely
		A11. Slightly corrosive mixture left standing too long (enhancing corrosion)	Unlikely	N	2			Extremely unlikely

HAZARD	PHENOMENA	CAUSES	CAUSE FREQ.	CONSEQUENCES		PREVENTION/MITIGATION		SCENARIO FREQUENCY
				OCC.	SEV.	ENGINEERING	ADMINISTRATIVE	
Electrical	Electrical short/sparks	A12. Power supply lines, outlets (external to sludge cask)	Anticipated	Y	4	Equipment design	Electrical work permits, routine maintenance/inspection	Extremely unlikely
		A13. Sludge cask mixer pump	Anticipated	N	4			Unlikely
		A14. Air compressor on trailer	Anticipated	Y	4			Unlikely
		A15. I&C	Anticipated	Y	4			Unlikely
Explosion	Highly energetic release internal or external to the sludge cask, possibly generating missiles	A16. Fuel or lube oil	Unlikely	Y	4	Cask material, pressurized gas storage	Routine maintenance/inspection, welding prohibition during unloading operations	Extremely unlikely
		A17. Welding gases	Unlikely	Y	4			Extremely unlikely
		A18. Hydrogen or other flammable gas within or released from sludge cask	Unlikely	Y	1	Cask I&C, ventilation, mixer pump	Sludge characterization analysis, pre-transport sludge sampling	Extremely unlikely
Fire	Exothermic release internal or external to the sludge cask, possibly long duration	A19. Truck-related: fuel, lube oil, engine, hot brakes	Anticipated	Y	4	Cask fire resistance, pressurized gas storage	Combustible control, routine maintenance/inspection, welding prohibition during unloading operations	Extremely unlikely
		A20. Welding gases	Unlikely	Y	4			Extremely unlikely
		A21. Hydrogen or other flammable gas within or released from sludge cask	Unlikely	Y	1	Cask I&C, flammable gas control, cask filter	Sludge characterization analysis, pre-transport sludge sampling, cask grounding	Extremely unlikely
		A22. Pyrophoric U metal in sludge cask	Anticipated	Y	1	Cask I&C, moisture, sludge mostly oxidized	Expeditious scheduling of sludge transfer	Extremely unlikely

HAZARD	PHENOMENA	CAUSES	CAUSE FREQ.	CONSE- QUENCES		PREVENTION/MITIGATION		SCENARIO FREQUENCY
				OCC.	SEV.	ENGINEERING	ADMINISTRATIVE	
Heat and Temperature	Uniform or differential heating of sludge cask from external source	A23. Solar exposure: overpressure, seal distortion	Anticipated	N	2	Cask thermal resistance, wall thickness, cask strength	Expeditious scheduling of sludge transfer, welding prohibition during unloading operations	Extremely unlikely
		A24. Exposure to welding equipment or materials	Unlikely	N	2			Extremely unlikely
		A25. Lead slump in shielding from heat exposure	Anticipated	N	2			Extremely unlikely
Low Temperature	Prolonged exposure to cold (either during transport to tank farm or upon receipt)	A26. Expansion of water as it freezes	Unlikely	N	3	Cask strength, internal heat generation in sludge cask, mixer pump	No outdoor exposure during cold snap	Extremely unlikely
		A27. Embrittlement of gaskets	Anticipated	Y	3	Material selection		Unlikely
		A28. Material brittle fracture (cask wall, penetrations)	Extremely unlikely	Y	1			Extremely unlikely
Temperature Change	Non-uniform heating and cooling of sludge cask either spatially or temporally	A29. Thermal stress for diurnal temperature change: seal deformation, structural fatigue	Anticipated	N	3	Material selection	Expeditious scheduling of sludge transfer	Extremely unlikely
		A30. Differential thermal expansion A31. of materials	Unlikely	N	3			Extremely unlikely
Impact and Shock	Rapid transfer of kinetic energy possibly beyond design limit	A31. Tank auxiliary struck by truck: pump pit, diversion box, riser, vent equipment	Unlikely	N	1	Crash barriers, marked roadway	Vehicle spotter, driver qualification	Unlikely
		A32. Sludge cask struck by missile: tornado-/wind-driven, explosion-driven	Unlikely	N	1	Cask strength	No outdoor exposure during severe winds	Extremely unlikely

HAZARD	PHENOMENA	CAUSES	CAUSE FREQ.	CONSE- QUENCES		PREVENTION/MITIGATION		SCENARIO FREQUENCY
				OCC.	SEV.	ENGINEERING	ADMINISTRATIVE	
		A33. Radiation-embrittled sludge cask struck	Extremely unlikely	N	1	Cask I&C, material selection	Routine maintenance/ inspection	Extremely unlikely
		A34. Mishandled truck drives atop tank dome	Unlikely	Y	1	Crash barriers, marked roadway, tank strength	Vehicle spotter, driver qualification	Beyond extremely unlikely
Leakage/ Spills (Gas, Vapor, Liquid)	Non-energetic release of sludge cask contents	A35. Improper sealing: over/under-torque, failure to install	Unlikely	N	2	Cask double containment, leak detection/ collection system	Cask loading procedures, routine maintenance/ inspection	Unlikely
		A36. Valve failure, failure to close	Unlikely	N	2	Cask I&C		Unlikely
		A37. Vapor leak through improperly installed HEPAs	Unlikely	N	2			Unlikely
High Pressure	Overpressure inside a container, causing a leak	A38. Sludge cask overpressure: chemical reaction, sloshing, hot spot	Unlikely	Y	1	Cask ventilation, cask strength, double containment, mixer pump	Expeditious scheduling of sludge transfer	Extremely unlikely
		A39. Air compressor (on trailer) overpressure	Anticipated	Y	NA	Automatic compressor shutoff	Routine maintenance/ inspection	Unlikely
Ionizing Radiation	External or internal exposure to excessive dose	A40. Surface contamination: sludge cask or tank farm	Anticipated	N	3	Cask I&C	Health physics inspection at K-Basin and tank farm	Unlikely
		A41. Excessive surface dose rate	Unlikely	N	3	Cask I&C, shielding		Unlikely
		A42. Inhalation of released radioactive vapors, gases	Unlikely	N	2	HEPA filters, tank ventilation		Unlikely

HAZARD	PHENOMENA	CAUSES	CAUSE FREQ.	CONSE- QUENCES		PREVENTION/MITIGATION		SCENARIO FREQUENCY
				OCC.	SEV.	ENGINEERING	ADMINISTRATIVE	
Structural Damage or Failure (see Leakage/Spills)	Sludge cask damage from inherent defects or induced forces	A43. Defective sludge cask fails	Unlikely	N	1	Material selection, cask structural integrity, double containment	Routine maintenance/ inspection, manufacturer QA, acceptance tests, pre- transport inspection, K-Basin loading procedures	Extremely unlikely
		A44. Trailer/ tiedown failure drops sludge cask to ground, breaking open	Unlikely	Y	1			Extremely unlikely
Toxicity	External or internal exposure to excessive levels of hazardous chemicals	A45. Exposure to sludge waste	Antici- pated	N	3	Cask double containment	Routine maintenance/ inspection, worker access to respirators, safety training	Unlikely
		A46. Exposure to chemicals in pump or compressor	Antici- pated	N	3	Equipment seals		Unlikely
Vibration	Repeated rapid movement from external sources	A47. Sludge cask seal, valve, or tiedown loosening during transport (road vibration)	Antici- pated	N	2	Cask seal design	Routine maintenance/ inspection, pre- transport inspection	Unlikely
		A48. Volatization of sludge: road transport, tank farm activities	Extremely unlikely	N	2	Cask I&C, HEPA filters	Speed limit, driver qualification	Extremely unlikely
Weather and Environment	External forces of nature sufficient to breach sludge cask	A49. Truck accident due to inclement weather	Unlikely	Y	1	Cask tiedown, structural integrity, tank farm location in low seismicity area	Transport limits during severe weather, driver qualification	Extremely unlikely
		A50. Earthquake	Extremely unlikely	Y	1		None	Beyond extremely unlikely
		A51. Flood (including dam burst), heavy rain, hail	Unlikely	Y	1	Tank farm elevation, surface drainage	Operations restricted during severe weather	Extremely unlikely
		A52. High wind, tornado	Unlikely	Y	1	Cask tiedown, structural integrity		Extremely unlikely

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7.0 SELECTION OF EVALUATION-BASIS ACCIDENT SCENARIOS

This chapter develops a comprehensive list of potential accident scenarios from the results of the PHA process and then screens the scenarios to develop a list of accidents that will be analyzed in detail to develop the authorization basis for K-Basin sludge transfer operations. The accident scenarios are catalogued in Section 7.1 and placed into appropriate frequency-consequence bins as determined from the PHA. Section 7.2 presents the list of evaluation-basis accidents and describes the rationale for their selection as well as the rationale for not selecting others.

7.1 DEVELOPMENT OF COMPREHENSIVE LIST OF ACCIDENT SCENARIOS

This section develops a comprehensive list of accident scenarios based on the information presented in Chapters 5 and 6. These data were examined to develop short narrative descriptions of accident scenarios, which often involve designation of an initiating event and subsequent failures that lead to a release of radioactive or hazardous materials to the environment. The accident scenarios are divided into their respective severity categories in the following sections.

A unique identification number was assigned to each potential accident scenario in the PHAs presented in Chapter 5 so each scenario would be properly accounted for in subsequent analyses. The identification number is a 2-digit alpha-numeric identifier placed in the "Causes" column of the PHA. The first digit refers to the process step being analyzed. First digit "A" refers to receipt and onsite transport of the sludge cask, "B" refers to connection and transfer operations, "C" refers to storage period, and "D" refers to retrieval. The second digit is a numerical identifier for the accident scenarios within each process step. For example, accident scenario "A2" refers to the second scenario listed in the receipt and transport PHA.

The comprehensive list of accident scenarios that resulted from the PHA process is provided in the following pages. The scenarios are binned into appropriate severity categories, as determined in the PHA. Note also that the natural phenomena and extrinsic hazards that were determined to be credible in Chapter 6 are also provided in this list.

Severity Category 1

Seismic event (see Chapter 6)

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- A18 Flammable gas released from cask explodes, fails cask, and releases contents to environment.
 - A21 Flammable gases from cask ignited, fails cask, and releases contents to environment.
 - A22 Pyrophoric material in cask ignited, fails cask, and releases contents to environment.
 - A23 Cold temperature fails cask due to brittle fracture and releases contents to environment.
 - A31 Truck strikes or drives over object in tank farm (above grade component), resulting in loss of tank containment/confinement function.
 - A32 Cask struck by missile generated in tank farm, fails cask, and releases contents to environment.
 - A33 Radiation-embrittles cask struck by object in tank farm, fails cask, and releases contents to environment.
 - A34 Mishandled truck drives over tank dome, causes dome collapse.
 - A38 Chemical reaction in cask causes failure due to overpressure, releases contents to environment.
 - A43 Defective sludge cask fails, releases contents to environment.
 - A44 Trailer/tie-down failure causes cask to fall to ground, cask fails, and releases contents to environment.
 - B1 Trailer slips during connection/transfer, breaks connection, releases contents to environment.
 - B8 See B15.
 - B9 See B16.
 - B15 Chemical reaction between K-Basin sludge and tank waste increases tank pressure and temperature, resulting in dome collapse.
 - B16 K-Basin sludge mistransferred to incorrect tank, causes chemical reaction between K-Basin sludge and tank waste increases tank pressure and temperature (explosion), resulting in dome collapse.
 - B17 Pyrophoric reaction in tank causes fire, overpressure, and tank failure (dome collapse).
 - B18 Flammable gas in tank ignited by spark created during transfer operations, fire causes overpressure and tank failure (dome collapse).
 - B19 Inadvertent connection made to flammable gas tank 241-AW-101, causes spark, ignites gases in AW-101, fire causes overpressure and tank failure (dome collapse).
 - B20 K-Basin sludge mistransferred to incorrect tank, causes chemical reaction (fire) between K-Basin sludge and tank waste increases tank pressure and temperature, resulting in dome collapse.
 - B35 See B15
 - B38 Rapid overcooling of tank vapor caused by transferring cold K-Basin sludge creates vacuum in tank, leading to dome collapse.
-

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- A1. Sludge cask dislodged from trailer due to collision, cask is breached, contents spill onto ground.
- A2. Sludge cask dislodged from trailer due to severe driving error, cask is breached, contents spill onto ground.
- A3. Sludge cask dislodged from trailer due to liquid sloshing (changes center of gravity), cask is breached, contents spill onto ground
- A10. Rapid shipping cask corrosion due to improperly-neutralized sludge results in shipping container failure and spill of contents onto ground.
- A11. Interruption of transfer operation causes shipping cask to be set aside in tank farms. Results in accelerated corrosion rates and cask failure, leading to spill on ground.
- A23. Solar heating of cask surface distorts seals, resulting in loss of containment barrier and pressurized release from cask.
- A24. Mishandled welding equipment or materials contact cask surface, distorts seals, and results in pressurized release from cask.
- A25. Lead shielding material in cask slumps due to overheat or impact and causes excessive radiation dose rate.
- A26. Water in cask freezes, volume expands, and fails cask wall or penetration.
- A35. Improperly sealed cask leaks material to environment.
- A36. Cask penetration seal fails, leaks material to environment.
- A37. Improperly sealed HEPA filter penetration leaks material to environment.
- A42. Gases/vapors released from cask, workers exposed to airborne material.
- A47. Road vibration causes incomplete seal, gases/vapors released from cask.
- A48. Road vibration increases internal pressure, material released when cask seals broken during connection activity.
- B7. Air/oxygen passes through open cask vents, contacts sludge, and chemical reaction produces heat and pressure that expels material from cask.
- B10. Chemical corrosion causes failure of transfer system component, releases material to the environment.
- B11. Galvanic corrosion (dissimilar metal contact) causes failure of transfer system component, releases material to the environment.
- B12. Loss of lighting causes improper connection, leading to pressurized release when transfer begins.
- B13. Loss of sludge mixer in cask causes excessive vapor generation

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- when mixing restored, vapor released to environment.
- B14 Electric fault in transfer pump, I&C system, causes transfer to be interrupted, causes excessive vapor generation when transfer restarted, vapor released to environment.
 - B21 Solar radiation embrittlement fails transfer equipment, results in spray leak during transfer.
 - B22 Cold weather conditions freezes material in transfer equipment, plugs lines or valves, results in failure of transfer system due to excessive pressure and spray release.
 - B25 Cask/trailer struck by moving vehicle, connection broken, material released to the environment.
 - B26 Failure of transfer line connections caused by fatigue, release occurs during transfer.
 - B28 Transfer line rupture during transfer releases material to the environment.
 - B33 Normal pump pressure fails transfer lines, connections, causes spray leak.
 - B34 High pump pressure caused by flow blockage (pump deadhead) fails pump, transfer lines, or connections, causes spray leak.
 - B36 Excessive steam generated in tank during transfer causes excessive vapor release.
 - B39 Operators exposed to leakage through connectors.
 - B40 "Fuel flea" in sludge exposes operators to excessive radiation dose rate.

Severity Category 3

- A6 Externally-contaminated shipping container received at tank farms, results in excessive worker exposures.
- A7 ????
- A8 High surface contamination in tank farms causes high dose rates in areas occupied by transfer personnel; results in excessive radiation doses to operators.
- A9 Chemicals used in tank farm escape container(s) and result in exposures of workers to potentially-hazardous vapors.
- A27 Cold ambient temperature embrittles gaskets, causes loss of containment, material released from cask.
- A29 Thermal cycling causes seal deformation, material released from cask.
- A30 Differential thermal expansion of cask and seal materials causes loss of containment boundary, material released from cask.
- A40 Excessive surface contamination (see A6)
- A41 Cask contains "fuel flea", surface dose rate exceeds limits, workers receive excessive exposures.

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- A45 Cask releases toxic vapors/gases, worker exposed.
 - A46 Workers exposed to toxic vapors released from fuel tank, compressor, etc.
 - B2 Fluid splashes when transferred into tank, results in excessive vapor generation in tank, vapors/gases released to environment.
 - B3 Sludge distributor fails, falls into tank, results in excessive vapor generation in tank, vapors/gases released to environment.
 - B4 Operators exposed to residual material in transfer lines, connectors, valves, etc.
 - B5 Contamination (e.g., sand) in transfer pump causes pump failure, missile generation, and operator injury.
 - B6 Residuals in lines/valves react, producing heat and pressure, and disperses residual material.
 - B23 Excessive vapor release from tank caused by cool K-Basin sludge striking warmer waste in tank.
 - B24 Excessive vapor release from tank caused by K-Basin sludge striking tank surfaces.
 - B27 Foreign object in sludge strikes tank wall or internal equipment (spark source).
 - B29 Loss of power source to cask instrumentation and control system causes operator error.
 - B30 Loss of power to tank farm lighting system causes operator error.
 - B31 Loss of power to sludge mixer in cask results sludge to settle to bottom, interferes with capability to completely empty cask, results in excessive radiation exposures.
 - B32 Loss of power to sludge distributor causes uneven distribution of sludge.
 - B37 Gas pockets in tank sludge released during transfer.

Severity category 4

- A16 Fuel or lube oil explosion on truck injures workers
- A17 Welding gases explode and injure workers
- A19 Truck-related fire (fuel, lube oil, hot brakes, engine) injures workers.
- A20 Welding gases start fire and injure workers

Industrial Accidents (scenarios that do not involve exposures to radioactive or hazardous chemical materials)

- A4 Truck collision injures driver or pedestrian in tank farm
 - A5 Severe driving error injures driver or pedestrian in tank farm
 - A12 Operator electrocuted or burned by contacting exposed electrical system components connecting shipping container to tank farm
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- A13 Operator electrocuted or burned by contacting exposed electrical system components on shipping container/vehicle (mixer pump power supply)
- A14 Operator electrocuted or burned by contacting exposed instrumentation and control (I&C) system components on shipping container/vehicle.
- A39 Air compressor fails, injures nearby worker.

NOTE: NEED TO ADD SCENARIOS FROM STORAGE AND RETRIEVAL PHAS

7.2 SELECTION OF EVALUATION-BASIS ACCIDENT SCENARIOS

The first step in the accident screening process was to identify accident scenarios assigned to severity category 1 that had frequencies greater than extremely unlikely. Such scenarios would clearly be evaluation-basis scenarios as they result in a combination of high consequence and relatively high frequency which would merit further analysis. Inspection of the PHA tables yielded no scenarios of this type.

The second step was to attempt to group the scenarios in severity category 1 into "families" or scenarios that share common initiating events or release mechanisms. These "families" were determined to be:

1. Rupture of transfer line, connections, etc. during a transfer. Many potential causes of such events were identified, including seismic events, overpressure, improper connection, trailer movement during transfer, and others. Depending upon the extent of the rupture and the system pressure, the release may consist of a spray release, liquid spill, or both.
2. Tank dome collapse was considered as a possible outcome of many different accident scenarios, including seismic events, flammable gas generation and subsequent fire or explosion, mixing of incompatible chemicals and subsequent fire or explosion, or pyrophoric reaction. The release from such an event would include vapors, supernate, and sludge material within tank AW-103, including K-Basin sludge.

All of the scenarios within these families were retained for further analysis.

The next step was to examine category 2 accident scenarios. The scenarios that were rated as having extremely unlikely frequencies in

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this severity category were screened out or tagged as potential contributors to the accident families listed above. This is because the risks of these scenarios would be lower than the risks of extremely unlikely scenarios in category 1 due to their lower consequences and approximately equivalent frequencies. Again, an attempt was made to group the scenarios into "families" as was done for Severity category 1 scenarios. This resulted in creation of the following families:

3. Shipping container seal failure. Such a release may be caused by improperly installed seals, seal failure in transit, or an event that could increase pressure within the container. The material released from such an event could be vapor or liquid, depending upon which seals are failed and the operation occurring when the seal fails.
4. Breach/rupture in AW Tank Farm ventilation system. These scenarios may be caused by incompatible chemical reactions, flammable gas deflagration, or other internal pressure-inducing mechanism or by outside forces, such as seismic events. The internal pressure generated in this family of accidents is not sufficient to cause tank dome collapse but could cause an overpressure of ventilation system components that results in loss of confinement of the vapors and gasses removed from the tank head space.

Note that many of the accident scenarios identified in Section 7.1 are contributors to the "families" identified above. In essence, they represent separate pathways towards the occurrence of the more-encompassing family event. For example, tank dome collapse may occur as a result of a severe exothermic chemical reaction that might occur when the K-Basin sludge contacts the material previously stored in AW-103, as a result of a pyrophoric reaction, or a seismic event. In the detailed accident scenario modeling process, all of these potential pathways will be explored and quantified to develop an estimate of the frequency of tank dome collapse. Therefore, the majority of the accident scenarios identified in Section 7.1 are actually subsumed within the families identified above and were not screened out from further consideration.

NOTE: NEED TO ADD SCENARIOS SELECTED FROM THE STORAGE AND RETRIEVAL PHA.

Additional families are likely to include:

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Criticality resulting from retrieval of waste from AW-103.

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GENERAL NOTES

1. RESPONSIBILITY NOTATIONS ARE:
SNF - SPENT NUCLEAR FUELS
KEL - KANSAS ELECTRIC
KEL - KANSAS ELECTRIC
2. ALL PIPING MATERIAL FABRICATION, WELDING, WELD INSPECTION, AND CONSTRUCTION SHALL BE COMPLETED WITHIN A CONSTRUCTION SPECIFICATION (CS).
3. CONTINUOUSLY SLOPE THE TEMPORARY TRANSFER LINE BETWEEN THE RETENTION PAD AND PUMP PIT WITH ELEVATIONS SHOWN ON THE DRAWING. NO TRAPS ALLOWED.
4. SHE WILL PROVIDE SOURCE TERM DATA FOR SHELDDING ANALYSIS BY 1 APRIL 1996.
5. CATHOLIC PROTECTION WILL BE PROVIDED AS REQUIRED.
6. PIPE END RADIUS, EXCEPT WHERE OTHERWISE SPECIFIED, SHALL BE 3'-0" FOR LINES AND ENCLOSURES AND (3) FIVE TIMES THE NOMINAL PIPE DIAMETER FOR ALL OTHER BENDS.
7. JOINT PIPING SPOOLS AS REQUIRED IN ACCORDANCE WITH SPLIT ENCLOSURE DETAIL. (SEE SHEET 4)
8. FINAL PLACEMENT AND ROUTING OF THE TRANSFER LINE WILL BE DETERMINED BY SHELDDING REQUIREMENTS.

SECTION A-A
TANK AW 103
SCALE 3/32" = 1'-0"

AW FARM PLOT PLAN
SCALE 1/8" = 1'-0"

TANK AW 103
SCALE 3/32" = 1'-0"

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U.S. DEPARTMENT OF ENERGY	
TANK AW 103	
TEMPORARY TRANSFER LINE	
INTERFACE CONTROL	
FIG. NO.	H-14-100727
SCALE	1/8" = 1'-0"
DATE	10/12/94
BY	10/12/94
CHECKED	10/12/94
APPROVED	10/12/94

D100

PLAN GAS CHARACTERIZATION BLDG
ELECTRICAL INSTALLATION
SCALE 3/8" = 1'-0"
SEE SHEET 1
FOR ELECT ONE LINE DIAGRAM

SECTION D-D
SCALE 3/8" = 1'-0"

SECTION C-C
SCALE 3/8" = 1'-0"

WALL DETAIL I
SCALE 1/4" = 1'-0"
FIELD
WHERE SHOWN

PUMP PIT 03A
SCALE 3/8" = 1'-0"

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U.S. DEPARTMENT OF ENERGY	TANK AW 103	TEMPORARY TRANSFER LINE	INTERFACE CONTROL	H-14-100727
NO. 001	NO. 002	NO. 003	NO. 004	NO. 005
NO. 006	NO. 007	NO. 008	NO. 009	NO. 010
NO. 011	NO. 012	NO. 013	NO. 014	NO. 015
NO. 016	NO. 017	NO. 018	NO. 019	NO. 020
NO. 021	NO. 022	NO. 023	NO. 024	NO. 025
NO. 026	NO. 027	NO. 028	NO. 029	NO. 030
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NO. 036	NO. 037	NO. 038	NO. 039	NO. 040
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NO. 046	NO. 047	NO. 048	NO. 049	NO. 050
NO. 051	NO. 052	NO. 053	NO. 054	NO. 055
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NO. 066	NO. 067	NO. 068	NO. 069	NO. 070
NO. 071	NO. 072	NO. 073	NO. 074	NO. 075
NO. 076	NO. 077	NO. 078	NO. 079	NO. 080
NO. 081	NO. 082	NO. 083	NO. 084	NO. 085
NO. 086	NO. 087	NO. 088	NO. 089	NO. 090
NO. 091	NO. 092	NO. 093	NO. 094	NO. 095
NO. 096	NO. 097	NO. 098	NO. 099	NO. 100

SHIELDING REQUIREMENTS FOR K-BASIN WASTE
TRANSFER LINE

חיימ יצחק בן זאור

8 March 1996

So how does this look??

K-East Basin sludge, mixed with water is to be transported to the tank farms using a high-integrity container mounted on a trailer. Load consideration preclude the driving the truck directly to the tank opening. Thus, it is envisioned that a transfer line from a tanker unloading point to a point where the waste can be injected into a waste tank.

It is presently envisioned that the waste will be pumped from the truck to the tank in a three inch pipe which is encased inside a six inch pipe. The transfer line will be shielded by either birming earth of density of approximately 2.00 g/cm^3 (125 #/ft^3) around the line, or constructing a concrete raceway.

An estimate of the worst case source term was culled from Schwarz (1996) and is incorporated in the Packaging Design Criteria (PDC) document which is presently in draft form. I went to the original memo because the PDC uses the total activity numbers from Schwarz, while the original memo also included the waste volume from which the activity density could be calculated. This quantity is more useful since the total source in this study will be limited by the volume of the inner pipe.

Table 1: Source Activity Concentration (Ci/m^3)

Isotope		Isotope	
^{60}Co	2.80×10^{-1}	^{242}Pu	5.50×10^{-4}
^{90}Sr	1.40×10^1	^{241}Am	6.35×10^0
^{90}Y	1.40×10^1	^{234}U	7.92×10^{-3}
^{137}Cs	1.07×10^1	^{235}U	3.23×10^{-4}
^{137m}Ba	1.01×10^1	^{236}U	1.17×10^{-3}
^{154}Eu	2.95×10^{-1}	^{238}U	5.88×10^{-3}
^{155}Eu	1.67×10^{-1}	^{231}Th	3.23×10^{-4}
^{238}Pu	8.35×10^{-1}	^{234}Th	5.90×10^{-3}
^{239}Pu	3.28×10^0	^{233}Pa	2.20×10^{-5}
^{240}Pu	1.80×10^0	^{234}Pa	7.67×10^{-6}
^{241}Pu	7.13×10^1	^{234m}Pa	5.90×10^{-3}

The computer code ISOSHL2 2.1 (Rittmann (1995)) was used to calculate the dose rates from the transfer line. The radii were taken from Crane (1979).

Table 2: Specifications for Sch 40 Pipe		
	Three inch pipe	Six inch pipe
O.D.	3.50"	6.625"
I.D.	3.068"	6.065"
Wall Thickness	0.216"	0.280"

A source length of 100' was arbitrarily selected. Essentially, this is an infinite source. The source was assumed to have the density of water. This is a conservative estimate.

The code was run for various thicknesses of either earth or concrete final shield. The dose point was placed three feet beyond the end of the final shield. This was done to model the body dose to a person standing on the top of the shield. The results are presented in Table 3 below. Note that there are three results for each distance.

The first result is the exposure rate in terms of Röntgens per hour (R/hr). This is actually what will be measured in the field using a "Cutie Pie" (CP) detector. The second and third are the dose rates in rem/hr. The second is the deep dose equivalent (DDE) rate, and the third is the effective dose equivalent (EDE) rate.

10CFR835 (1993), which is also reproduced in Hanford (1995) states:

For purposes of compliance with this part, deep dose equivalent to the whole body may be used as effective dose equivalent for external exposure.

The DDE is the older methodology of dose calculation while the EDE is the newer methodology. All of the worker limits are expressed in terms of the EDE, but as stated above, one may be substituted for the other.

Table 3: ISOSHLd Results

Shield Thickness	Earth Berm	Concrete Shield
0 ft	3.97×10^{-2} R/hr	3.97×10^{-2} R/hr
	4.30×10^{-2} rem/hr DDE	4.30×10^{-2} rem/hr DDE
	3.46×10^{-2} rem/hr EDE	3.46×10^{-2} rem/hr EDE
1"	2.96×10^{-2} R/hr	2.81×10^{-2} R/hr
	3.20×10^{-2} rem/hr DDE	3.04×10^{-2} rem/hr DDE
	2.57×10^{-2} rem/hr EDE	2.45×10^{-2} rem/hr EDE
2"	2.17×10^{-2} R/hr	1.96×10^{-2} R/hr
	2.35×10^{-2} rem/hr DDE	2.12×10^{-2} rem/hr DDE
	1.89×10^{-2} rem/hr EDE	1.71×10^{-2} rem/hr EDE
3" (1/4')	1.58×10^{-2} R/hr	1.35×10^{-2} R/hr
	1.71×10^{-2} rem/hr DDE	1.46×10^{-2} rem/hr DDE
	1.38×10^{-2} rem/hr EDE	1.18×10^{-2} rem/hr EDE
6", (1/2')	5.92×10^{-3} R/hr	4.26×10^{-3} R/hr
	6.37×10^{-3} rem/hr DDE	4.58×10^{-3} rem/hr DDE
	5.15×10^{-3} rem/hr EDE	3.71×10^{-3} rem/hr EDE
9" (3/4')	2.17×10^{-3} R/hr	1.32×10^{-3} R/hr
	2.33×10^{-3} rem/hr DDE	1.41×10^{-3} rem/hr DDE
	1.89×10^{-3} rem/hr EDE	1.14×10^{-3} rem/hr EDE
1'	7.91×10^{-4} R/hr	4.06×10^{-4} R/hr
	8.47×10^{-4} rem/hr DDE	4.33×10^{-4} rem/hr DDE
	6.87×10^{-4} rem/hr EDE	3.52×10^{-4} rem/hr EDE
1 1/2'	1.07×10^{-4} R/hr	3.97×10^{-5} R/hr
	1.13×10^{-4} rem/hr DDE	4.19×10^{-5} rem/hr DDE
	9.22×10^{-5} rem/hr EDE	3.43×10^{-5} rem/hr EDE
2'	1.50×10^{-5} R/hr	4.17×10^{-6} R/hr
	1.57×10^{-5} rem/hr DDE	4.35×10^{-6} rem/hr DDE
	1.29×10^{-5} rem/hr EDE	3.59×10^{-6} rem/hr EDE

The question then arises as to what limit this system should be designed. WHC (1994), reflecting DOE (1994) sets a shielding design criterion of 0.25 mrem/hr for a controlled area which can be continuously occupied. In practice we have continued to set a target of 40% of this number, or 0.1 mrem/hr. This is a design criterion and not an operating criterion. The question arises as to whether the transfer line in question is a "facility" I cannot answer this question.

I am including the graphs of the three sets of numbers tabulated above. You can draw the lines to give the thickness of earth or concrete which will give you the dose rate you want. Note that the maximum thickness of earth needed to achieve the 0.1 mrem/hr level is approximately 1.5 ft and the thickness of concrete needed is approximately 1.3 ft.

Figure 1: Variation of Exposure Rate (R/hr) with shield thickness

Figure 2: Variation of Deep Dose Equivalent Rate with shield thickness

Figure 3: Variation of Effective Dose Equivalent with shield thickness

References

- 10CFR835 (1993) Title 10 of the code of federal regulations, part 835, *Occupational Radiation Protection*, 1993
- Crane (1979) Crane Technical Paper No 410, *Flow of Fluids through Valves, Fittings, and Pipes*, Crane Co., New York, N. Y., 1979
- DOE (1994) DOE/EH-0256T (DOE N 5480.6), *U. S. Department of Energy Radiological Control Manual*, April 1994
- Hanford (1995) HSRCM-1 Rev. 2, *Hanford Site Radiological Control Manual*, 5 July 1995
- Rittmann (1995) WHC-SD-WM-UM-030 Rev 0, *ISO-PC Version 1.98 User's Guide*, P. D. Rittmann, May 1995, version 2.1 was issued in March 1996 and is in a beta testing stage at the moment. I ran several cases against the previous version and found the results comparable and the small differences (<10%) seem to be for the better.
- Schwarz (1996), Internal Memo 8M730-RAS-96-001, *Source Term Description for the K Basin Sludge*, from R. A. Schwarz to J. R. Green, 29 January 1996
- WHC (1994) WHC-SD-GN-DGS-30011, *Radiological Design Guide*, 1994

APPENDIX E DRAWINGS

GENERAL NOTES

1. RESPONSIBILITY ASSIGNATIONS ARE:
THE TRANSFER SYSTEM INTERGRATION
TEAM LEADER SHALL BE THE PROJECT
MANAGER FOR THIS PROJECT
2. ALL PIPING INTERNAL DISSECTION, WELD INSPECTION,
CLEANING AND TESTING SHALL BE DONE WITH A
CONSTRUCTION SPECIFICATION (NFI)
3. CONTINUOUSLY SURVEY THE TROOPERY TRANSFER LINE BETWEEN
THE RETENTION POND AND LAKE WITH ELEVATIONS SHOWN
ON THE DRAWING; NO TAPS ALLOWED.
4. FINAL PLACEMENT AND BORING OF THE TRANSFER LINE WILL
BE DETERMINED BY BUILDING REQUIREMENTS.

ARRANGEMENT, TEMPORARY WASTE TRANSFER LINE

SCALE	NOTES
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AW FARM PLOT PLAN

FORM NO. GL-106-JAN 74	U.S. DEPARTMENT OF ENERGY Office of Civil Defense, Research & Development		
CAMPBELL 6-98	SLUDGE TRANSFER		
BY J. A. ROSSINI	OFF LOAD SYSTEM		
	INTERFACE CONTROL DRAWING		
	F 241G	BOZ 2502	H-14-100727
			O

[illegible]

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RETENTION PAD DETAIL

SCALE: 3/8" = 1'-0"

[illegible]

FLUSH PIT 241-AW

TYPICAL SECTION B-B

SLM : 31005

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NOTE: * DENOTES GFCI CIRCUIT BREAKER

ONE LINE DIAGRAM

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VIEW A-A
SCALE 3/8" = 1'-0"

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U.S. DEPARTMENT OF ENERGY
DOE Field Office, Kansas
Washington, Kansas
TANK AW 105
TEMPORARY TRANSFER LINE
INTERFACE CONTROL
H-14-10072

H-14-10072

1 ASSEMBLY, PIT ENTRY SPOOL

2 ASSEMBLY, PIPE EXTENSION SPOOL E8

4 ASSEMBLY, PIPE SUPPORT (ADJUSTABLE)

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

- BREAK ALL SHARP EDGES AND REMOVE ALL BURRS.
- DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONAL $\pm 1/16"$ PER ANSI Y14.5M (1994)
DECIMAL ± 0.01
ANGULAR $\pm 1/4^\circ$
- WELD AND INSPECT IN ACCORDANCE WITH AWS D1.1. WT WELDS AS INDICATED. WT WELDS AT FINAL PASS. WELDING QUALIFICATIONS PER ASME SECT. IX ARE ACCEPTABLE. (WS-V-5-0013)
- IDENTIFY ASSEMBLY USING 3/16 HIGH CHARACTERS DIE STAMPING IN LOCATION SHOWN. (WS-BS-0015, TYPE 2)

PARTS/MATERIAL LIST									
QTY	REF	PART/ASH NUMBER	DESCRIPTION	MATERIAL/PROCESS	SHEET	ITEM			
1		-010	ASSEMBLY, PIT ENTRY SPOOL			1			
1		-020	ASSEMBLY, PIPE EXTENSION SPOOL			2			
1		-030	ASSEMBLY, PIPE SPOOL			3			
1		-040	ASSEMBLY, PIPE SUPPORT (ADJUSTABLE)			4			
2		-050	ASSEMBLY, PIPE SUPPORT BRACKET			5			
2		-060	ASSEMBLY, SUPPORT BRACKET			6			
1		-070				7			
1		-001	PLATE, 3/4"			8			
1	AR	-002	ANGLE, 2" x 2" x 1/4"			9			
2		-003	PLATE, GUSSET, 1/4"	ASTM A240 (304) SST		10			
1		-004	PLATE, STIFFENER, 1/4"	ASTM A240 (304) SST		11			
1		-005	PLATE, BRACKET, 3/4"	ASTM A240 (304) SST		12			
1		-006	PLATE, BRACKET, 3/4"	ASTM A240 (304) SST		13			
AR			PLATE, 1/4", C.S.	ASTM A36		14			
AR			ALLTHREAD, 1"-8 UNC x AR	ASTM A193, GR 88, (304) SST		15			
1			PLATE, 1/4" x 1'-2" x 1'-0"	ASTM A36		16			
1		H-2-30185-2	NOZZLE, MALE, 2", SCHED 40			17			
1		H-2-3184-6	KICK-OFF PLATE, 12" NOZZLE			18			
1		1-1/2" 406 USE	VALVE, BALL, 1-1/2", THREADED	WORCESTER		19			
1			THREADED, REDUCING, 1-1/2" RUN PIPE, 1" BRANCH, SST			20			
AR	AR	P1000	CHANNEL, 1-5/8" x 1-5/8"	UNISTRUT		21			
2		P5543	"U" SHAPE FITTING	UNISTRUT		22			
1		P5500	CHANNEL, 2-7/16" x 1-5/8"	UNISTRUT		23			
2		P1001	CHANNEL, 3-1/4" x 1-5/8"	UNISTRUT		24			
1		P2558-30	PIPE/CONDUIT CLAMP, 3"	UNISTRUT		25			
6		P1010	CHANNEL NUT WITH SPRING, 1/2-13 UNC-28	UNISTRUT		26			
2		P5508	CHANNEL NUT WITH SPRING, 3/8-16 UNC-28	UNISTRUT		27			
6			SCREW, HEX HD, 1/2-13 UNC-2A x 1-1/2" L			28			
2			SCREW, HEX HD, 3/8-16 UNC-2A x 1-1/2" L			29			
AR			PIPE, 3" SCHED 40, SMLS	ASTM A312 GRADE TP 304L		30			
AR			PIPE, 4" SCHED 40, SMLS	ASTM A312 GRADE TP 304L		31			
AR			PIPE, 1-1/2" SCHED 40, SMLS	ASTM A312 GRADE TP 304L		32			
2			FLANGE, 3" RF WELD NECK, CLASS 150			33			
1			REDUCER, 4" x 3", CONCENTRIC, SCHED 40, BUTT WELD			34			
1			ELBOW, 90°, 4" SCHED 40, BUTT WELD			35			
2			ELBOW, 90°, 1-1/2" SCHED 40, BUTT WELD			36			
1			REDUCER, 2" x 1-1/2", CONCENTRIC SCHED 40, BUTT WELD			37			

PARTS/MATERIAL LIST CONTINUED ON SH. 3.

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D. CAMPBELL		U.S. DEPARTMENT OF ENERGY	
H-14-100776		SLUDGE TRANSFER OFF LOAD SYSTEM PIPING SPOOLS/SUPPORTS	
H-14-100776		H-14-100780	
H-14-100776		H-14-100780

6 ASSEMBLY, SUPPORT BRACKET

9 PLATE

12 PLATE, STIFFENER

13 PLATE, BRACKET

14 PLATE, BRACKET

11 PLATE, GUSSET

5 ASSEMBLY, PIPE SUPPORT BRACKET

SEE SH. NO. 1 FOR GENERAL NOTES AND REFERENCE DRAWINGS.

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E9

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SLUDGE TRANSFER OFF LOAD SYSTEM PIPING SPOOLS/SUPPORTS	
DATE: 2410 BY: F CHECKED: [] APPROVED: []	H-14-100780 Page 2 of 2

DETAIL 1

GENERAL NOTES: (UNLESS SPECIFIED OTHERWISE)

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DETAIL-COVER BLOCK

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TANK FARM ENGINEERING

U.S. DEPARTMENT OF ENERGY	
SLUDGE TRANSFER OFF LOAD SYSTEM COVER BLOCK DETAILS	
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